

THE IMPACT OF CHILD MALTREATMENT ON THE DEVELOPMENT OF ALCOHOL
AND SUBSTANCE USE: COMPARING TRAJECTORIES OF ALCOHOL AND
SUBSTANCE USE IN ADOLESCENCE AND YOUNG ADULTHOOD BETWEEN VICTIMS
AND NON-VICTIMS OF MALTREATMENT

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ABSTRACT

McLean Dickinson Pollock: The Impact of Child Maltreatment on the Development of Alcohol and Substance Use: Comparing Trajectories of Alcohol and Substance Use in Adolescence and Young Adulthood between Victims and Non-Victims of Maltreatment
(Under the direction of Sandra L. Martin)

The purpose of this dissertation is to examine the impact of self-reported child maltreatment and involvement of child welfare services (CWS) on alcohol, marijuana, and other substance use in adolescence and young adulthood. Using data from the National Longitudinal Study of Adolescent to Adult Health (Add Health), a nationally representative dataset, and hierarchical linear and generalized linear modeling, we first investigated the long-term impact of child maltreatment and involvement of CWS on alcohol, marijuana and other substance use in young adulthood. We found that experiencing poly-victimization impacted average monthly alcohol consumption when compared to non-victims of maltreatment. After conditioning on identified covariates and modification by biological sex, all measures of maltreatment except sexual abuse are associated with an increased odds of more frequent marijuana use, and poly-victimization is associated with an increased odds of more frequent use of other substances in adulthood.

Next we examined the effect of self-reported childhood maltreatment victimization and involvement of child welfare on trajectories of alcohol, marijuana, and other substance use from adolescence into young adulthood. Results from these analyses show that, overall, maltreatment is associated with higher amounts of alcohol consumed and higher odds of using marijuana and other substances at higher levels. Through stratified analyses for males and females, we were

able to identify separate associations by specific measures of maltreatment and CWS involvement. Developmental trajectories for all participants revealed patterns of increasing use of alcohol, marijuana, and other substances into late adolescence and emerging adulthood, followed by gradual decreases in use as participants aged into young adulthood; however, some differences by maltreatment or CWS status in the use of alcohol, marijuana, and other substances persisted into adulthood.

Substance use prevention and intervention efforts should consider the role of maltreatment and related trauma on substance use for both males and females in the general population.

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LIST OF ABBREVIATIONS

ACE	Adverse Childhood Experiences
Add Health	National Longitudinal Study of Adolescent to Adult Health
CASI	Computer-Assisted Self Interviews
CDC	Centers for Disease Control and Prevention
CI	confidence interval
CM	child maltreatment
CWS	child welfare services
GED	General education development
GF	graduated frequency
GLLAMM	generalized linear latent and mixed model
HLM	hierarchical linear model
HGLM	hierarchical generalized linear models
GM	geometric mean
n	number
NH	non-Hispanic
NIS-4	National Incidence Study of Child Abuse and Neglect
OR	odds ratio
p	p-value
PN	physical neglect
SE	standard error
TEDS	Treatment Episode Data Set
U.S.	United States

CHAPTER 1. INTRODUCTION

Alcohol and substance use

Substance use and substance use disorders have been linked to numerous health, mental health, behavioral, and societal problems. Persons who abuse substances have a higher mortality rate and risk of premature death than the general population (1), and the total annual cost to society due to tobacco, alcohol, and illicit drug use and use disorders is estimated at approximately \$524 billion (2).

Use of alcohol and other substances typically begins during adolescence, a period of development marked by increased impulsivity and risk-taking behaviors, and extends into adulthood. In the general population, the average age of first use of alcohol is 14 years (3) and first use of marijuana is 18 years; for most other substances, the average age of first use occurs before the age of 26 (4). Over two percent of youths between 12 and 13 years of age use illicit substances, such as marijuana, cocaine, and nonmedical use of prescription medications but not including underage tobacco use, or alcohol (2.6% and 2.1%, respectively) (4), and the prevalence rate of both illicit substance use and alcohol use increases as youths age with a peak prevalence around late adolescence/emerging adulthood. The highest prevalence of illicit substance use is between the ages of 18 to 20 years (22.6%), which is followed by a steady decline in older adults (4). The prevalence of alcohol use follows a similar pattern with a slightly later peak at 69.3% between 21 and 25 years of age, followed by a gradual decline in prevalence as adults age (4).

While patterns of substance use over time follow similar trajectories for males and females, the prevalence of use for alcohol and substances differs by gender. Males and females

have a similar prevalence rate of current alcohol use between 12 and 17 years of age (11.2% and 11.9%, respectively) (4), but as youths age, the differences in use widen. In emerging adulthood (18-25 years of age), 62.3% of males and 56.9% of females are current drinkers, and among adults ages 26 and older, the prevalence of use remains the same for males (62.2%) but declines for females (50.1%) (4). Additionally, a larger proportion of males than females use illicit substances. Among persons ages 12 and older, 11.5% of males and 7.3% of females use illicit substances (4). In 2013, approximately 21.6 million persons age 12 years and older met criteria for a substance use disorder, and the rate of use disorders was greater for males (10.8%) than females (5.8%) (4).

Substance use and use disorders in both adolescence and adulthood have been associated with increased risk of morbidity (5, 6), mortality (7, 8), and risk behaviors (9, 10). Youths who endorse problems related to substance use are more likely to engage in sexual risk behaviors, such as early onset of sexual activity, more sexual partners, and less consistent use of condoms (11). Marijuana use has been associated with impaired driving skills, chronic inflammation of the airways, precipitation of the onset or relapse of schizophrenia, and immediate cognitive impairments (12). Alcohol-dependent youths have demonstrated neuropsychological deficits compared with non-alcohol-abusing adolescents (13), and college students who are binge drinkers have been found to be more likely to get hurt or injured, to miss classes, to engage in unplanned sexual activity, and to get into legal trouble than their non-binge drinking counterparts (14). Compared to the general adult population, adults receiving treatment for substance use disorders had more problems with quality of life and mental functioning (15).

Past research has shown a link between child maltreatment and alcohol and substance use and misuse (16, 17), but findings vary based on measures of maltreatment and alcohol or substance use.

Child Maltreatment and Child Welfare Services Involvement

Child maltreatment is a public health problem that involves the neglect or abuse of children by an adult caregiver. It has been associated with elevated risk of fatalities, physical and mental health morbidities, behavioral problems, negative educational consequences and criminal involvement (18). In 2008 alone, the total lifetime economic costs from new and existing cases of child maltreatment in the United States, including health care costs, productivity losses, child welfare and criminal or law enforcement costs, and special education costs, were estimated at \$124 billion (19).

Estimates of the prevalence of child maltreatment vary based on how maltreatment is defined and assessed. In particular, estimates based on victim report of child maltreatment are higher than those based on records of child maltreatment incidents reported to or substantiated by Child Welfare Services (CWS) (20-22). One study found that prevalence estimates of child maltreatment are between four to six times higher when using adolescent self-report compared with determination of maltreatment through CWS (23), and another study found that CWS records identify only about one third of the maltreated children known to community professionals (24). Based on estimates of CWS substantiated or indicated maltreatment, in 2012, 686,000 children or 9.2 per 1,000 children were victims of substantiated maltreatment (25).

Another estimate of the national incidence of child maltreatment from the Fourth National Incidence Study of Child Abuse and Neglect (NIS-4), which is based on cases of maltreatment that were reported to CWS and instances of potential maltreatment that were not

reported but were identified by other human service professionals, such as teachers, social workers, and law enforcement officers, found that 1,256,600 children experienced maltreatment in the United States between 2005 to 2006, representing an annual rate of 17.1 children per 1,000 experiencing maltreatment (24). The differential rates of child maltreatment when using cases identified through child welfare services compared with estimates that identify maltreatment through self-report or cases known to community professionals indicate that children who are involved with CWS may be different from children who are maltreated but not involved with CWS. Thus estimates that rely only on CWS identification may not accurately represent the full scale of maltreatment.

Regardless of how child maltreatment is identified, all methods generally find that neglect is the most common form of child maltreatment. Most CWS substantiated cases are identified as neglect (71%), followed by physical abuse (16%), sexual abuse (9%), and emotional abuse (7%) (26). Among cases of maltreatment identified through the NIS-4, 61% are identified as neglect, followed by physical abuse at 26%, emotional abuse at 12%, and sexual abuse at 11% (24). Using retrospective, self-reported measures of maltreatment, 41.5% of young adults reported experiencing supervisory neglect, 28.4% reported physical abuse, 11.8% reported physical neglect, and 4.5% reported experiencing sexual abuse at least once before the age of 18 (27).

Most research on the impact of child maltreatment on subsequent health and mental health outcomes has focused on single forms of maltreatment, but more recent research has found that often children experience multiple forms of maltreatment rather than just a single type of maltreatment (28). A study using Adverse Childhood Experiences (ACE) data examined sexual, physical abuse, emotional abuse, and witnessing maternal battering as a child and found

that almost 35% of persons reporting any maltreatment experienced two or more types of child maltreatment (29). Among a sample of undergraduate students, 38.2% of respondents who reported any child maltreatment indicated that they experienced multiple forms of maltreatment (30). Previous studies have also shown an exposure response relationship between the number of different types of maltreatment and increased risk of adverse outcomes. A study of urban youth involved with CWS found that youths who experienced more types of maltreatment reported more aggression, lower self-esteem, and less optimal cognitive development when compared with youths who experienced fewer types of maltreatment (31). Another study examining ACE data found that as the number of types of childhood maltreatment increases, mental health functioning decreases (29). Thus, recent studies have called for increased attention to poly-victimization when studying relationships involving child maltreatment (30, 32, 33).

Relationship between Child Maltreatment and Alcohol or Substance Use

An important risk factor for substance use, substance use disorders, and related problematic behaviors in both adolescence and adulthood is child maltreatment (16, 17), involving an act or actions by a parent or caregiver that result in harm, potentially harm, or threats to harm a child (34). Hernandez and colleagues found that high school students who reported experiencing child sexual abuse had significantly higher levels of substance use and more problems related to substance use than students who reported no sexual abuse (35). Another study of high school students found an association between child abuse and past 30 day alcohol and drug use, as well as initial use of alcohol and drugs before the age of 11 (36). Similarly, another study of secondary school students found that experiencing physical or sexual abuse was associated with early initiation of alcohol use before age 13 (37). Childhood emotional maltreatment has also been associated with substance use problem severity among

youths receiving substance use treatment services (38). Finally, when examining this relationship among youths involved with child welfare, the number of out-of-home placements and the age of entry into the CWS are positively associated with the severity of substance involvement (39).

The impact of maltreatment on alcohol and substance use reaches into adulthood. Research has shown that child maltreatment victimization is associated with an increased risk for alcohol and substance abuse in adulthood. One study based in an urban area found that adults who reported childhood sexual abuse were three times as likely to engage in past-month binge drinking than their non-maltreated counterparts (40). Among a sample of adults who actively used substances, those with a history of physical and sexual abuse were over three times more likely to report heavy inhalant use compared to persons who reported no maltreatment (41). A longitudinal study using a sample of racial minorities and economically disadvantaged families found that young adults who were victims of CWS-substantiated or indicated childhood maltreatment were more likely to report substance misuse than non-maltreated adults (42). Another study that also relied on substantiated reports by CWS found that young adults who had experienced childhood maltreatment experienced higher frequencies of illicit substance use and problematic substance use compared with non-maltreated adults (43). Prior research has found that adults with a history of substantiated childhood maltreatment are more likely to report past-year use of any illicit drug and more problems related to illicit drug use, compared with non-maltreated adults (44).

Previous studies that have utilized nationally representative data have also found increased risks for alcohol and substance use by both individual types of maltreatment and poly-victimization. One retrospective cohort analysis looking at the relationship between individual types of maltreatment (supervisory neglect, physical neglect, physical abuse, and sexual abuse)

and alcohol and substance use in emerging adulthood (ages 18-26 years) estimated that all four types of maltreatment were associated with an increased likelihood of regular alcohol use, binge drinking, and marijuana use (27). In addition, persons reporting supervisory neglect, physical abuse, and sexual abuse had a higher likelihood of lifetime use of inhalants compared to non-victims of child maltreatment (27). Shin and colleagues also conducted a retrospective cohort analysis and found that all types of maltreatment and all combinations of maltreatment were associated with an increased likelihood of binge drinking in adolescence compared with non-maltreated counterparts (45). In a subsequent study, the same researchers examined the developmental trajectories of binge drinking from early adolescence through young adulthood (ages 24-32) by comparing persons reporting neglect, physical abuse, or sexual abuse with non-maltreated participants. They found that persons reporting neglect or physical abuse and the combination of the two types experienced faster increases in binge drinking during adolescence and elevated rates of binge drinking in emerging adulthood compared with non-maltreated persons, but these differences in binge drinking did not persist into young adulthood (46). Another study looked at maltreatment and its impact on past 30-day and past-year illicit drug use and drug related problems over the past year during emerging adulthood and found that victims of childhood physical abuse had a higher likelihood of using illicit drugs over the past 30 days and past year and a higher likelihood of reporting drug related problems over the past year compared with non-maltreated persons (47).

Thus, the existing literature provides substantial evidence that child maltreatment is associated with substance use, both in adolescence and adulthood, yet gaps in our understanding of this relationship remain. Most research studies investigating the relationship between experiencing childhood maltreatment and substance use or substance use disorders later in life

has utilized cross-sectional designs, clinical samples, or measure child maltreatment through CWS-identified cases. No studies to date have utilized a nationally representative dataset to examine the relationships between self-reported child maltreatment, as well as CWS involvement, and the trajectories of alcohol, marijuana and other substance use from adolescence to young adulthood.

Theories Guiding the Dissertation Research

Two theories have informed the proposed research: coping theory and the life course perspective. Coping theory addresses the relationship between child maltreatment and later substance use. The life course perspective addresses the developmental trajectory of substance use from adolescence into young adulthood.

Coping Theory

Based on the foundational work of Lazarus and colleagues, the concept of coping is understood as a mechanism for the management of demands that stress or overwhelm the person's existing resources (48-51). In terms of understanding the relationship between childhood maltreatment and substance use, coping theory posits that adolescents and young adults would use substances as a form of coping with the stress and trauma related to the maltreatment experience or that the use of substances serve as a way to avoid any unwanted emotions or reactions to the traumatic experience of maltreatment (52). If this coping strategy is successful at mitigating the negative experiences, then it will be used again as a continued means of coping (52). A review of preclinical research, clinical trials, and population studies shows that highly stressful situations, such as childhood neglect and abuse, increase vulnerability to substance use since these stressors, especially ones that begin in childhood and persist, result in physiological and behavioral changes (53).

Other studies have shown that some persons are motivated to use alcohol in order to cope with problems (54), and a high dose of alcohol has a greater impact on attenuating the effect of stressors among persons at high-risk of alcoholism compared with low-risk individuals, which supports the reinforcing effect of alcohol on stressful situations (55). Accordingly, given that child maltreatment is considered a stressful experience that may be one of the most prominent causes of trauma and Post-Traumatic Stress Disorder among children and adolescents (56), it is highly plausible that maltreated children may use substances earlier and may use a greater number of substances in order to cope with their related emotions and reactions.

Life course Perspective

The life course perspective helps to explain how maltreatment experienced in childhood continues to affect health outcomes into adolescence and adulthood. Founded in developmental, social, and health sciences, the life course perspective postulates that experiences early in life, such as child maltreatment, can affect future outcomes through accumulation and interaction with other experiences or sequences of experiences (57). Much of the current literature related to the impact of child maltreatment on chronic diseases or impairments later in life is based on earlier research on the impact of ACEs on adult health (58). This research shows that childhood and adolescence offer an opportune time to prevent adult morbidities and mortality by preventing or reducing the harm of their social and health determinants (59). Therefore, by understanding the long-term impact of childhood maltreatment, substance use prevention efforts should focus the timing of these interventions to have the most impact.

Study Overview

To address gaps in the literature, this dissertation research utilizes a nationally representative dataset to examine the relationships between self-reported individual types of

maltreatment, poly-victimization, and CWS involvement on alcohol and substance use in adolescence and young adulthood. Informed by the Coping Theory and Life course Perspective, this research first examines the long-term impact of child maltreatment and CWS involvement on alcohol and substance use in adulthood. After examining the impact of maltreatment on alcohol and substance use in adulthood, this dissertation research studies the effect of maltreatment and CWS involvement on patterns of alcohol and substance use beginning in adolescence through young adulthood.

By assessing the relationship between maltreatment and alcohol or substance use through the use of a self-reported measure of maltreatment, instead of relying on CWS identification, and by comparing CWS involvement among victims of maltreatment, we are able to better understand the full scale of the impact of maltreatment and CWS involvement on patterns of alcohol and substance use in adolescence and adulthood. Accordingly, the aims of this study were to:

- 1) Examine the impact of self-reported child maltreatment and CWS involvement on alcohol, marijuana, and other substance use in young adulthood, and
- 2) Examine the impact of self-reported child maltreatment and CWS involvement on patterns of alcohol, marijuana, and other substance use from adolescence into young adulthood.

The next two chapters summarize the findings of each aim, respectively, while the concluding chapter discusses the overall implications for this dissertation research.

CHAPTER 2. THE IMPACT OF CHILD MALTREATMENT AND CHILD WELFARE SERVICES INVOLVEMENT ON ALCOHOL AND SUBSTANCE USE IN YOUNG ADULTHOOD

Introduction

Child maltreatment is a public health problem that involves the neglect or abuse of children by an adult caregiver. It has been associated with elevated risk of fatalities, physical and mental health morbidities, behavioral problems, negative educational consequences and criminal involvement (18). In 2008 alone, the total lifetime economic costs from new and existing cases of child maltreatment in the United States, including health care costs, productivity losses, child welfare and criminal or law enforcement costs, and special education costs, were estimated at \$124 billion (19).

Estimates of the prevalence of child maltreatment vary based on how maltreatment is defined and assessed. In particular, estimates based on victims' self-report of child maltreatment are higher than those based on maltreatment incidents reported to or substantiated by Child Welfare Services (CWS) (20-22). Prevalence estimates of child maltreatment are between four to six times higher when using adolescent self-report compared with determination of maltreatment through CWS (23). Based on estimates of CWS substantiated or indicated maltreatment, in 2012, 9.2 per 1,000 children were victims of substantiated maltreatment (25). Another estimate of the national incidence of child maltreatment based on CWS reported cases of maltreatment and instances of potential maltreatment that were identified by community professionals found an annual rate of 17.1 children per 1,000 in 2005-2006 (24).

The differential rates of child maltreatment when using cases identified through CWS compared with additional cases known to community professionals indicate that children who are involved with CWS may be different from children who are maltreated but not involved with CWS. For instance, previous analyses examining reports of maltreatment to CWS have found that neglect is substantiated at a lower rate than abuse, and child and family characteristics, including the child's age, sex, socioeconomic status, prior maltreatment reported and cooperativeness of the parent, are associated with the likelihood of substantiation (60). Additionally, other analyses found that professionals' likelihood of reporting maltreatment to CWS was influenced by a history of maltreatment, severity of abuse, victim recantation of maltreatment, child age, socioeconomic status, perpetrator's characteristics (61), race-ethnicity (62, 63), the type of abuse, mother's role in the abuse (63), and socioeconomic status (61-63). This indicates that there are differences between children who are abused or neglected but are not reported to CWS and those children and families identified by CWS. Thus estimates that rely only on CWS identification may not accurately represent the full scale of maltreatment.

Most research on the impact of child maltreatment has focused on single forms of maltreatment, but more recent analyses have found that often children experience multiple rather than single forms of maltreatment (28). A study using Adverse Childhood Experiences (ACE) data examined sexual abuse, physical abuse, emotional abuse, and witnessing maternal battering as a child and found that almost 35% of persons reporting any maltreatment experienced two or more types of maltreatment (29). Previous studies have also shown an exposure-response relationship between the number of different types of maltreatment and adverse outcomes. A study of CWS-involved youth found that youths who experienced more types of maltreatment reported more aggression, lower self-esteem, and less optimal cognitive development when

compared with youths who experienced fewer types of maltreatment (31). Another study found that as the number of types of maltreatment increases, mental health functioning decreases (29). Thus, recent studies have called for increased attention to poly-victimization when studying the impact of child maltreatment (30, 32, 33).

Additionally, past research has found an association between child maltreatment and increases in the risk of substance use, substance use disorders, and related problematic behaviors (16, 17). Among adults who actively used substances, participants who reported a history of physical and sexual abuse were over three times more likely to report heavy inhalant use compared to persons who reported no maltreatment (41). A longitudinal study using a sample of racial minorities and economically disadvantaged families found that young adults who had been victims of CWS-substantiated or indicated childhood maltreatment were more likely to report substance misuse than non-maltreated adults (42). Another study that also relied on substantiated reports by CWS found that young adults who had experienced childhood maltreatment experienced higher frequencies of illicit substance use and problematic substance use compared with non-maltreated adults (43). Prior research has found that adults with a history of substantiated childhood maltreatment are more likely to report past-year use of any illicit drug and more problems related to illicit drug use, compared with non-maltreated adults (44). One study based in the Detroit area utilized self-reports of childhood maltreatment and found a statistically significant positive relationship between childhood maltreatment and past month binge drinking in adulthood; in particular, adults who reported childhood sexual abuse were three times as likely to engage in past-month binge drinking than their non-maltreated counterparts (40).

Previous studies that have utilized nationally representative data have found increased risks for alcohol and substance use by both individual types of maltreatment and poly-victimization. One retrospective cohort analysis looking at the relationship between individual types of maltreatment (supervisory neglect, physical neglect, physical abuse, and sexual abuse) and alcohol and substance use in emerging adulthood (ages 18-26 years) estimated that all four types of maltreatment were associated with an increased likelihood of regular alcohol use, binge drinking, and marijuana use, and persons reporting supervisory neglect, physical abuse, and sexual abuse had a higher likelihood of lifetime use of inhalants compared to non-victims of child maltreatment (27). Shin and colleagues also conducted a retrospective cohort analysis and found that all types of maltreatment and all combinations of maltreatment were associated with an increased likelihood of binge drinking in adolescence compared with non-maltreated counterparts (45). The same researchers found and reported in a different publication that persons reporting all types and combinations of maltreatment, except physical abuse only, had a higher likelihood of binge drinking in emerging adulthood compared to non-victims; the researchers also found that persons who reported experiencing all types of maltreatment (neglect, physical abuse, and sexual abuse) had a greater likelihood of binge drinking compared to those who reported only one or two types of maltreatment (64). Another study looked at maltreatment and its impact on past 30-day and past-year illicit drug use and drug related problems over the past year during emerging adulthood and found that victims of childhood physical abuse had a higher likelihood of using illicit drugs over the past 30 days and past year and a higher likelihood of reporting drug related problems over the past year compared with non-maltreated persons (47).

A recent study examined the developmental trajectories of binge drinking from early adolescence through young adulthood (ages 24-32) by comparing persons reporting neglect, physical abuse, or sexual abuse with non-maltreated participants. The researchers found that persons reporting neglect or physical abuse and the combination of the two types experienced faster increases in binge drinking during adolescence and elevated rates of binge drinking in emerging adulthood compared with non-maltreated persons, but these differences in binge drinking did not persist into young adulthood (46).

Substance use and substance use disorders have been linked to numerous health, mental health, behavioral, and societal problems. A literature review of the impact of marijuana use on adverse outcomes noted that research has found associations between marijuana use and impaired driving skills, chronic inflammation of the airways, precipitation of the onset or relapse of schizophrenia, and immediate cognitive impairments (12). Young adults who endorse problems related to substance use are more likely to engage in sexual risk behaviors, such as early onset of sexual activity, more sexual partners, and less consistent use of condoms (11). Persons who abuse substances also have a higher mortality rate and risk of premature death than the general population (1). Alcohol-dependent youths have demonstrated neuropsychological deficits compared with non-alcohol-abusing adolescents (13), and college students who are binge drinkers have been found to be more likely to get hurt or injured, to miss classes, to engage in unplanned sexual activity, and to get into legal trouble than their non-binge drinking counterparts (14). Not only is alcohol and substance abuse associated with an increased risk for morbidities and mortality, but it also creates an economic burden on the country. The total cost to society due to tobacco, alcohol, and illicit drug abuse and addiction is estimated at approximately \$524 billion annually (2).

Although past research has found associations between child maltreatment and substance use, there have been methodological limitations that hinder generalizability and do not address important questions concerning patterns of use over time among the general population who self-report childhood maltreatment. Most of the studies that have investigated this relationship measure maltreatment by CWS report or CWS substantiation, which likely does not capture a large proportion of individuals who were maltreated but not known to CWS. Additionally, most studies have used non-representative samples, which often exclude important subpopulations and can constrain the generalizability of the findings to groups other than the study sample. Finally, most research has relied on dichotomous measures of substance use, and very few studies have examined the impact of maltreatment on levels of alcohol and substance use over time. This study addresses these gaps through use of the National Longitudinal Study of Adolescent to Adult Health (Add Health) dataset, a longitudinal cohort study that includes both self-report measures of maltreatment as well as CWS involvement, which allows for the assessment of individual types of maltreatment as well as poly-victimization, and report of levels of alcohol, marijuana, and other substance use among a nationally representative sample followed from adolescence to young adulthood.

The primary aim of this study is to employ a nationally representative sample to assess the long-term impact of self-reported childhood maltreatment on alcohol, marijuana, and other substance use in young adulthood. Specifically, we investigated the effect of individual types of maltreatment, poly-victimization, CWS investigation, and removal from the home by CWS on levels of alcohol and substance use. Findings from this study will help inform alcohol and substance use prevention and intervention efforts to consider the impact of childhood maltreatment experiences on alcohol and substance use, which should expand the reach of these

efforts to address the impact of maltreatment on the general population instead of focusing solely on providing these services to maltreated youths identified by child welfare.

Methods

Data source and analytic sample

Data for this study are drawn from the Add Health study, which is a nationally representative probability sample of adolescents in school in the 1994-95 school year (65). The primary focus of the Add Health study was to examine influences on adolescents' health and health-related behaviors. Study participants were drawn from an original sample of students from 80 high schools and 52 middle schools across the United States. The probability of selecting a school to be in the study was based on the school's size. Schools were stratified by region, urbanicity, school type, ethnic mix, and size (65). The in-school surveys were then followed by a series of in-home surveys conducted in 1994-1995 (Wave I), 1996 (Wave II), 2001-2002 (Wave III), and 2007-2008 (Wave IV) with a core sample of adolescents from each community and selected oversamples, such as racial minorities and disabled persons. There were 20,745 adolescent in-home questionnaires completed at Wave I, followed by 14,738 questionnaires completed at Wave II (88% of eligible participants), 15,197 questionnaires completed at Wave III (76% of eligible participants), and 15,701 questionnaires (80% of eligible participants) completed at Wave IV. In-home questionnaires were conducted by Computer-Assisted Personal Interviews, and sensitive questions were administered through Computer-Assisted Self Interviews (CASI) (66), which have been shown to enhance disclosure of sensitive information.

As shown in Figure 2.1, the analytic sample for this research study consists of respondents who participated in Waves I and IV of the Add Health study and who have valid Wave IV sampling weights (n=14,800), when respondents were between 24 and 32 years of age.

Additionally, those included in the sample had to have responses to questions about the main exposure of interest, child maltreatment, the outcomes of interest for at least one time point, alcohol, marijuana, and other substance use, and non-missing responses for all covariates. The final samples consisted of 9,885 individuals for alcohol use, 9,941 individuals for marijuana use, and 9,842 individuals for other substance use. All Add Health study procedures were approved by the Institutional Review Board for the Protection of Human Subjects at the University of North Carolina at Chapel Hill. Current analyses were deemed exempt from further review (Study # 13-1646).

Measures

Outcome variables

Three types of substance use were examined in this study: alcohol use, marijuana use, and other substance use.

Alcohol use. Monthly alcohol use during adulthood (Wave IV) was measured as a graduated frequency (GF) index, using a method described by Armor & Polich (67, 68). By including a separate measure of heavy alcohol or binge drinking, this index measure allows for a comprehensive estimate of the actual pattern and volume of alcohol consumption compared to measuring only typical or average drinking (69). Details regarding the creation of the graduated frequency index for this study are provided in Appendix A.

Univariate tests of monthly alcohol use indicated that the distribution was highly, positively skewed (4.56) and highly kurtotic (32.54), compared to a kurtosis value of three for a normal distribution. Thus, monthly alcohol use was log-transformed for analysis. A higher score on the alcohol GF index indicates higher average monthly alcohol consumption.

Marijuana use. The second outcome variable of interest is frequency of marijuana use over the past 30 days during adulthood (Wave IV). Respondents were asked about frequency of past 30-day use, and six possible responses were provided ranging from none to every day or almost every day. For this study, marijuana use was considered an ordinal variable with three categories: no use, occasional use from one to three times per month, and regular or frequent use from weekly to every day or almost every day. The proportional odds assumption of this three-category variable was confirmed using a Wald test.

Other substance use. The last outcome of interest is the frequency of use of other types of substances (i.e., substances other than alcohol or marijuana, such as cocaine, opioids, and amphetamines) over the past 30 days during adulthood (Wave IV). Participants were asked about frequency of use of their substance of choice, other than marijuana, over the past 30 days, and six possible responses were provided from none to every day or almost every day. For this study, other substance use was considered an ordinal variable with three categories: no use, occasional use from one to three times per month, and regular or frequent use from weekly to every day or almost every day. The proportional odds assumption of this three-category variable was confirmed using a Wald test.

Primary exposure variables

Child maltreatment. Six separate measures of child maltreatment were used in this study: any maltreatment, physical neglect, emotional abuse, physical abuse, sexual abuse, and poly-victimization (number of types of maltreatment experienced).

In emerging adulthood (ages 18-26; Wave III), participants were asked about the frequency of a parent or adult caregiver perpetrating physical neglect (“not taken care of your basic needs, such as keeping you clean or providing food or clothing”) before starting the 6th

grade. Additionally, in young adulthood (ages 24-32; Wave IV), participants were asked about the frequency of a parent or adult caregiver perpetrating emotional abuse (“say things that really hurt your feelings or made you feel like you were not wanted or loved”), physical abuse (“hit you with a fist, kick you, or throw you down on the floor, into a wall, or down stairs”), and sexual abuse (“touch you in a sexual way, force you to touch him or her in a sexual way, or force you to have sexual relations”) before the age of 18; participants who reported any maltreatment were then asked how old they were when the abuse first happened. To be consistent with the measure of physical neglect in childhood, this analysis only included reported emotional, physical and sexual abuse that occurred before the age of 12.

Consistent with the Centers for Disease Control and Prevention (CDC) definition of child maltreatment and extant literature (34, 70-72), the exposure of child maltreatment was examined as a dichotomous variable in which participants who reported experiencing any of the four types of maltreatment assessed (physical neglect, emotional abuse, physical abuse or sexual abuse) were classified as being a victim of maltreatment, and persons who did not report experiencing any type of maltreatment were categorized as being a non-victim of child maltreatment.

The individual types of maltreatment were also examined for their specific impact on later alcohol and substance use, including any report of physical neglect, emotional abuse, physical abuse, and sexual abuse.

In addition, we examined the impact of experiencing poly-victimization (none, one, two, and three or four types of maltreatment) on alcohol and substance use (note that the last category of three or four types of maltreatment was combined due to the small number of participants who experienced all four types of maltreatment).

Involvement of Child Welfare Services (CWS). Lastly, we investigated whether the CWS investigation or removal from the home was associated with later alcohol or substance use. In addition to questions about maltreatment experiences, participants in emerging adulthood were asked about frequency of CWS investigation (“investigated how you were taken care of or tried to take you out of your living situation”) and removal of the home (“actually been taken out of your living situation by Social Services”) before starting the 6th grade. For this study, CWS investigation was measured as a dichotomous variable with zero indicating a self-report of child maltreatment but no CWS investigation, and a value of one indicated self-report of any maltreatment and any CWS investigation (i.e., a response of one or more times). Similarly, removal from the home was dichotomized with zero representing never being removed from the home and one indicating removal from the home at least once.

Covariates

Several covariates identified from the extant literature on child maltreatment and alcohol or substance use were included in this analysis.

Age. At Wave IV, participants were between 24 and 34 years of age, but we excluded data for five participants who were 34 years old given the small sample size for this age cohort.

Biological sex. Biological sex was measured as male or female. Information on intersex or transsexual status was not obtained.

Race/ethnicity. This study included four categories of race/ethnicity: Non-Hispanic Caucasian, Non-Hispanic African American, Hispanic, and Non-Hispanic Other race.

Parental alcoholism. Parental alcoholism was defined as a dichotomous variable; no parental alcoholism indicates that neither the biological mother nor the biological father had

alcoholism, and parental alcoholism indicates that at least one parent had alcoholism. This classification was based on questions asked of parents/caregivers at Wave I.

Family structure. For the proposed research, family structure was defined by a nominal variable with four categories: two biological parents; two parents, other type; single parent; and other family structures. This measure was derived from information collected at Wave I of the Add Health study, in which participants listed all of the people with whom they lived and indicated their relationship with those people.

Parent's educational attainment. For this study, the participant's parent's educational attainment was measured using the highest level of education of all parents or parental figures at Waves I and II as reported by either the parent or participant, and was measured as an ordinal variable with four levels: less than high school, high school graduate or GED, some college or an Associate's degree, and college graduate or beyond.

Poverty status. We also included a measure of poverty at Wave I, which occurred in 1994. Categories of the poverty variable include: less than or equal to \$15,000 (based on poverty level in 1994 for a family of four (73) and above \$15,000, as was done in previous research (27).

Analytic Strategy

First, univariate analyses were conducted to examine the characteristics of the study sample (age, biological sex, race/ethnicity, family structure, parental alcoholism, parental educational level, and poverty). Continuous variables were summarized using means and standard deviations. Categorical variables were summarized with frequencies and percentages.

Next, bivariate analyses were conducted to compare values of the covariates and outcomes between participants who report child maltreatment and those who do not. Chi-square

tests and t-tests evaluated significant differences at $p < 0.05$ for categorical and continuous variables, respectively.

We used multilevel modeling, specifically, hierarchical linear models (HLM) and hierarchical generalized linear models (HGLM), to examine the relationships between experiencing child maltreatment and involvement of CWS on alcohol and substance use in adulthood. For the multivariate models, biological sex was considered an effect measure modifier since the relationship between child maltreatment and alcohol and substance use likely differs for males and females (44, 74, 75), and all other covariates were included as potential confounders. Our models included robust standard errors and rescaled sampling weights, which account for the unequal probability of selection into the Add Health study. Given the sampling scheme of the Add Health study in which participants were included in the study in part based on the school they attended, it was also important to account for clustering or nesting within schools. In this case, participants from the same school may have more similar substance use patterns compared with students from other schools due to similar factors that may be attributable to the school. The residuals of nested data tend to be autocorrelated and heteroscedastic, which violates the assumptions of independence and homoscedasticity of residuals for Ordinary Least Squares regression (76), and unlike traditional methods for analyzing data, HLMs and HGLMs can account for clustering of individuals within groups by adding random effects into the model, which corrects for the biases caused by autocorrelation (77). Not accounting for the clustering of study participants by sampling unit could result in biased estimates and standard errors (78).

A log-linear distribution was used for monthly alcohol use given the skewness and kurtotic nature of the non-transformed alcohol use variable. Ordinal logistic regression was used

for marijuana and other substance use since these outcomes are categorical variables with ordered categories. All analyses were run using Stata 13 (79); multilevel models were estimated using generalized linear latent and mixed model (GLLAMM) commands that allow for estimation using sampling weights and clustering at multiple levels (80), which are important to consider given the sampling design of the Add Health study.

Results

Table 2.1 presents estimates of the prevalence of early child maltreatment and CWS involvement experiences. Over one-quarter of the sample reported experiencing any type of maltreatment, with 11% experiencing physical neglect, almost 24% experiencing emotional abuse, 9% experiencing physical abuse, and 4% experiencing sexual abuse. Twenty percent of the sample experienced one type of maltreatment, 6% experienced two types, and almost 2% experienced three or four types of maltreatment.

Examination of CWS involvement showed that 9% of maltreatment victims experienced some form of CWS involvement and 3% were removed from their homes by CWS. Among those who reported CWS involvement, 28% reported experiencing physical neglect, 16% experienced emotional abuse, 34% experienced physical abuse, and 21% experienced sexual abuse, which was different than the experiences of maltreatment victims who did not report CWS involvement, with 23% experiencing physical neglect, 40% experiencing emotional abuse, 25% experiencing physical abuse, and 11% experiencing sexual abuse ($p < 0.001$).

Table 2.2 presents information on the participants' characteristics, stratified by their maltreatment status. Percentages and mean scores are weighted to yield nationally representative estimates. Both victims and non-victims of maltreatment were similar in age at Wave IV (approximately 28 years) and percentage of male participants (approximately half). There were

statistically significant differences between victims and non-victims for race/ethnicity ($p<0.01$), family structure ($p<0.001$), parental alcoholism ($p<0.001$), parent's educational level at Wave I ($p<0.01$), and poverty status at the beginning of the Add Health study ($p<0.001$). More non-victims identified as non-Hispanic Caucasian than victims of maltreatment. Fewer victims of maltreatment lived with two biological parents, and more victims of maltreatment had a parent with alcoholism than non-victims. Fewer victims of maltreatment had a parent with a college degree or more, and more victims lived at or below the poverty line at Wave I than non-victims.

Table 2.3 provides the descriptive statistics of monthly alcohol use, past 30-day marijuana use, and past 30-day other substance use for the study sample. The maltreated and non-maltreated groups did not differ significantly in terms of their average number of drinks per month (maltreated 19.8 drinks per month and non-maltreated 18.5 drinks per month). Most study participants reported that they did not use marijuana during the past 30 days (83.0%). However, there was a statistically significant difference in marijuana use between victims and non-victims, with a larger percentage of victims reporting frequent use (one to seven days per week) than non-victims ($p<0.001$). Similarly, most participants reported no use of other substances (93.7%), and a larger percentage of victims of child maltreatment reported frequent use of other types of substances than non-victims ($p<0.01$).

Table 2.4 provides the unadjusted arithmetic and geometric means of monthly alcohol use for the different types of maltreatment and CWS involvement. There were statistically significant differences between victims of physical neglect and non-victims of maltreatment ($p<0.01$), victims who had at least one CWS investigation compared to victims of maltreatment

who were not investigated ($p<0.05$), and victims of maltreatment who were removed from the home compared to those who were not removed ($p<0.01$).

Table 2.5 provides unadjusted odds ratios for marijuana and other substance use for the different types of maltreatment and CWS involvement. We see statistically significant differences in marijuana use for all measures of maltreatment and experiencing one and two types of maltreatment. All of these crude odds ratios indicate that the odds of marijuana use frequency increases with exposure to the different types of maltreatment and polyvictimization.

We see fewer statistically significant associations for other substance use. Experiencing any maltreatment, emotional abuse, and two types of maltreatment have statistically significant associations with other substance use. Each of these significant associations shows an increase in other substance use with experiencing maltreatment or polyvictimization.

Table 2.6 presents the estimated coefficients and geometric means for the multivariate multilevel regression model of the association between different types of maltreatment and CWS involvement on log-transformed alcohol use. After accounting for identified sociodemographic, family, and behavioral factors, we only see a statistically significant difference on alcohol use by experiencing poly-victimization. After controlling for covariates, experiencing two types of maltreatment is associated with monthly alcohol use for both males and females ($p<0.05$). Among females, victims of two types of maltreatment consume 72% more alcohol per month ($p<0.05$), and among males, victims of two types of maltreatment drink 38% less alcohol per month ($p<0.05$). As age increases above the youngest age of the cohort (26 years), monthly alcohol use consumption is 17% lower ($p<0.001$), indicating that alcohol use declines among older adults. We also find that non-Hispanic African American adults consume 77% less alcohol per month with non-Hispanic Caucasians ($p<0.001$), and adults who identify with other non-

Hispanic races drink 39% less than Caucasians ($p<0.01$). Compared with respondents who had a parent or caregiver who had earned a bachelor's degree, respondents whose parents had not completed high school drink 62% less per month ($p<0.001$), and respondents whose parents completed high school but did not receive further education consume 43% less alcohol per month ($p<0.001$).

Table 2.7 presents the multivariate, multilevel models using ordinal logistic regression to estimate the effects of child maltreatment and CWS involvement on marijuana use. After accounting for identified sociodemographic and family factors, we see statistically significant increases in the odds of marijuana use by all types of maltreatment except sexual abuse and measures of CWS involvement. Additionally, biological sex modifies the relationships for any maltreatment, emotional abuse, physical abuse, and two types of maltreatment. Among females, experiencing any type of maltreatment is associated with a 91% increase ($p<0.001$) in the odds of using marijuana at higher frequencies, a 95% increase by emotional abuse ($p<0.001$), 129% by physical abuse ($p<0.001$), and two types of maltreatment by 155% ($p<0.001$), compared to female non-victims. Among males, victims of any maltreatment had a 16% higher odds ($p<0.01$), victims of emotional abuse had a 1% higher odds ($p<0.001$), victims of physical abuse had a 19% higher odds ($p<0.01$), and victims of two types of maltreatment had a 5% higher odds ($p<0.01$) of using marijuana at higher frequencies than non-victims. Victims of physical neglect had an 88% higher odds ($p<0.05$) and victims of one type of maltreatment had a 71% ($p<0.01$) higher odds of using marijuana at higher levels, but these relationships were not modified by sex. We also see that as age increases above the youngest age of the cohort (26 years), the odds of using marijuana at higher frequencies decreases by approximately 10% across the different measures of maltreatment, indicating that marijuana use is less frequent among older adults.

Family structures other than having two biological parents are associated with a higher odds of having higher frequencies of marijuana use for any maltreatment, physical neglect, emotional abuse, physical abuse and poly-victimization.

Table 2.8 presents the multivariate, multilevel models using ordinal logistic regression to estimate the effects of child maltreatment and CWS involvement on other substance use. After accounting for identified sociodemographic, and family factors, we see a statistically significant increase in the odds of other substance use by experiencing two types of maltreatment and CWS investigation, but biological sex does not modify these relationships. Experiencing two types of maltreatment is associated with a 128% increase ($p < 0.01$) and CWS investigation is associated with a 150% increase ($p < 0.05$) in the odds of using other substances at higher frequencies. We also see that as age increases above the youngest age of the cohort (26 years), the odds of using other substances at higher frequencies decreases by 21% for victims of two types of maltreatment ($p < 0.01$), indicating that the frequency of other substance use declines among older adults. The results also show that African Americans have a 63% decrease ($p < 0.001$) in the odds of other substance use for victims of two types of maltreatment and a 65% decrease ($p < 0.05$) for victims with a CWS investigation, and living in a single parent home in adolescence is associated with a higher odds of having higher frequencies of other substance use (50%, $p < 0.05$) for victims of two types of maltreatment.

Discussion

The purpose of this study was to examine the impact of experiencing maltreatment in early childhood on alcohol and substance use in young adulthood. We found that experiencing poly-victimization impacted average monthly alcohol consumption when compared to non-victims of maltreatment. After conditioning on identified covariates and effect modification by

biological sex, all measures of maltreatment except sexual abuse, which may be due to the small numbers of victims of sexual abuse in this dataset, are associated with an increased odds of marijuana use, and poly-victimization and CWS investigation are associated with increased odds of other substance use in adulthood.

Previous research has shown that child maltreatment has a lasting impact on health and risk behaviors into adulthood; however, this study utilized several measures of both maltreatment and alcohol and substance use that have not previously been used with a nationally representative sample. The Add Health study measured alcohol use over the past 12 months, which allows researchers to capture infrequent heavy or light alcohol use that is missed when only accounting for use over the past month (69). For this study, we took advantage of the numerous alcohol use measures in the Add Health study to formulate an index measure of alcohol consumption based on the graduated frequency index that incorporated both regular use and binge drinking (67, 68, 81). This method attempts to compensate for underreporting of average alcohol use that occurs when study participants do not incorporate binge drinking into their report of usual use (68, 82). Approximately 20-40% of adults ages 18-55 (83) and 22% of adolescents (84) engage in heavy drinking, but survey respondents typically exclude episodes of heavy or binge drinking from their estimates of usual alcohol use (85). Thus, measures that include only measures of typical alcohol use underestimate average consumption of alcohol by failing to account for binge drinking. Additionally, a number of studies that have researched the relationship between maltreatment and alcohol or substance use often utilize a dichotomous measure for use disorders or any use, rather than examining levels of use (27, 47, 86-89). This type of measurement limits the ability to assess the level of impact of maltreatment on alcohol and substance use, rather than just determining if victims of maltreatment are more likely to use alcohol or substances at all.

For this study, the index measure we used allowed for an examination of typical drinking that may include binge drinking; thus we were able to capture a more accurate measure of monthly alcohol consumption.

We found that other than experiencing poly-victimization, maltreatment and CWS involvement experiences were not associated with alcohol use in adulthood. Female victims of two types of maltreatment consume more alcohol per month than non-victims while male victims consume less alcohol per month compared to male non-victims, but the relationship for three or four types of maltreatment was not significant, which may be due to small cell sizes at this level. Past research findings related to the impact of maltreatment on alcohol use have been equivocal. A study of young adults in Spain recruited from a university found no association between emotional or physical neglect and the number of drinks consumed (90). Another study that examined the impact of maltreatment on binge drinking in emerging adulthood (between 18 and 26 years of age) found that victims of supervisory and physical neglect had a 20% higher odds of reporting binge drinking than non-victims (64). However, a subsequent analysis examining binge drinking into young adulthood showed no difference in the frequency of use between victims of maltreatment and non-victims by the time adults reach the age of 32 (46), which may be a result of developmentally maturing out of problematic alcohol consumption in adulthood (91).

It is important to note the range of alcohol use among the study population; a large proportion of study participants reported no use (27%) and some participants reported use of up to 15.4 drinks per day. This disproportionate and wide range in drinking experiences may have resulted in the index measure that could not accurately assess the study participants' actual alcohol consumption patterns. On the other hand, the results from this study may indicate that

other than experiencing poly-victimization, the impact of childhood maltreatment experiences on alcohol consumption patterns may not persist into adulthood.

Another facet of the dynamics between child maltreatment and alcohol use is the impact of parental alcohol use disorders. The Add Health study measured parental alcoholism, and we see that a larger percentage of victims of childhood maltreatment (22.1%) than non-victims (13.8%) reported that at least one biological parent had alcoholism ($p < 0.001$). Previous research has shown that some children of adults with alcoholism respond by avoiding alcohol as a result of experiencing or witnessing the consequences of their parents' addiction and perceiving their own risk for developing alcoholism (92), which may have influenced the relationship between maltreatment victimization and later alcohol use.

In addition to the more expansive investigation of alcohol and substance use, this study also utilized different measures of child maltreatment that allowed for the examination of experiencing any maltreatment, individual types of maltreatment, and also met the call from previous research to examine the impact of poly-victimization on health outcomes (28, 29, 31, 33, 89). We also included measures of CWS investigation and removal from the home to determine if this population was different from self-reported victims of maltreatment. Previous research has used assessments of CWS involvement and removal from the home as a measure of severity of maltreatment based on the assumption that children who are removed from the home have experienced higher levels of maltreatment severity (46).

Our findings on marijuana and other substance use are consistent with previous research. First, individual types of maltreatment have been found to impact substance use later in life. An investigation of experiencing different types of maltreatment on any substance use in young adulthood found an association with physical abuse but not neglect or sexual abuse (47). The

current study found associations with individual types of maltreatment for marijuana use, but for other substance use, the only significant relationships were with polyvictimization and CWS investigation; the difference in findings may be due to the measure of other substance use. Whereas Huang and colleagues (47) measured substance use as a dichotomous variable, for this study it was measured as an ordinal variable. Consistent with prior research, we also found an exposure-response relationship between experiences of maltreatment and both marijuana and other substance use. A study of rural high school students found that adolescents who self-reported emotional, physical, or sexual abuse had significantly higher levels of substance use, and there was a larger effect on substance use among those who experienced both physical and sexual abuse (93).

It is important to note that the similar findings for marijuana use and other substance use may be due to individuals who engage in poly-substance use and who would influence the estimates of the impact of maltreatment for both marijuana and substance use. An initial assessment of the prevalence of substance use found that 21% of respondents who reported using marijuana in young adulthood also reported using another substance over the past 30 days, and over half of respondents who reported using other substances reported concurrent use of marijuana over the past 30 days (58%). Marijuana is the most commonly used illicit substance in the United States; according to the National Survey on Drug Use and Health, in 2013, approximately 7.6% of persons aged 12 and older use marijuana, followed by prescription drug misuse at 2.5%, and 15.9% of people aged 12 and older report using both marijuana and another substance (4).

Limitations

This study is subject to certain limitations. First, childhood maltreatment experiences and involvement with CWS are based on retrospective self-reports and require the respondents to remember and determine when those experiences first occurred. Even though self-reports of childhood maltreatment tend to be a better predictor of prevalence of maltreatment than CWS reports, previous studies have found that self-reported childhood physical abuse (94) and sexual abuse (95) tend to be underreported (96), which may be due to not remembering the abuse or not wanting to report it. The Add Health study utilized CASI when inquiring about sensitive topics, such as child maltreatment and alcohol and substance use, and the CASI has been shown to enhance disclosure of sensitive and stigmatized information (97, 98). One study that compared CWS reports with adolescent recall of psychological, physical and sexual abuse found that the estimated prevalence of maltreatment as determined by self-report was higher than the estimate from CWS reports, even though some adolescents who had experienced childhood maltreatment, as determined by CWS report, failed to self-report the maltreatment; however, use of CASI allowed for eliciting more new reports of abuse, especially psychological maltreatment, when compared with CWS substantiated cases (23). Additionally, while the Add Health study includes the measurement of multiple types of maltreatment, childhood exposure to intimate partner violence was not assessed. Witnessing intimate partner violence as a child is considered a form of child maltreatment in some states and has been linked to substance use in adolescence (99) and adulthood (100). The exclusion of this measure of maltreatment is a limitation to understanding the child maltreatment-substance use relationship. Additionally, although the Add Health study measured the number of times the participants experienced different types of childhood maltreatment, the severity of maltreatment was not assessed. In a community sample

of adult women, persons reporting more severe child sexual abuse were more likely to report problematic substance use and substance abuse (101), and among youths receiving treatment for alcohol or drug use disorders, respondents who reported more severe childhood maltreatment exhibited more symptoms of problematic substance use (102). Without a measure of the severity of maltreatment, the effect of maltreatment on substance may be diluted. Similarly, given the design of study questions, we were unable to distinguish between maltreatment that occurred only in early childhood and ongoing maltreatment into adolescence, which may differentially impact substance use in adulthood.

While there is no best measurement of alcohol consumption, past research has found that reports of alcohol use were more accurate if study participants were asked about consumption of specific categories of alcohol (e.g., beer, wine, and liquor) (103, 104). The Add Health study did not capture this specific information, thus, it is possible that this study is still capturing an underestimate of alcohol consumption. Additionally, the index measure used in this study does not allow for a measure of variability in drinking patterns since it creates an average consumption rate.

While there is some information about the concurrent use of alcohol, marijuana, or some other substance, Wave IV of the Add Health study separately measured use of other substances by first determining the participant's "favorite drug" or the one used most often. Therefore, poly-substance use was not assessed in this study, even though studies have found a high prevalence of simultaneous substance use among substance users. Findings from the national Treatment Episode Data Set (TEDS) show that among substance abuse treatment admissions, almost 40% of admissions reported alcohol and other drug use, with 23.1% reporting use of alcohol and one

other drug and 14.1% reporting concurrent use of alcohol and at least two other drugs (105). Our study attempted to counteract this weakness by examining substances separately in adulthood.

Future research should examine the longitudinal impact of child maltreatment on alcohol and substance use to better understand patterns of use from adolescence into adulthood. Some studies have conditioned on substance use in adolescence when studying the role of child maltreatment on substance use in adulthood (106), but none have examined levels of use from adolescence into adulthood using a nationally representative sample that incorporates multiple measures of maltreatment and CWS involvement.

Finally, these analyses are limited by sample attrition and missing data. In particular, this study conducted complete case analyses, and there was a high percentage of missingness for the variable measuring parental alcoholism and poverty since these measures relied on parent or caregiver response; thus, these results may be biased by the non-response. Future research using other datasets or methods for handling missing data should be conducted to replicate the findings from this study.

Conclusions

This study is the first to examine different measures of maltreatment, including individual types, poly-victimization and levels of CWS involvement, on alcohol, marijuana, and other substance use in young adulthood among a nationally representative sample. The findings from this study show that early childhood maltreatment is associated with alcohol and substance use in young adulthood. An important next step in studying this relationship is to determine the patterns of use from adolescence into adulthood in order to determine effective points of interventions for youths who have been maltreated by their caregivers.

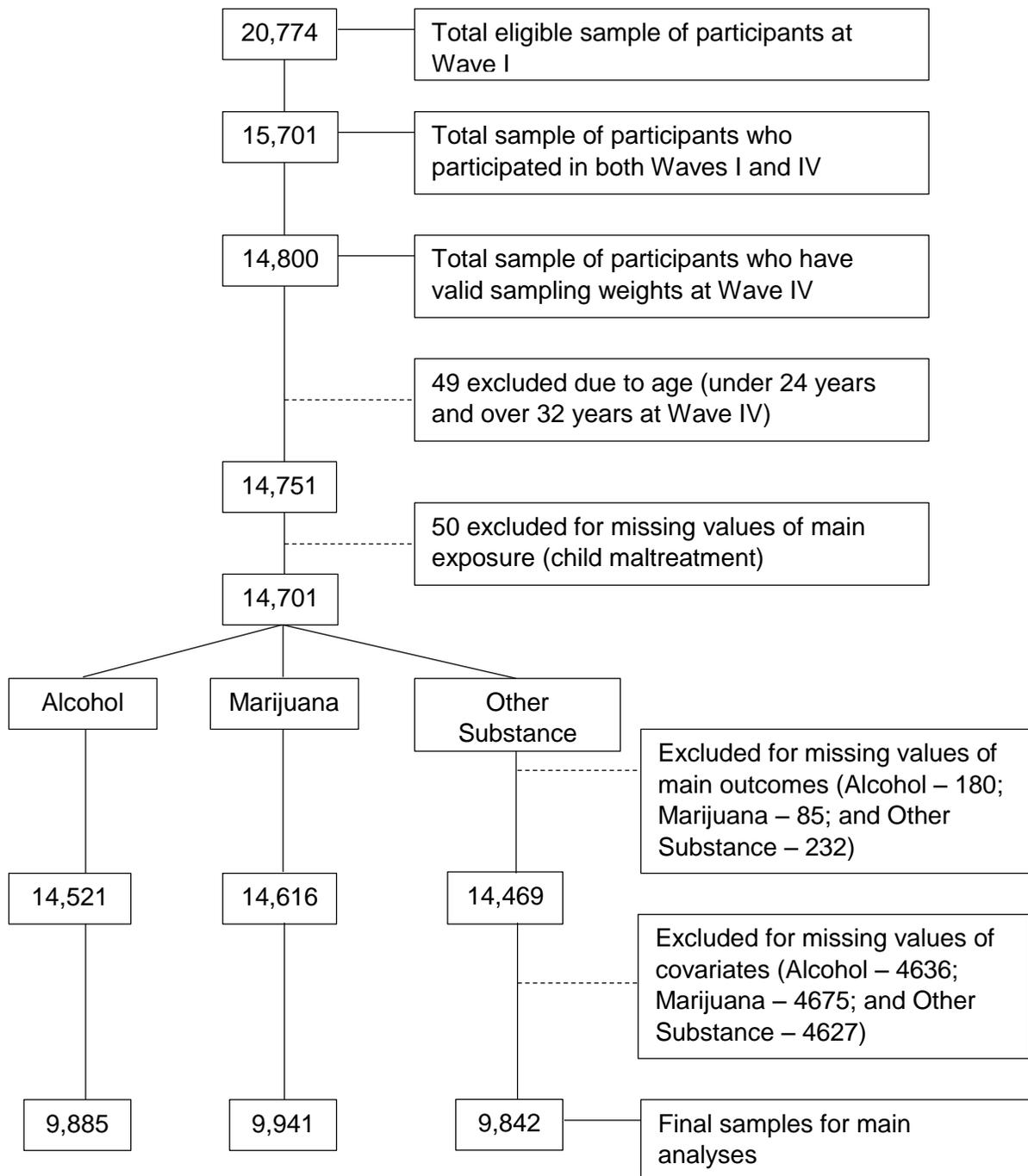


Figure 2.1. Construction of analytic sample with detailed sample exclusions

Table 2.1. Prevalence of Child Maltreatment and Child Welfare Services (CWS) Involvement Experiences of the Study Population (N=9,885)

Child maltreatment and CWS involvement, %, (n)	%	(n)
Maltreatment and maltreatment type		
No report of maltreatment	72.3	(7,200)
≥ 1 report of maltreatment	27.8	(2,685)
≥ 1 report of physical neglect	11.1	(841)
≥ 1 report of emotional abuse	24.3	(1,677)
≥ 1 report of physical abuse	9.1	(805)
≥ 1 report of sexual abuse	3.5	(332)
Poly-victimization		
No maltreatment	72.3	(7,200)
1 type of maltreatment	19.8	(1,913)
2 types of maltreatment	6.3	(603)
3 or 4 types of maltreatment	1.7	(169)
Any CWS investigation		
No investigation	91.5	(2,467)
At least one report of CWS investigation	8.5	(218)
Removed from the home by CWS		
Not removed from the home	96.6	(2,594)
Removed from the home	3.4	(91)

Note: percentages and means are weighted to yield nationally representative estimates. Percentages may not sum to 100% due to rounding.

Abbreviations: CWS, Child Welfare Services; %, weighted percent; SE, standard error of the mean.

Table 2.2. Characteristics of the Study Population at Wave IV, National Longitudinal Study of Adolescent to Adult Health

Characteristic	Total sample (n=9,885)		Any maltreatment ^a (n=2,685)		No maltreatment ^b (n=7,200)	
<u>Participant's characteristics</u>						
Age, mean (SE), years	28.3	(0.13)	28.4	(0.14)	28.3	(0.13)
Biological sex, %, (n)						
	Female	48.9 (5,204)	48.3 (1,411)		49.2 (3,793)	
	Male	51.1 (4,681)	51.7 (1,274)		50.8 (3,407)	
Race/ethnicity, %, (n) †						
	White, non-Hispanic	62.4 (5,754)	59.2 (1,495)		63.7 (4,259)	
	Black, non-Hispanic	14.4 (1,737)	14.0 (471)		14.5 (1,266)	
	Hispanic	14.1 (1,485)	14.8 (409)		13.8 (1,076)	
	Other race, non-Hispanic	9.1 (909)	12.0 (310)		8.0 (599)	
<u>Parent/Caregiver's or Family's characteristics</u>						
Family structure, %, (n) ‡						
	Two biological parents	60.4 (5,832)	49.3 (1,291)		64.6 (4,541)	
	Two parents	15.4 (1,570)	20.0 (541)		13.6 (1,029)	
	Single parent	21.0 (2,189)	26.6 (748)		18.9 (1,441)	
	Other	3.3 (294)	4.2 (105)		3.0 (189)	
Parental alcoholism, %, (n) ‡						
	No	84.0 (8,238)	78.1 (2,078)		86.2 (6,160)	
	Yes	16.0 (1,647)	21.9 (607)		13.8 (1,040)	
Educational level, %, (n) †						
	Less than high school	9.8 (986)	10.0 (277)		9.7 (709)	
	High school graduate or GED	25.9 (2,445)	26.1 (674)		25.8 (1,771)	
	Some college or Associate's degree	31.3 (3,097)	34.0 (896)		30.3 (2,201)	
	College graduate or beyond	33.1 (3,357)	29.9 (838)		34.3 (2,519)	
Poverty, %, (n) ‡						
	Above the poverty line	85.5 (8,393)	82.1 (2,192)		86.8 (6,201)	
	At or below the poverty line	14.5 (1,492)	17.9 (493)		13.2 (999)	

Note: percentages and means are weighted to yield nationally representative estimates. Percentages may not sum to 100% due to rounding.

Abbreviations: %, weighted percent; SE, standard error of the mean.

* p<0.05; † p<0.01; ‡ p<0.001

^a Any maltreatment: frequency is based on the unweighted sample; 28% of the weighted sample.

^b No maltreatment: frequency is based on the unweighted sample; 72% of the weighted sample.

Table 2.3. Descriptive statistics for monthly alcohol use, past 30-day marijuana use, and past 30-day other substance use, National Longitudinal Study of Adolescent to Adult Health, Wave IV

Characteristic	Total sample	CM ^a	No CM ^b
Alcohol use, drinks per month	(n=9,885)	(n=2,685)	(n=7,200)
Arithmetic mean (SE)	18.9 (0.70)	19.8 (1.31)	18.5 (0.72)
Geometric mean (SE)	1.13 (0.11)	1.14 (0.14)	1.13 (0.12)
Marijuana use, %, (n), past 30-days‡	(n=9,941)	(n=2,696)	(n=7,245)
None	83.0 (8,328)	79.4 (2,167)	84.3 (6,161)
One to three day per month	6.3 (596)	6.3 (167)	6.3 (429)
One to seven days per week	10.7 (1,017)	14.3 (362)	9.4 (655)
Other substance use, %, (n), past 30-days†	(n=9,842)	(n=2,663)	(n=7,179)
None	93.7 (9,239)	92.6 (2,452)	94.2 (6,787)
One to three day per month	3.5 (341)	3.5 (107)	3.5 (234)
One to seven days per week	2.8 (262)	4.0 (104)	2.3 (158)

Note: percentages and means are weighted to yield nationally representative estimates. Percentages may not sum to 100% due to rounding.

Abbreviations: CM, child maltreatment; %, weighted percent; SE, standard error of the mean.

* p<0.05; † p<0.01; ‡ p<0.001

^a CM: Frequency is based on the unweighted sample; 28% of the weighted sample.

^b No CM: Frequency is based on the unweighted sample; 72% of the weighted sample.

Table 2.4. Monthly Alcohol Use – Unadjusted Mean and Geometric Mean (SE) by Maltreatment Status

	Mean alcohol use (SE) ^a	Geometric mean of alcohol use (SE) ^a
Type of maltreatment		
Not a victim	18.53 (0.72)	1.13 (0.12)
Victim of any type of maltreatment	19.76 (1.31)	1.14 (0.14)
Victim of physical neglect†	19.99 (2.46)	0.64 (0.16)
Victim of emotional abuse	19.61 (1.40)	1.34 (0.16)
Victim of physical abuse	21.25 (1.92)	1.45 (0.22)
Victim of sexual abuse	21.56 (3.94)	1.12 (0.28)
Poly-victimization		
Not a victim	18.53 (0.72)	1.13 (0.12)
Victim of 1 type of maltreatment	19.41 (1.45)	1.15 (0.16)
Victim of 2 types of maltreatment	20.53 (2.28)	1.29 (0.21)
Victim of 3 or 4 types of maltreatment	20.97 (4.99)	0.70 (0.24)
Child Welfare Services Investigation*		
Not investigated	20.14 (1.32)	1.23 (0.15)
≥ 1 CWS investigation	15.62 (3.07)	0.51 (0.21)
Removed from the home†		
Not removed by CWS	19.94 (1.30)	1.20 (0.14)
≥ 1 removal from home by CWS	14.61 (4.34)	0.27 (0.13)

Abbreviations: SE (Standard Error), CWS (Child Welfare Services)

^a Coefficients based on weighted data.

* p<0.05; † p<0.01; ‡ p<0.001

Table 2.5. Marijuana and other substance use (Past 30 Days) – unadjusted OR (95% CI) by maltreatment status

	Marijuana use		Other substance use	
	OR	(95% CI)	OR	(95% CI)
Any type of maltreatment	1.50‡	(1.29, 1.74)	1.50†	(1.08, 2.07)
Physical neglect	1.66†	(1.21, 2.27)	1.55	(0.86, 2.79)
Emotional abuse	1.42‡	(1.20, 1.68)	1.50*	(1.04, 2.16)
Physical abuse	1.82‡	(1.39, 2.38)	1.86	(0.98, 3.53)
Sexual abuse	1.54*	(1.05, 2.25)	1.47	(0.89, 2.43)
Poly-victimization				
1 type of maltreatment	1.39‡	(1.16, 1.67)	1.30	(0.96, 1.78)
2 types of maltreatment	1.71‡	(1.29, 2.25)	2.21*	(1.16, 4.20)
3 or 4 types of maltreatment	1.95	(1.00, 3.82)	1.10	(0.45, 2.73)
Child Welfare Services Investigation	1.40	(0.81, 2.42)	2.28	(0.70, 7.50)
Removed from the home	2.12	(0.90, 5.01)	1.12	(0.44, 2.84)

Abbreviations: OR (Odds Ratio), CI (Confidence Interval)

^a ORs and CIs based on weighted data.

* p<0.05; † p<0.01; ‡ p<0.001

Table 2.6. Estimated HLM coefficients of the effects of child maltreatment on monthly alcohol use (log-transformed), Wave IV of the National Longitudinal Study of Adolescent to Adult Health

	Any maltreatment		Physical neglect		Emotional abuse		Monthly Alcohol use (log transformed) ^a				CWS investigated		Removed			
	b (SE)	GM	b (SE)	GM	b (SE)	GM	b (SE)	GM	b (SE)	GM	b (SE)	GM	b (SE)	GM		
Fixed effects																
Maltreatment type	-0.02 (0.14)	0.98	-0.49 (0.34)	0.61	0.05 (0.14)	1.05	0.26 (0.18)	1.30	0.31 (0.23)	1.36			-0.39 (0.46)	0.68	-0.23 (0.80)	0.80
One type											-0.17 (0.18)	0.84				
Two types											0.54* (0.26)	1.72				
Three or four types											-0.19 (0.33)	0.82				
Age	-0.18‡ (0.04)	0.83	-0.19‡ (0.05)	0.83	-0.18‡ (0.04)	0.83	-0.17‡ (0.05)	0.84	-0.18‡ (0.05)	0.83	-0.18‡ (0.04)	0.83	-0.12* (0.06)	0.89	-0.12* (0.06)	0.89
Sex*maltreatment	-0.12 (0.24)	0.88	-0.12 (0.45)	0.88	-0.09 (0.29)	0.91	-0.26 (0.32)	0.77	0.03 (0.72)	1.03			0.56 (0.70)	1.75	-0.26 (1.36)	0.77
One type											0.14 (0.27)	1.15				
Two types											-1.02* (0.47)	0.36				
Three or four types											0.18 (0.86)	1.20				
Biological sex	1.22‡ (0.14)	3.40	1.23‡ (0.14)	3.44	1.22‡ (0.14)	3.37	1.23‡ (0.14)	3.43	1.23‡ (0.14)	3.42	1.22‡ (0.14)	3.40	1.06‡ (0.23)	2.88	1.12‡ (0.23)	3.06
Race (referent – NH Caucasian)																
NH African American	-1.47‡ (0.23)	0.23	-1.39‡ (0.25)	0.25	-1.37‡ (0.21)	0.25	-1.21‡ (0.20)	0.30	-1.20‡ (0.19)	0.30	-1.46‡ (0.23)	0.23	-2.52‡ (0.42)	0.08	-2.50‡ (0.43)	0.08
Hispanic	-0.44 (0.34)	0.64	-0.46 (0.38)	0.63	-0.49 (0.36)	0.61	-0.47 (0.38)	0.62	-0.46 (0.38)	0.63	-0.42 (0.35)	0.66	-0.38 (0.41)	0.68	-0.35 (0.41)	0.70
NH Other	-0.50† (0.18)	0.61	-0.46* (0.20)	0.63	-0.45* (0.19)	0.64	-0.53* (0.20)	0.59	-0.41* (0.20)	0.66	-0.50† (0.18)	0.61	-0.66* (0.28)	0.52	-0.67* (0.29)	0.51
Family structure (referent – two biological parents)																
Two parents, other	-0.12 (0.15)	0.89	-0.20 (0.16)	0.82	-0.13 (0.17)	0.88	-0.14 (0.17)	0.87	-0.08 (0.17)	0.92	-0.11 (0.15)	0.90	-0.12 (0.30)	0.89	-0.12 (0.31)	0.88
Single parent	0.20 (0.14)	1.23	0.23 (0.15)	1.26	0.23 (0.13)	1.25	0.17 (0.15)	1.19	0.22 (0.15)	1.25	0.21 (0.14)	1.23	0.17 (0.30)	1.19	0.15 (0.30)	1.16
Other	0.28 (0.44)	1.32	0.28 (0.50)	1.32	0.26 (0.48)	1.30	0.26 (0.49)	1.29	0.17 (0.52)	1.18	0.27 (0.44)	1.31	0.53 (0.47)	1.69	0.50 (0.47)	1.65
Parental alcoholism	-0.08 (0.16)	0.92	-0.02 (0.19)	0.98	-0.06 (0.17)	0.95	-0.04 (0.19)	0.96	0.00 (0.18)	1.00	-0.09 (0.16)	0.91	-0.15 (0.28)	0.86	-0.15 (0.28)	0.86
Parental education (referent – college or more)																
Less than high school	-0.94‡ (0.20)	0.39	-0.97‡ (0.25)	0.38	-1.01‡ (0.20)	0.36	-0.96‡ (0.22)	0.38	-0.95‡ (0.23)	0.39	-0.96‡ (0.20)	0.38	-0.89* (0.39)	0.41	-0.91* (0.39)	0.40
High school	-0.57‡ (0.15)	0.56	-0.60‡ (0.17)	0.55	-0.66‡ (0.16)	0.52	-0.56† (0.17)	0.57	-0.64‡ (0.18)	0.53	-0.57‡ (0.15)	0.57	-0.36 (0.31)	0.70	-0.35 (0.30)	0.70
Some college	-0.24 (0.13)	0.79	-0.27 (0.14)	0.76	-0.23 (0.14)	0.80	-0.19 (0.14)	0.83	-0.23 (0.15)	0.80	-0.23 (0.13)	0.79	-0.18 (0.27)	0.83	-0.18 (0.27)	0.83

Poverty status	-0.23 (0.19)	0.79	-0.34 0.97‡	0.71 2.63	-0.24 (0.20)	0.78	-0.23 (0.20)	0.79	-0.38 (0.23)	0.69	-0.24 (0.19)	0.79	-0.01 (0.29)	0.99	-0.01 (0.30)	0.99
Intercept	0.90‡ (0.25)	2.46	0.97‡	2.63	0.93‡ (0.25)	2.52	0.83† (0.24)	2.30	0.90‡ (0.26)	2.47	0.90‡ (0.25)	2.47	0.73* (0.32)	2.08	0.71* (0.31)	2.04
Random effects (variance component)																
Variance between schools	0.07		0.08		0.08		0.08		0.10		0.07		0.06		0.06	
Number of subjects	9,885		8,058		8,893		8,022		7,547		9,885		2,689		2,689	
Number of schools	132		132		132		132		132		132		132		132	

Abbreviations: SE (Standard Error), GM (Geometric Mean), NH (non-Hispanic)

^a Coefficients and geometric means based on weighted data. All models adjusted for age, sex, race, family structure, parental alcoholism, parental education, and poverty status.

* p<0.05; † p<0.01; ‡ p<0.001

Table 2.7. Estimated HGLM coefficients of the effects of child maltreatment on monthly marijuana use, Wave IV of the National Longitudinal Study of Adolescent to Adult Health

Fixed effects	Past 30 Day Marijuana Use ^a													
	Any maltreatment		Physical neglect		Emotional abuse		Poly-victimization		CWS investigated					
	b	OR	b	OR	b	OR	b	OR	b	OR				
Maltreatment type	0.65	1.91 [‡]	0.63	1.88*	0.67	1.95 [‡]	0.83	2.29 [‡]	0.49	1.63	0.28	1.32	0.64	1.90
	(1.50, 2.44)		(1.06, 3.31)	(1.51, 2.52)	(1.50, 3.50)	(0.93, 2.86)					(0.65, 2.68)	(0.48, 7.58)		
									0.53	1.71 [†]				
									(1.26, 2.31)					
									0.94	2.55 [‡]				
									(1.64, 3.96)					
									0.69	2.00				
									(0.56, 7.17)					
Age	-0.10	0.90 [†]	-0.13	0.88 [†]	-0.10	0.90 [†]	-0.13	0.88 [†]	-0.12	0.89 [†]	-0.10	0.90 [†]	-0.05	0.95
	(0.85, 0.96)		(0.81, 0.95)	(0.85, 0.96)	(0.82, 0.95)	(0.82, 0.95)	(0.85, 0.96)	(0.85, 1.05)	(0.85, 1.05)	(0.85, 1.05)	(0.85, 1.05)	(0.85, 1.05)	(0.85, 1.05)	(0.85, 1.05)
Sex*maltreatment	-0.50	0.61 [†]	-0.40	0.67	-0.66	0.52 [‡]	-0.66	0.52 [‡]	0.09	1.09	-0.02	0.98	0.09	1.09
	(0.44, 0.83)		(0.35, 1.27)	(0.36, 0.74)	(0.32, 0.84)	(0.41, 2.87)					(0.30, 3.17)	(0.17, 7.10)		
One type											-0.39	0.68		
											(0.45, 1.01)			
Two types											-0.89	0.41 [†]		
											(0.23, 0.74)			
Three or four types											-0.16	0.85		
											(0.16, 4.48)			
Biological sex	0.95	2.59 [‡]	0.97	2.64 [‡]	0.95	2.58 [‡]	0.96	2.62 [‡]	0.97	2.63 [‡]	0.95	2.58 [‡]	0.43	1.54 [†]
	(2.05, 3.25)		(2.10, 3.32)	(2.05, 3.25)	(2.08, 3.31)	(2.08, 3.32)	(2.05, 3.25)	(2.05, 3.25)	(2.05, 3.25)	(2.05, 3.25)	(1.15, 2.07)	(1.15, 2.02)		
Race (referent – NH Caucasian)														
NH African American	-0.27	0.77	-0.26	0.77	-0.20	0.82	-0.13	0.88	-0.17	0.84	-0.25	0.78	-0.44	0.64
	(0.58, 1.01)		(0.55, 1.09)	(0.62, 1.08)	(0.67, 1.15)	(0.62, 1.15)	(0.59, 1.02)	(0.39, 1.05)	(0.38, 1.03)	(0.38, 1.03)	(0.38, 1.03)	(0.38, 1.03)	(0.38, 1.03)	(0.38, 1.03)
Hispanic	-0.13	0.87	-0.07	0.93	-0.22	0.80	-0.13	0.87	-0.17	0.84	-0.11	0.89	-0.03	0.97
	(0.55, 1.38)		(0.59, 1.47)	(0.51, 1.25)	(0.54, 1.42)	(0.53, 1.33)	(0.56, 1.41)	(0.57, 1.64)	(0.58, 1.58)	(0.58, 1.58)	(0.58, 1.58)	(0.58, 1.58)	(0.58, 1.58)	(0.58, 1.58)
NH Other	-0.13	0.88	-0.17	0.85	-0.01	0.99	-0.12	0.89	0.00	1.00	-0.13	0.88	-0.23	0.80
	(0.60, 1.27)		(0.57, 1.25)	(0.67, 1.47)	(0.59, 1.33)	(0.63, 1.60)	(0.60, 1.28)	(0.50, 1.27)	(0.50, 1.28)	(0.50, 1.28)	(0.50, 1.28)	(0.50, 1.28)	(0.50, 1.28)	(0.50, 1.28)
Family structure (referent – two biological parents)														
Two parents, other	0.37	1.44 [†]	0.27	1.31	0.47	1.61 [†]	0.49	1.63 [†]	0.35	1.41*	0.36	1.44 [†]	0.36	1.43
	(1.12, 1.85)		(0.99, 1.75)	(1.22, 2.12)	(1.20, 2.21)	(1.03, 1.93)	(1.12, 1.84)	(0.95, 2.14)	(0.95, 2.06)	(0.95, 2.06)	(0.95, 2.06)	(0.95, 2.06)	(0.95, 2.06)	(0.95, 2.06)
Single parent	0.47	1.61 [†]	0.58	1.78 [†]	0.52	1.68 [‡]	0.59	1.80 [‡]	0.47	1.60 [†]	0.47	1.60 [†]	0.43	1.53
	(1.22, 2.11)		(1.24, 2.56)	(1.28, 2.19)	(1.30, 2.50)	(1.19, 2.16)	(1.23, 2.09)	(0.90, 2.61)	(0.91, 2.64)	(0.91, 2.64)	(0.91, 2.64)	(0.91, 2.64)	(0.91, 2.64)	(0.91, 2.64)
Other	0.65	1.92*	0.36	1.44	0.81	2.25 [†]	0.63	1.87	0.37	1.45	0.63	1.88*	0.92	2.52*
	(1.17, 3.15)		(0.69, 3.01)	(1.34, 3.77)	(0.99, 3.56)	(0.68, 3.10)	(1.15, 3.08)	(1.12, 5.66)	(1.14, 5.74)	(1.14, 5.74)	(1.14, 5.74)	(1.14, 5.74)	(1.14, 5.74)	(1.14, 5.74)
Parental alcoholism	0.05	1.06	0.20	1.22	-0.02	0.98	0.05	1.06	0.20	1.22	0.04	1.05	-0.23	0.79
	(0.80, 1.40)		(0.90, 1.65)	(0.73, 1.32)	(0.77, 1.45)	(0.89, 1.66)	(0.79, 1.38)	(0.50, 1.26)	(0.51, 1.25)	(0.51, 1.25)	(0.51, 1.25)	(0.51, 1.25)	(0.51, 1.25)	(0.51, 1.25)
Parental education (referent – college or more)														
Less than high school	-0.19	0.83	-0.20	0.82	-0.25	0.78	-0.20	0.82	-0.28	0.75	-0.19	0.82	0.05	1.06
	(0.58, 1.18)		(0.55, 1.24)	(0.54, 1.14)	(0.54, 1.23)	(0.49, 1.15)	(0.58, 1.18)	(0.62, 1.80)	(0.61, 1.83)	(0.61, 1.83)	(0.61, 1.83)	(0.61, 1.83)	(0.61, 1.83)	(0.61, 1.83)
High school	-0.05	0.95	-0.06	0.94	-0.04	0.96	-0.01	0.99	-0.09	0.91	-0.05	0.95	-0.00	1.00
	(0.75, 1.21)		(0.74, 1.19)	(0.75, 1.23)	(0.76, 1.28)	(0.72, 1.16)	(0.75, 1.21)	(0.63, 1.57)	(0.63, 1.57)	(0.63, 1.57)	(0.63, 1.57)	(0.63, 1.57)	(0.63, 1.57)	(0.63, 1.57)
Some college	-0.03	0.97	-0.01	0.99	0.03	1.03	0.04	1.04	0.06	1.06	-0.4	0.96	-0.19	0.83
	(0.74, 1.27)		(0.72, 1.36)	(0.76, 1.39)	(0.75, 1.43)	(0.75, 1.48)	(0.74, 1.26)	(0.56, 1.22)	(0.56, 1.22)	(0.56, 1.22)	(0.56, 1.22)	(0.56, 1.22)	(0.56, 1.22)	(0.56, 1.22)

Poverty status	0.09 1.10 (0.86, 1.40)	0.04 1.04 (0.77, 1.41)	0.13 1.14 (0.88, 1.49)	0.09 1.10 (0.84, 1.44)	0.09 1.09 (0.83, 1.44)	0.09 1.09 (0.85, 1.39)	-0.08 0.92 (0.63, 1.35)	-0.09 0.91 (0.62, 1.33)
Random effects (variance component)								
Variation between schools	0.08	0.08	0.09	0.12	0.08	0.08	0.18	0.18
Number of subjects	9,941	8,106	8,943	8,069	7,595	9,941	2,700	2,700
Number of schools	132	132	132	132	132	132	132	132

Abbreviations: OR (Odds Ratio), CI (Confidence Interval), CWS (Child Welfare Services), NH (non-Hispanic)

* p<0.05; † p<0.01; ‡ p<0.001

^a Based on weighted data. All models adjusted for age, sex, race, family structure, parental alcoholism, parental education, and poverty status.

Table 2.8. Estimated HGLM coefficients of the effects of child maltreatment on monthly other substance use, Wave IV of the National Longitudinal Study of Adolescent to Adult Health

Fixed effects	Any maltreatment		Physical neglect		Emotional abuse		Past 30 Day Other Substance Use ^a		Poly-victimization	CWS investigated	Removed
	b OR (95% CI)	b OR (95% CI)	b OR (95% CI)	b OR (95% CI)							
Maltreatment type	0.22 1.25 (0.80, 1.95)	0.12 1.12 (0.50, 2.51)	0.23 1.26 (0.81, 1.94)	0.39 1.48 (0.84, 2.62)	0.31 1.37 (0.71, 2.65)				0.92 2.50* (1.13, 5.56)	1.12 3.06 (1.00, 9.38)	
One type									0.00 1.00 (0.58, 1.73)		
Two types									0.83 2.28† (1.37, 3.82)		
Three or four types									-0.50 0.61 (0.17, 2.22)		
Age	-0.24 0.79† (0.68, 0.92)	-0.18 0.83† (0.74, 0.93)	-0.25 0.78† (0.66, 0.93)	-0.23 0.80 (0.37, 1.70)	-0.21 0.81† (0.70, 0.94)				-0.24 0.82 (0.56, 1.19)	-0.21 0.81 (0.55, 1.18)	
Sex*maltreatment	0.22 1.25 (0.54, 2.91)	0.36 1.44 (0.58, 3.55)	0.21 1.24 (0.45, 3.38)	0.11 1.11 (0.35, 3.53)	0.26 1.30 (0.34, 5.02)				0.47 1.60 (0.24, 10.52)	-1.55 0.21 (0.02, 1.99)	
One type									0.38 1.46 (0.69, 3.08)		
Two types									-0.18 0.84 (0.20, 3.42)		
Three or four types									0.85 2.35 (0.35, 15.68)		
Biological sex	0.50 1.65* (1.07, 2.52)	0.50 1.65* (1.05, 2.59)	0.51 1.67† (1.09, 2.55)	0.50 1.65† (1.15, 2.37)	0.51 1.66* (1.06, 2.60)				0.50 1.64* (1.07, 2.53)	0.71 2.04† (1.26, 3.30)	0.79 2.21† (1.25, 3.91)
Race (referent – NH Caucasian)											
NH African American	-1.02 0.36‡ (0.23, 0.57)	-1.17 0.31‡ (0.20, 0.51)	-0.96 0.38‡ (0.24, 0.62)	-1.03 0.36* (0.15, 0.84)	-1.15 0.32‡ (0.19, 0.52)				-1.00 0.37‡ (0.23, 0.57)	-1.06 0.35* (0.15, 0.78)	-1.04 0.35* (0.16, 0.78)
Hispanic	0.22 1.25 (0.73, 2.14)	0.34 1.41 (0.73, 2.70)	0.21 1.23 (0.72, 2.13)	0.21 1.23 (0.60, 2.53)	0.29 1.34 (0.71, 2.52)				0.24 1.28 (0.75, 2.17)	0.10 1.10 (0.48, 2.56)	0.04 1.04 (0.43, 2.51)
NH Other	-0.53 0.59 (0.33, 1.03)	-0.89 0.41† (0.21, 0.80)	-0.34 0.71 (0.42, 1.22)	-0.68 0.51 (0.24, 1.08)	-0.78 0.46* (0.23, 0.89)				-0.53 0.59 (0.34, 1.03)	-0.33 0.72 (0.31, 1.68)	-0.37 0.69 (0.30, 1.59)
Family structure (referent – two biological parents)											
Two parents, other	0.07 1.07 (0.69, 1.66)	0.18 1.20 (0.72, 1.99)	0.17 1.19 (0.72, 1.96)	0.14 1.15 (0.65, 2.03)	0.32 1.38 (0.80, 2.40)				0.07 1.07 (0.69, 1.67)	-0.57 0.56 (0.31, 1.03)	-0.54 0.58 (0.33, 1.03)
Single parent	0.41 1.51* (1.07, 2.14)	0.54 1.73* (1.14, 2.62)	0.49 1.63* (1.10, 2.41)	0.53 1.70* (1.07, 2.68)	0.58 1.78* (1.14, 2.79)				0.40 1.50* (1.05, 2.14)	-0.09 0.92 (0.57, 1.48)	-0.12 0.89 (0.54, 1.47)
Other	0.45 1.57 (0.83, 2.95)	0.20 1.23 (0.62, 2.44)	0.69 2.00* (1.00, 3.99)	0.67 1.95 (0.89, 4.26)	0.42 1.52 (0.70, 3.32)				0.46 1.58 (0.84, 2.98)	0.44 1.55 (0.62, 3.90)	0.45 1.56 (0.56, 4.32)
Parental alcoholism	0.11 1.11 (0.70, 1.77)	0.15 1.16 (0.72, 1.88)	0.03 1.03 (0.62, 1.72)	0.00 1.00 (0.58, 1.73)	0.07 1.07 (0.63, 1.82)				0.09 1.10 (0.69, 1.73)	0.28 1.33 (0.79, 2.24)	0.29 1.34 (0.80, 2.25)
Parental education (referent – college or more)											
Less than high school	0.15 1.16 (0.69, 1.95)	-0.14 0.87 (0.47, 1.62)	0.34 1.40 (0.77, 2.55)	0.49 1.63 (0.88, 2.07)	0.14 1.15 (0.61, 2.18)				0.14 1.15 (0.68, 1.95)	0.00 1.00 (0.43, 2.31)	0.02 1.02 (0.45, 2.34)
High school	0.02 1.02 (0.65, 1.61)	-0.03 0.97 (0.66, 1.42)	0.23 1.26 (0.79, 2.02)	0.38 1.47 (0.98, 2.19)	0.10 1.11 (0.78, 1.58)				0.01 1.01 (0.66, 1.54)	-0.44 0.65 (0.32, 1.32)	-0.32 0.73 (0.31, 1.73)
Some college	0.09 1.09 (0.73, 1.63)	0.09 1.10 (0.71, 1.70)	0.26 1.30 (0.86, 1.96)	0.30 1.34 (0.87, 2.07)	0.23 1.26 (0.79, 2.01)				0.08 1.09 (0.73, 1.61)	-0.32 0.73 (0.43, 1.24)	-0.29 0.75 (0.44, 1.27)

Poverty status	-0.25 0.78 (0.58, 1.04)	-0.21 0.81 (0.57, 1.16)	-0.17 0.85 (0.62, 1.16)	-0.28 0.75 (0.49, 1.15)	-0.22 0.80 (0.54, 1.19)	-0.27 0.76 (0.56, 1.04)	-0.43 0.65 (0.35, 1.20)	-0.25 0.78 (0.47, 1.29)
Random effects (variance component)								
Variation between schools	0.16	0.08	0.20	0.14	0.08	0.16	0.11	0.44
Number of subjects	9,842	8,026	8,864	7,995	7,527	9,842	2,667	2,667
Number of schools	132	132	132	132	132	132	132	132

Abbreviations: OR (Odds Ratio), CWS (Child Welfare Services), NH (non-Hispanic)

* p<0.05; † p<0.01; ‡ p<0.001

^a Based on weighted data. All models adjusted for age, sex, race, family structure, parental alcoholism, parental education, and poverty status.

CHAPTER 3. THE IMPACT OF CHILD MALTREATMENT AND CHILD WELFARE SERVICES INVOLVEMENT ON TRAJECTORIES OF ALCOHOL AND SUBSTANCE USE FROM ADOLESCENCE TO YOUNG ADULTHOOD

Introduction

Substance use and substance use disorders have been linked to numerous health, mental health, behavioral, and societal problems. Persons who abuse substances also have a higher mortality rate and risk of premature death than the general population (1), and the total annual cost to society due to tobacco, alcohol, and illicit drug use and use disorders is estimated at approximately \$524 billion (2).

Use of alcohol and other substances typically begins during adolescence, a period of development marked by increased impulsivity and risk-taking behaviors, and extends into adulthood. In the general population, the average age of first use of alcohol is 14 years (3), marijuana use is 18 years, and the average age of first use for most other substances occurs before the age of 26 (4). Over two percent of youths between 12 and 13 years of age use illicit substances or alcohol (2.6% and 2.1%, respectively) (4), and the prevalence rate of both illicit substance use and alcohol use increases as youths age with a peak prevalence around late adolescence/emerging adulthood. The highest prevalence of illicit substance use is between the ages of 18 to 20 years (22.6%), which is followed by a steady decline in older adults (4). The prevalence of alcohol use follows a similar pattern with a slightly later peak at 69.3% between 21 and 25 years of age, followed by a gradual decline in prevalence as adults age (4).

While patterns of substance use over time follow similar trajectories for males and females, the prevalence of use for alcohol and substances differs by gender. Males and females

have a similar prevalence rate of current alcohol use between 12 and 17 years of age (11.2% and 11.9%, respectively) (4), but as youths age, the differences in use widens. In emerging adulthood (18-25 years of age), 62.3% of males and 56.9% of females are current drinkers, and among adults ages 26 and older, the prevalence of use remains the same for males (62.2%) but declines for females (50.1%) (4). Additionally, a larger proportion of males than females use illicit substances. Among persons ages 12 and older, 11.5% of males and 7.3% of females use illicit substances (4).

Substance use in adolescence has been associated with physical and mental health consequences as well as increased engagement in risk behaviors. Youths who endorse problems related to substance use are more likely to engage in sexual risk behaviors, such as early onset of sexual activity, more sexual partners, and less consistent use of condoms (11). Alcohol-dependent youths have demonstrated neuropsychological deficits compared with non-alcohol-abusing adolescents (13), and college students who are binge drinkers have been found to be more likely to get hurt or injured, to miss classes, to engage in unplanned sexual activity, and to get into legal trouble than their non-binge drinking counterparts (14).

An important risk factor for substance use, substance use disorders, and related problematic behaviors in both adolescence and adulthood is child maltreatment (16, 17), involving an act or actions by a parent or caregiver that result in harm, potentially harm, or threaten to harm a child (34). Hernandez and colleagues found that high school students who reported experiencing child sexual abuse had significantly higher levels of substance use and more problems related to substance use than students who reported no sexual abuse (35). Another study of high school students found an association between child abuse and past 30 day alcohol and drug use and initial use of alcohol and drugs before the age of 11 (36). Similarly,

another study of secondary school students found that experiencing physical or sexual abuse was associated with early initiation of alcohol use before age 13 (37). Childhood emotional maltreatment has also been associated with substance use problem severity among youths receiving substance use treatment services (38). Finally, when examining this relationship among youths involved with child welfare, the number of out-of-home placements and the age of entry into the Child Welfare system (CWS) are positively associated with the severity of substance involvement (39), and the impact of maltreatment on alcohol and substance use reaches into adulthood.

Past research has shown an increased risk for alcohol and substance abuse in adulthood among victims of maltreatment. One study based in an urban area found an increased risk for binge drinking among self-reported victims of maltreatment; in particular, adults who reported childhood sexual abuse were three times as likely to engage in past-month binge drinking than their non-maltreated counterparts (40). Among a sample of adults who actively used substances, those with a history of physical and sexual abuse were over three times more likely to report heavy inhalant use compared to persons who reported no maltreatment (41). A longitudinal study among a sample of racial minorities and economically disadvantaged families found that young adults who were victims of CWS-substantiated or indicated childhood maltreatment were more likely to report substance misuse than non-maltreated adults (42). Another study that also relied on substantiated reports by CWS found that young adults who had experienced childhood maltreatment experienced higher frequencies of illicit substance use and problematic substance use compared with non-maltreated adults (43). Prior research has found that adults with a history of substantiated childhood maltreatment are more likely to report past-year use of any

illicit drug and more problems related to illicit drug use, compared with non-maltreated adults (44).

Previous studies that have utilized nationally representative data have found increased risks for alcohol and substance use by both individual types of self-reported maltreatment and poly-victimization. Retrospective cohort studies have found that individual types of child maltreatment have been associated with an increased likelihood of binge drinking (45), marijuana use (27), and illicit substance use (47) in late adolescence/emerging adulthood (ages 18-26), and experiencing multiple types of maltreatment, or poly-victimization, is also associated with an increased likelihood of binge drinking (45) and lifetime use of inhalants (27) compared to non-victims of child maltreatment.

Longitudinal studies have also examined the developmental trajectories of binge drinking from early adolescence through young adulthood (ages 24-32) by comparing persons reporting neglect, physical abuse, or sexual abuse with non-maltreated participants. Researchers have found that persons reporting neglect or physical abuse and the combination of the two types experienced faster increases in binge drinking during adolescence and elevated rates of binge drinking in emerging adulthood compared with non-maltreated persons, but these differences in binge drinking did not persist into young adulthood (46).

Although past research has found associations between child maltreatment and substance use, there have been methodological limitations that hinder generalizability and do not address important questions concerning patterns of use over time among the general population who self-report childhood maltreatment, rather than relying on maltreatment experiences identified by CWS. The majority of studies that examine the impact of child maltreatment on substance use are cross-sectional or measure alcohol or substance use at only one time point. A lack of

longitudinal research on this relationship hinders our understanding of the impact of maltreatment on patterns of use over time, especially during the influential periods of adolescence and early adulthood. Most of the studies that have investigated this relationship measure maltreatment by CWS report or CWS substantiation, which likely does not capture a large proportion of individuals who were maltreated but not known to CWS. Additionally, most studies have used non-representative samples, which often exclude important subpopulations and can constrain the generalizability of the findings to groups other than the study sample. Finally, most research has relied on dichotomous measures of substance use or substance use disorders, and very few studies have examined the impact of maltreatment on levels of alcohol and substance use over time, which can impact levels of use and problematic use in later adulthood.

This study addresses these gaps in the research through use of the National Longitudinal Study of Adolescent to Adult Health (Add Health) dataset, longitudinal cohort study that includes measures of self-reported levels of alcohol, marijuana, and other substance use and both self-report measures of maltreatment as well as CWS involvement. These measures allow for the assessment of the impact of individual types of maltreatment, poly-victimization and levels of CWS involvement on patterns of alcohol and substance use from adolescence into young adulthood among a nationally representative sample.

The primary aim of this study is to employ a nationally representative sample to examine the impact of self-reported child maltreatment and CWS involvement on trajectories of alcohol, marijuana, and other substance use. Specifically, we investigated the effect of individual types of maltreatment, poly-victimization, CWS investigation, and removal from the home by CWS on levels of alcohol and substance use from early adolescence into young adulthood for males and females. Findings from this study will help to determine if alcohol and substance use prevention

and intervention efforts should consider the impact of any childhood maltreatment experiences on alcohol and substance use. In addition, this study will help determine if gender-specific curricula should be utilized in substance abuse treatment for adolescents.

Methods

Data source and analytic sample

Data for this study are drawn from the Add Health, which is a nationally representative probability sample of adolescents in school in the 1994-95 school year (65). The primary focus of the Add Health study was to examine influences on adolescents' health and health-related behaviors. Study participants were drawn from an original sample of students from 80 high schools and 52 middle schools across the United States. The probability of selecting a school to be in the study was based on the school's size. Schools were stratified by region, urbanicity, school type, ethnic mix, and size (107). The in-school surveys were then followed by a series of in-home surveys conducted in 1994-1995 (Wave I), 1996 (Wave II), 2001-2002 (Wave III), and 2007-2008 (Wave IV) with a core sample of adolescents from each community and selected oversamples, such as racial minorities and disabled persons. There were 20,745 adolescent in-home questionnaires completed at Wave I, followed by 14,738 questionnaires completed at Wave II (88% of eligible participants), 15,197 questionnaires completed at Wave III (76% of eligible participants), and 15,701 questionnaires (80% of eligible participants) completed at Wave IV. In-home questionnaires were conducted by Computer-Assisted Personal Interviews, and sensitive questions were administered through Computer-Assisted Self Interviews (CASI) (66), which have been shown to enhance disclosure of sensitive information.

The analytic sample for the proposed research consists of respondents who participated in all four waves of the Add Health study and who have valid Wave IV sampling weights, which

account for selection of individuals within schools and regions of the U.S. (n=9,421). Additionally, those included in the sample had to have responses to questions about the main exposure of interest, child maltreatment, the outcomes of interest for at least one time point, alcohol, marijuana, and other substance use, and non-missing responses for all covariates. The final sample ranged depending on the outcome of interest and consisted of 25,490 observations for 6,691 participants from 132 schools for the alcohol use outcome measure, 26,215 observations for 6,692 participants in 132 schools of the marijuana use outcome measure, and 26,550 observations for 6,692 participants in 132 schools. All Add Health study procedures were approved by the Institutional Review Board for the Protection of Human Subjects at the University of North Carolina at Chapel Hill. Current analyses were deemed exempt from further review (Study # 13-1646).

Measures

Outcome variables

Three types of substance use were examined in this study: alcohol use, marijuana use, and other substance use.

Alcohol use. Monthly alcohol use from adolescence into adulthood was measured as a graduated frequency (GF) index, using a method described by Armor & Polich (67, 68). By including a separate measure of heavy alcohol or binge drinking, this index measure allows for a comprehensive estimate of the actual pattern and volume of alcohol consumption compared to measuring only typical or average drinking (69). Details regarding the creation of the graduated frequency index for this study are provided in Appendix A.

Univariate tests of monthly alcohol use at each wave indicated that the distribution was highly, positively skewed (4.87) and highly kurtotic (34.88), compared to a kurtosis value of

three for a normal distribution. Thus, monthly alcohol use was log-transformed for analysis. A higher score on the alcohol GF index indicates higher average monthly alcohol consumption.

Marijuana use. The second outcome variable of interest is frequency of marijuana use over the past 30 days. Participants were asked about frequency of past 30-day use from adolescence into young adulthood, and six possible responses were provided ranging from none to every day or almost every day. For this study, marijuana use was considered an ordinal variable with three categories: no use, occasional use from one to three times per month, and regular or frequent use from weekly to every day or almost every day.

Other substance use. The last outcome of interest is the frequency of other types of substances (i.e., substances other than alcohol or marijuana, such as cocaine, opioids, and amphetamines) over the past 30 days from adolescence into young adulthood. Participants were asked about frequency of past 30-day use from adolescence into young adulthood, and six possible responses were provided from none to every day or almost every day. For this study, other substance use was considered an ordinal variable with three categories: no use, occasional use from one to three times per month, and regular or frequent use from weekly to every day or almost every day.

Primary exposure variables

Child maltreatment. Six separate measures of child maltreatment were used in this study: any maltreatment, physical neglect, emotional abuse, physical abuse, sexual abuse, and poly-victimization (number of types of maltreatment experienced).

In young adulthood (ages 24-32), participants were asked retrospectively about the frequency of a parent or adult caregiver perpetrating emotional abuse (“say things that really hurt your feelings or made you feel like you were not wanted or loved”), physical abuse (“hit you

with a fist, kick you, or throw you down on the floor, into a wall, or down stairs”), and sexual abuse (“touch you in a sexual way, force you to touch him or her in a sexual way, or force you to have sexual relations”) before the age of 18; participants who reported any maltreatment were then asked how old they were when the abuse first happened. This analysis only included reported maltreatment that occurred before the age of 12, the youngest age at the beginning of the study. Additionally, in emerging adulthood (ages 18-26), participants were asked about the frequency of a parent or adult caregiver perpetrating physical neglect (“not taken care of your basic needs, such as keeping you clean or providing food or clothing”) before starting the 6th grade. In addition to questions about maltreatment experiences, participants in emerging adulthood were asked about frequency of CWS investigation (“investigated how you were taken care of or tried to take you out of your living situation”) and removal of the home (“actually been taken out of your living situation by Social Services”) before starting the 6th grade.

Consistent with the Centers for Disease Control and Prevention (CDC) definition of child maltreatment and extant literature (34, 70-72), the exposure of child maltreatment was examined as a dichotomous variable in which participants who reported experiencing any of the four types of maltreatment assessed (physical neglect, emotional abuse, physical abuse or sexual abuse) were classified as being a victim of maltreatment, and persons who did not report experiencing any type of maltreatment were categorized as being a non-victim of maltreatment.

The individual types of maltreatment were also examined for their specific impact on later alcohol and substance use, including any report of physical neglect, emotional abuse, physical abuse, and sexual abuse.

In addition, we examined the impact of experiencing poly-victimization (none, one, two, and three or four types of maltreatment) on alcohol and substance use (note that the last category

of three or four types of maltreatment was combined due to the small number of participants who experienced all four types of maltreatment).

Involvement of Child Welfare Services (CWS). Lastly, we investigated whether the CWS investigation or removal from the home was associated with later alcohol or substance use. For this study, CWS investigation was measured as a dichotomous variable with zero indicating a self-report of child maltreatment but no CWS investigation, and a value of one indicated self-report of any maltreatment and any CWS investigation (i.e., a response of one or more times). Similarly, removal from the home was dichotomized with zero representing never being removed from the home and one indicating removal from the home at least once.

Covariates

Several covariates identified from the extant literature on child maltreatment and alcohol or substance use were included in this analysis.

Age. At each wave, age was calculated by subtracting the participant's date of birth from the interview date. From the study sample, we excluded data for five participants who were younger than twelve years at Wave I and sixteen participants who were 33 years old at Wave IV given the small sample sizes for these age cohorts.

Biological sex. Biological sex was measured as male or female. For this study, biological sex was considered an effect modifier for the relationship between maltreatment and alcohol or substance use; thus all analyses were stratified by biological sex to consider differences between males and females.

Race/ethnicity. This study included four categories of race/ethnicity: Non-Hispanic Caucasian, Non-Hispanic African American, Hispanic, and Non-Hispanic Other race.

Parental alcoholism. Parental alcoholism was defined as a dichotomous variable; no parental alcoholism indicates that neither the biological mother nor the biological father had alcoholism, and parental alcoholism indicates that at least one parent had alcoholism. This classification was based on questions asked of parents/caregivers at Wave I.

Family structure. For the proposed research, family structure was defined by a nominal variable with four categories: two biological parents; two parents, other type; single parent; and other family structures. This measure was derived from information collected at Wave I of the Add Health study, in which participants listed all of the people with whom they lived and indicated their relationship with those people.

Parents' educational attainment. For this study, the participants' parents' educational attainment was measured using the highest level of education of all parents or parental figures at Wave I and was measured as an ordinal variable with four levels: less than high school, high school graduate or GED, some college or an Associate's degree, and college graduate or beyond.

Poverty status. We also included a measure of poverty at Wave I, which occurred in 1994. Categories of the poverty variable include: less than or equal to \$15,000 (based on poverty level in 1994 for a family of four (73) and above \$15,000, as was done in previous research (27).

Analytic Strategy

First, univariate analyses, stratified by biological sex, were conducted to examine the characteristics of the study sample (age, race/ethnicity, family structure, parental alcohol use disorder, parental educational level, and poverty). Continuous variables were summarized using means and standard deviations. Categorical variables were summarized with frequencies and percentages.

Next, bivariate analyses, stratified by biological sex, were conducted to compare values of the covariates and outcomes between participants who report child maltreatment and those who do not. Chi-square tests and t-tests evaluated significant differences at $p < 0.05$ for categorical and continuous variables, respectively.

For each maltreatment-substance use relationship, we ran unconditional growth models to test the functional form for time, and we determined that the quadratic function for age was the best fit for examining patterns of alcohol, marijuana and other substance use patterns from adolescence into young adulthood. We used multilevel modeling, specifically, three-level hierarchical linear models (HLM) and hierarchical generalized linear models (HGLM), to examine the relationships between experiencing child maltreatment and involvement of CWS on trajectories of alcohol and substance use from adolescence into adulthood for males and females.

Our models included robust standard errors and rescaled sampling weights, which account for the unequal probability of selection into the Add Health study. Missing data for the outcome variables were addressed through HLM and HGLM, which are sufficiently robust to handle missing cases in the outcome measures at different waves. Given the sampling scheme of the Add Health study in which participants were included in the study in part based on the school they attended, it was also important to account for clustering or nesting within schools. Since persons were selected to participate in the Add Health study through their schools, there is a potential correlation based on the school community; in other words, participants from the same school may have more similar substance use patterns compared with students from other schools due to similar factors that may be attributable to the school or school community.

Additionally, outcomes for multiple time points are often nested within the individual, so that for an individual substance use in adolescence may influence substance use in adulthood.

The residuals of nested data tend to be autocorrelated and heteroscedastic, which violates the assumptions of independence and homoscedasticity of residuals for Ordinary Least Squares regression (76), and unlike traditional methods for analyzing data, HLMs and HGLMs can account for clustering of individuals within groups by adding random effects into the model, which corrects for the biases caused by autocorrelation (77). Not accounting for the clustering of observations nested within individuals and study participants by schools, the sampling unit, could result in biased estimates and standard errors (78).

Final models were stratified by gender to examine differential impacts of maltreatment and CWS involvement on alcohol and substance use for males and females. These models included the other identified sociodemographic, family, and behavioral characteristics, and indicator measures of each wave of the study to account for the potential period effect of age at each wave.

A log-linear distribution was used for monthly alcohol use given the skewness and kurtotic nature of the non-transformed alcohol use variable. Ordinal logistic regression was used for marijuana and other substance use since these outcomes are categorical variables with ordered categories. All analyses were run using Stata 13 (79); multilevel models were estimated using generalized linear latent and mixed model (GLLAMM) commands that allow for estimation using sampling weights and clustering at multiple levels (80), which are important to consider given the sampling design of the Add Health study.

Results

Table 3.1 presents estimates of the prevalence of child maltreatment and CWS involvement experiences, stratified by gender. Almost thirty percent of the sample reported experiencing any type of maltreatment. The prevalence of individual types of maltreatment are

experienced is slightly different for males and females: 14% of males and 8% of females experienced physical neglect, 14% of males and 18% of females experienced emotional abuse, 8% of males and 7% of females experienced physical abuse, and 2% of males and 5% of females experienced sexual abuse. Experiences of poly-victimization were similar for males and females: 22% of males and 20% of females experienced one type of maltreatment, 6% of males and 6% of females experienced two types of maltreatment, and 1% of males and 2% of females experienced three or four types of maltreatment.

Experiences of CWS involvement were also different for males and females. Among victims of maltreatment, a smaller proportion of males (8%) than females (12%) experienced CWS investigation, but a similar proportion (4%) of males and females experienced removal from the home by CWS. We also see statistically significant differences ($p < 0.001$) in maltreatment experiences between victims with CWS involvement and those who had no CWS involvement. For participants who had no CWS involvement, 30% experienced physical neglect, 38% experienced emotional abuse, 22% experienced physical abuse, and 10% experienced sexual abuse. For participants who reported some CWS involvement, 26% experienced physical neglect, 17% experienced emotional abuse, 32% experienced physical abuse, and 25% experienced sexual abuse.

Table 3.2 presents information on the participants' sociodemographic and family characteristics, stratified by gender and their maltreatment status. Percentages and mean scores are weighted to yield nationally representative estimates. Both victims and non-victims of maltreatment were similar in age at each wave, with an average age of 15 years at Wave I and 28 years at Wave IV of the Add Health study. There were statistically significant differences between victims and non-victims for race/ethnicity ($p < 0.05$), family structure ($p < 0.001$), parental

alcoholism ($p < 0.001$), parent's educational level ($p < 0.01$), and poverty status at the beginning of the Add Health study ($p < 0.001$). For both sexes, more non-victims identified as non-Hispanic Caucasian and fewer identified with other races than victims of maltreatment. Fewer victims of maltreatment lived with two biological parents, a larger percentage of maltreatment victims had a parent with an alcoholism than non-victims, a smaller percentage of maltreatment victims' parents had a college degree or more, and more victims lived at or below the poverty line in early adolescence (Wave I).

Table 3.3 provides the unadjusted arithmetic and geometric means of monthly alcohol use, past 30 day marijuana use, and past 30 day other substance use across the four waves of the Add Health study, stratified by gender and maltreatment status. For both males and females, we see increases in alcohol use until emerging adulthood (Wave III, ages 18-26), followed by slight declines into young adulthood (Wave IV, ages 24-32). On average, males consumed more alcohol than females. Most differences in alcohol use between victims and non-victims of maltreatment were not statistically significant, and patterns of use varied when comparing victims and non-victims of different types of maltreatment and CWS involvement.

We see statistically significant differences in marijuana use for males at Waves II and IV. A larger percentage of victims reported using marijuana occasionally (1-3 days per month) and frequently (4-7 days per week) at Wave II, and at Wave IV over the past 30 days. We also found statistically significant differences in past 30-day marijuana use for females at Waves I, III, and IV of the Add Health study. Among females, a larger percentage of victims reported using marijuana occasionally and frequently over the past 30 days than non-victims.

For relationships with other substance use, we see similar patterns as those found for marijuana use, but the only statistically significant differences were among males at Wave I and

IV where a larger percentage of victims use other substances occasionally and frequently over the past 30 days than non-victims at both waves.

The results for the conditional growth models of monthly alcohol use for measures of child maltreatment and CWS involvement for males are found in Table 3.4 and Table 3.5 for females. We found differential impacts by types of child maltreatment and CWS involvement on monthly alcohol use by gender. After accounting for sociodemographic and family factors, the initial status of alcohol use (when participants were 12 years of age) for male victims of physical neglect was significantly higher than male non-victims of child maltreatment ($p < 0.05$). Among females, initial alcohol use was significantly more for victims of any maltreatment ($p < 0.01$), victims of physical neglect ($p < 0.001$), victims of sexual abuse ($p < 0.05$), victims of one type of maltreatment ($p < 0.05$), two types of maltreatment ($p < 0.01$), and three or four types of maltreatment ($p < 0.05$) than non-victims. Initial alcohol use followed an exposure-response relationship for poly-victimization, with more initial use for additional types of maltreatment experienced. Additionally, both male ($p < 0.05$) and female ($p < 0.01$) maltreatment victims who had at least one CWS investigation had a significantly more initial monthly alcohol use than victims who reported no CWS investigation, and female maltreatment victims who were removed from the home by CWS had significantly more initial monthly alcohol use than victims who were not removed ($p < 0.01$).

The positive coefficients for age and negative coefficients for age^2 indicate that for both victims and non-victims of maltreatment, monthly use of alcohol increases into late adolescence or emerging adulthood and then begins to decline into young adulthood. These trajectories are shown for the statistically significant relationships between maltreatment and alcohol use, comparing male non-victims and victims of physical neglect and comparing male maltreatment

victims who experienced a CWS investigation with male victims who did not experience a CWS investigation in early childhood in Figure 3.1. We see that on average, a 12 year old male who did not experience child maltreatment consumed low levels of alcohol, followed by an increase in monthly alcohol consumption until reaching a peak between 20 and 25 years of age and then decreasing use into young adulthood, as indicated by the positive coefficient for age (0.93) and the negative coefficient for age-squared (-0.04). We see that victims of physical neglect have more initial alcohol use, and after peaking in emerging adulthood (around Wave III of the Add Health study), their trajectories converge with non-victims' levels of alcohol use as they move into young adulthood (around Wave IV of the Add Health study). When comparing male victims who did experience a CWS investigation with those who did not, we see that the trajectories of alcohol use follow similar patterns, but victims with a CWS investigation have elevated levels of initial alcohol use, and this higher level of use persists into young adulthood. The trajectories among females comparing victims of any maltreatment, physical neglect, sexual abuse, polyvictimization, CWS investigation and removal from the home are shown in Figure 3.2. We see that female victims of any type of maltreatment and victims with CWS involvement have more initial alcohol use, but after peaking in emerging adulthood (around Wave III of the Add Health study), their trajectories converge with non-victims' or non-CWS involved victims' levels of alcohol use as they move into young adulthood (around Wave IV of the Add Health study). However, among females, elevated levels of alcohol use among victims of sexual persist into young adulthood compared to females who experienced no childhood maltreatment.

Table 3.6 presents the results for the conditional growth models examining the impact of maltreatment and types of child maltreatment on past 30-day marijuana use for males and results for females are found in Table 3.7. The results show that both males and females have initial

higher odds of using marijuana at higher levels for each type of maltreatment, but statistically significant differences were not consistently found for both sexes. Whereas female victims of any type of maltreatment ($p < 0.05$) and physical abuse ($p < 0.05$) had statistically significant higher odds of using marijuana at higher levels than non-victims, male victims had statistically significant higher odds of using marijuana at higher levels if they experienced any maltreatment ($p < 0.05$), physical neglect ($p < 0.05$), emotional abuse ($p < 0.05$), or sexual abuse ($p < 0.01$); however due to the small number of observations for sexual abuse, this estimate has a large confidence interval and lacks precision. We found statistically significant differences for both sexes when examining the impact of poly-victimization on marijuana use with an exposure-response relationship found for females. As the number of types of maltreatment increased, females had a larger odds of using marijuana at higher levels; victims of one type of maltreatment experienced twice the odds of using marijuana at higher levels ($p < 0.01$), victims of two types of child maltreatment had almost over four times the odds ($p < 0.01$), and male victims of three or four types of maltreatment had fourteen times the odds ($p < 0.01$) of using marijuana at higher levels than male, non-victims of maltreatment. Finally, among female victims of maltreatment, those who were removed from the home had a higher odds of using marijuana more frequently than victims who were not removed ($p < 0.01$), yet this effect is likely influenced by a small number of observations and it should be interpreted with caution. This finding indicates that the act of removal, placement out of the home, or circumstances related to being removed by CWS substantially impacts marijuana use among female victims of child maltreatment.

The positive coefficients for age and negative coefficients for age² indicate that for both victims and non-victims of maltreatment, using marijuana at higher levels increases into late

adolescence or emerging adulthood and then begins to decline into young adulthood. The trajectories of the probability of marijuana use for statistically significant relationships of individual types of maltreatment for males are shown comparing victims and non-victims in Figure 3.3. We see that on average, a 12 year old male who did not experience child maltreatment initially used marijuana infrequently followed by an increase in frequency of marijuana use until reaching a peak around 20 years of age and then decreasing use into young adulthood, as indicated by the positive coefficient for age (0.71, $p < 0.001$) and the negative coefficient for age-squared (-0.04, $p < 0.001$). Male victims of any maltreatment, physical neglect and poly-victimization have consistently higher initial levels of marijuana use from early adolescence into young adulthood and while they follow similar trajectories of use into young adulthood, these levels remain higher than non-victims. Male victims of emotional and sexual abuse have substantially higher levels of marijuana use than non-victims of maltreatment, levels become closer with non-victims into emerging adulthood (Wave III of the Add Health study) as non-victims' use peaks, and then non-victims' use drops into young adulthood (Wave IV of the Add Health study) while use among male victims of emotional and sexual abuse decreases at a slower rate.

The trajectories of the probability of marijuana use for the statistically significant relationships for females are shown comparing victims of any maltreatment, physical abuse and increasing levels of poly-victimization and non-victims and among female victims of maltreatment, comparing those removed from the home with those who were not removed in Figure 3.4. We see that victims of any maltreatment and physical abuse have higher initial levels of marijuana use, and these increased levels persist over time. When looking at poly-victimization, victims of one of two types of maltreatment higher levels of marijuana use persist

from adolescence into young adulthood. On the other hand, victims of three or four types of maltreatment and victims of maltreatment who were removed from the home follow different trajectories into adulthood, which may be influenced by the small numbers of observations for these experiences.

Table 3.8 presents the results for the conditional growth models examining the impact of maltreatment and types of maltreatment on past 30-day other substance use for males and Table 3.9 presents the results for females. The results show that male victims of any maltreatment ($p < 0.05$), physical neglect ($p < 0.05$), and emotional abuse ($p < 0.05$) had statistically significant higher odds of using other substances at higher levels than non-victims. Male victims of sexual abuse ($p < 0.001$) had statistically significant higher odds of other substance use than non-victims. Due to the small number of male victims of sexual abuse who used other substances, other substance use was measured as a dichotomous variable comparing no use with any use, and the large magnitude of effect for male victims of sexual abuse should be interpreted with caution given the small numbers. We also found statistically significant differences for the impact of poly-victimization on other substance use with an exposure-response relationship found. As the number of types of maltreatment increased, males had a larger odds of using other substances at higher levels; victims of one type of maltreatment experienced over three times the odds of using other substances at higher levels ($p < 0.05$), and victims of two types of child maltreatment had over four times the odds ($p < 0.05$). Male victims of three or four types of maltreatment had over eight times the odds of using marijuana at higher levels than male, non-victims of maltreatment, but this latter finding was not statistically significant.

Among females, we only found statistically significant differences between victims who experienced CWS involvement compared to maltreatment victims who reported no CWS

involvement. Female maltreatment victims who had at least one CWS investigation had over seven times the odds of using other substance at higher levels than victims who were not investigated by CWS ($p < 0.05$), and victims who were removed from the home by CWS had almost 100 times the odds of using other substances at higher levels than victims who were not removed from the home ($p < 0.01$). However, the results for removal from the home should be considered within the context of small numbers of female victims who were removed from the home and the small number of females who used other substances.

The positive coefficients for age and negative coefficients for age² indicate that for both victims and non-victims of maltreatment or victims with CWS involvement and victims with no involvement, using other substances at higher levels increases into late adolescence or emerging adulthood and then begins to decline into young adulthood. The trajectories of the probability of other substance use for statistically significant relationships of maltreatment for males, including any maltreatment, physical neglect, emotional abuse, sexual abuse, and poly-victimization are shown comparing victims and non-victims in Figure 3.5. We see that on average, a 12 year old male who did not experience child maltreatment initially used other substances infrequently followed by an increase in frequency of other substance use until reaching a peak between 20 and 25 years of age and then decreasing use into young adulthood, as indicated by the positive coefficient for age (1.17) and the negative coefficient for age-squared (-0.07). Male victims of any maltreatment and physical neglect have consistently higher levels of other substance use from early adolescence through young adulthood than non-victims, and victims of emotional abuse have higher initial levels of other substance use but these trajectories converge in young adulthood and then decrease at a slower rate than non-victims into young adulthood. Male victims of sexual abuse have substantially higher odds of other substance use than non-victims of

maltreatment, the probability of other substance use becomes closer with non-victims into emerging adulthood (Wave III of the Add Health study) as non-victims' use peaks, and then non-victims' use drops into young adulthood while use among male victims of sexual abuse decreases at a slower rate. Finally, we see that among males, victims of different levels of maltreatment have higher initial levels of other substance use than non-victims with much higher initial levels among victims of three or four types of maltreatment, and differences in other substance use for all levels of maltreatment persist into young adulthood.

The trajectories of the probability of other substance use for the statistically significant relationships for females are shown comparing victims of maltreatment who had CWS involvement with victims who had no CWS involvement (Figure 3.6). Among female victims of maltreatment, we see that those with at least one CWS investigation had higher initial levels of other substance than victims without a CWS investigation. The trajectories of use then converge in emerging adulthood and then into young adulthood, female victims with CWS investigation had higher levels of other substance use than victims without a CWS investigation. On the other hand, victims who were removed from the home had substantially higher levels of other substance use in adolescence than victims not removed from the home, but those removed followed a trajectory of use that is the opposite of victims not removed. In late adolescence or emerging adulthood, victims who were removed have a dip in use, followed by an increase in use into young adulthood while victims not removed from the home have a peak in other substance use during late adolescence or emerging adulthood, followed by a decrease in other substance use into young adulthood. This difference may be due to the small numbers of victims removed from the home who used other substances, thus, this figure should be interpreted with caution.

Discussion

Using a nationally representative sample, this study examined the effect of self-reported childhood maltreatment victimization and involvement of child welfare on trajectories of alcohol, marijuana, and other substance use from adolescence into young adulthood. Consistent with the extant literature, our analyses found that, overall, maltreatment is associated with higher amounts of alcohol consumed and higher odds of using marijuana and other substances at higher levels. Through stratified analyses for males and females, we were able to identify separate effects by specific measures of maltreatment and CWS involvement. Developmental trajectories for all participants revealed patterns of increasing use of alcohol, marijuana, and other substances into late adolescence and emerging adulthood, followed by gradual decreases in use as participants aged into young adulthood; however, some differences by maltreatment or CWS status in the use of alcohol, marijuana, and other substances persisted into adulthood.

The current study found that both male and female victims of maltreatment consumed more alcohol or had higher odds of using marijuana or other substances at higher levels than non-victims of maltreatment, but they appeared to be impacted differently by the type of maltreatment. These findings are in line with previous studies, which have also found differential impacts of maltreatment on alcohol and substances by gender. Lansford and colleagues found that experiencing physical abuse before the age of six impacted substance use in adolescence and adulthood among females, but this relationship was not found for males (74). A study of high school students found that females who were victims of physical abuse or sexual abuse had higher odds of an early onset of regular alcohol consumption, and males who experienced sexual abuse had a higher odds of engaging in binge drinking (37). Moran and colleagues found a stronger association between physical abuse and substance use for females than males and a

stronger association of experiencing both physical and sexual abuse on substance use for males than females (93). Another study examining the impact of individual types of maltreatment on substance use in emerging adulthood found that neglect was indirectly related to illicit drug use for females but not males (47). The findings from this study and previous research indicate that males and females are impacted by maltreatment differently, which results in different patterns of alcohol and substance use.

Consistent with existing research, this study also found relationships between CWS involvement and alcohol or substance use. We saw differences in initial levels of alcohol use for both males and females when comparing maltreatment victims with at least one CWS investigation and victims without CWS involvement, and female victims of maltreatment who were removed from the home also had more alcohol use than victims not removed. For females, we found that victims of maltreatment who were removed from the home by CWS had a higher odds of using marijuana at higher levels than victims not removed from their home, and victims of maltreatment who were investigated by CWS and victims who were removed from the home had higher odds of using other substances at higher levels than victims not investigated by CWS and not removed from the home, yet the latter finding should be interpreted with caution due to small numbers in this analysis.

These findings are consistent with previous research. In their investigation of the impact of CWS involvement on adolescent illicit substance use, Cheng and Lo found that compared to adolescents who did not have CWS-substantiated maltreatment, CWS involvement and service provision in the home was associated with greater use of substances while out of home placement did not have a statistically significant association, indicating that adolescents may not have received sufficient in-home services to address their use of substances (108); however, this

study did not stratify the analysis by gender, so separate relationships for males and females cannot be compared. Another study found that adolescents who reported ever being placed in foster care were more likely to use alcohol, more likely to use illicit substances and more likely to have a substance use disorder than adolescents who were never placed in foster care (109), which is similar to our findings for female victims who had been removed from the home.

Unlike previous studies, the current research compared victims of maltreatment who also reported CWS involvement with victims who reported no involvement, whereas most studies compare victims of CWS-identified maltreatment with persons who have not been maltreated. Our measure allowed us to examine differences by CWS involvement rather than CWS-identified maltreatment. Specifically, we were able to ask if victims of maltreatment who have been identified by CWS have different patterns of alcohol or substance use than victims of maltreatment who have not been identified by child welfare. We found that CWS involvement was associated with more alcohol use among males and more alcohol use and higher odds of using marijuana and other substances more frequently among females. Victims of maltreatment who are known to CWS or who are removed from their homes may be involved with CWS because they experience more severe maltreatment (110), or they may have fewer supports or resources to help cope with the effect of maltreatment, which may subsequently impact alcohol and substance use.

This study adds to the extant literature by the ways in which maltreatment and alcohol or substance use were measured, examining the relationship separately for males and females, the use of a nationally representative sample, and a longitudinal design that followed alcohol and substance use from early adolescence into young adulthood.

In line with prior research and calls for measures of experiencing multiple forms of maltreatment, this study including measures of any type of maltreatment, individual types of maltreatment, and experiences of poly-victimization.

For this study, we took advantage of the numerous alcohol use measures in the Add Health study to formulate an index measure of alcohol consumption based on the graduated frequency index that incorporated both regular use and binge drinking (67, 68, 81). This method attempts to compensate for underreporting of average alcohol use that occurs when study subjects do not incorporate binge drinking into their report of usual use (68, 82). Approximately 20-40% of adults ages 18-55 (83) and 22% of adolescents (84) engage in heavy drinking, but survey respondents typically exclude episodes of heavy or binge drinking from their estimates of usual alcohol use (85). Thus, measures that include only measures of typical alcohol use underestimate average consumption of alcohol by failing to account for binge drinking. Additionally, a number of studies that have researched the relationship between maltreatment and alcohol or substance use often utilize a dichotomous measure for use disorders or any use, rather than examining levels of use (27, 47, 86-89). This type of measurement limits the ability to assess the level of impact of maltreatment on alcohol and substance use, rather than just determining if victims of maltreatment are more likely to use alcohol or substances at all.

Findings from this study underscore the importance of providing substance abuse prevention and treatment interventions before early adolescence, especially for victims of maltreatment. Because most maltreatment victims are not identified by CWS, universal early substance use prevention efforts that consider the impact of maltreatment on alcohol and substance use and screening for substance use in early adolescence are warranted. In addition, there has been a recent call for child welfare agencies to engage in primary and secondary

substance abuse prevention efforts to prevent initiation of use and mitigate problematic use among CWS involved youth (111). The findings from this study show that victims of maltreatment who are involved with CWS have higher odds of alcohol and substance use than victims not identified by CWS, which supports this call for child welfare agencies, in particular, to pursue the implementation of substance abuse prevention and treatment interventions.

Given the differences in the impacts of types of maltreatment and CWS involvement on alcohol, marijuana, and other substances for females and males, substance abuse treatment interventions for adolescents should also incorporate gender-specific curricula. Previous studies have found that motives related to alcohol use differ for male and female adolescents. Research has shown that girls were more likely than boys to use alcohol as a coping strategy, whereas alcohol use for boys was associated with sensation seeking and social motives (112). Similarly, Liu and Kaplan found that males seek social bonding and to feel more powerful through the use of both alcohol and other substances, whereas females use alcohol and other substances as a form of coping with problems and to alleviate feelings of sadness or depression (113).

While some gender-specific substance abuse treatment and prevention interventions for adult women, such as Seeking Safety (114), have been tested and shown to be effective among adolescent girls, there are no known evidence-based prevention or interventions specifically designed to address the unique and separate needs of male and female adolescents related to preventing or attenuating alcohol and substance use. Therefore, substance use and prevention programs that account for the differential impact of trauma and motivation to initiate and escalate substance use for young adolescent boys and girls should be developed.

Limitations

Findings from this study should be interpreted in light of its limitations. First, childhood maltreatment experiences and involvement with CWS are based on retrospective self-reports and require the respondents to remember and determine when those experiences first occurred. Even though self-reports of childhood maltreatment tend to be a better predictor of prevalence of maltreatment than CWS reports, previous studies have found that self-reported childhood physical abuse (94) and sexual abuse (95) tend to be underreported (96), which may be due to not remembering the abuse or not wanting to report it. The Add Health study utilized Computer Assisted Self Interviews (CASI) when inquiring about sensitive topics, such as child maltreatment and alcohol and substance use, and the CASI has been shown to enhance disclosure of sensitive and stigmatized information (97, 98). Additionally, this study relied on self-report of CWS involvement whereas most studies use official CWS records. One study that compared CWS reports with adolescent recall of psychological, physical and sexual abuse found that the estimated prevalence of maltreatment as determined by self-report was higher than the estimate from CWS reports, even though some adolescents who had experienced childhood maltreatment, as determined by CWS report, failed to self-report the maltreatment; however, use of CASI allowed for eliciting more new reports of abuse, especially psychological maltreatment, when compared with CWS substantiated cases (23).

Additionally, although the Add Health study measured the number of times the participants experienced different types of childhood maltreatment, the severity of maltreatment was not assessed. In a community sample of adult women, persons reporting more severe child sexual abuse were more likely to report problematic substance use and substance abuse (101), and among youths receiving treatment for alcohol or drug use disorders, respondents who

reported more severe childhood maltreatment exhibited more symptoms of problematic substance use (102). Without a measure of the severity of maltreatment, the effect of maltreatment on substance may be diluted. Similarly, given the design of study questions, we were unable to distinguish between maltreatment that occurred only in early childhood and ongoing maltreatment into adolescence, which may differentially impact substance use in adulthood.

While there is some information about the concurrent use of alcohol, marijuana, or some other substance, the Add Health study measured different substances other than marijuana at each wave, Wave IV of the Add Health study separately measured use of other substances by first determining the participant's "favorite drug" or the one used most often. Thus, use of substances other than marijuana had to be grouped together as other substances, rather than evaluating specific other substance use over time. Additionally, since marijuana and other substance use were measured differently than alcohol use across the four waves of the Add Health study, concurrent poly-substance use was not assessed in this research, even though studies have found a high prevalence of simultaneous substance use among substance users. Findings from the national Treatment Episode Data Set (TEDS) show that among substance abuse treatment admissions, almost 40% of admissions reported alcohol and other drug use, with 23.1% reporting use of alcohol and one other drug and 14.1% reporting concurrent use of alcohol and at least two other drugs (105). Our study attempted to counteract this weakness by examining multiple substances separately in adulthood.

Finally, this study used complete case analysis to estimate the relationships between child maltreatment and alcohol and substance use; therefore, the results from this study may be influenced by survey non-response. While the results from this study are similar to past research,

future studies should replicate these analyses with different datasets or analytical tools to estimate these relationships and confirm our findings.

Conclusions

This study is the first to examine different measures of maltreatment and levels of CWS involvement separately for males and females on trajectories of alcohol, marijuana, and other substance use from adolescence to young adulthood among a nationally representative sample. The findings from this study show that childhood maltreatment and CWS involvement affect males and females differently and impact levels of alcohol and substance use from adolescence into adulthood. In order to further understand the lasting impact of child maltreatment and involvement of child welfare, future research should build on these findings to examine the progression of these trajectories into older adulthood.

Table 3.1. Prevalence of child maltreatment and child welfare services involvement experiences by gender

	Males (n=3,046)		Females (n=3,608)		Total sample (n=6,654)	
	%	(n)	%	(n)	%	(n)
Child Maltreatment						
No maltreatment	70.7	(2,179)	72.7	(2,621)	71.7	(4,800)
Any type of maltreatment	29.3	(867)	27.3	(987)	28.3	(1,854)
Physical neglect	14.0	(400)	7.6	(278)	10.8	(678)
Emotional abuse	14.2	(446)	18.4	(649)	16.3	(1,095)
Physical abuse	8.2	(258)	7.1	(248)	7.7	(506)
Sexual abuse	1.8	(45)	5.0	(179)	3.4	(224)
Poly-victimization						
No victimization	70.7	(2,179)	72.7	(2,621)	71.7	(4,800)
One type	21.8	(636)	19.1	(709)	20.5	(1,345)
Two types	6.2	(187)	5.9	(202)	6.1	(389)
Three or four types	1.2	(44)	2.3	(76)	1.8	(120)
CWS involvement						
No CWS investigation	91.8	(799)	88.0	(881)	90.0	(1,680)
CWS Investigation	8.2	(68)	12.0	(106)	10.0	(174)
Not removed from home	96.5	(837)	96.0	(949)	96.3	(1,786)
Removed from home	3.5	(30)	4.0	(38)	3.7	(68)

Note: percentages are weighted to yield nationally representative estimates.
Abbreviations: %, weighted percent; CWS, Child Welfare Services

Table 3.2. Descriptive statistics for covariates by child maltreatment status

	Males (n=3,046)				Females (n=3,608)				Total Sample (n=6,654)			
	No CM (n=2,179)		CM (n=867)		No CM (n=2,621)		CM (n=987)		No CM (n=4,800)		CM (n=1,854)	
Age, mean (SE), years												
Wave I	15.2	(0.13)	15.3	(0.16)	15.0	(0.13)	15.1	(0.13)	15.1	(0.13)	15.2	(0.14)
Wave II	16.1	(0.14)	16.2	(0.17)	16.0	(0.13)	16.0	(0.13)	16.0	(0.13)	16.1	(0.15)
Wave III	21.6	(0.13)	21.7	(0.17)	21.4	(0.13)	21.4	(0.13)	21.5	(0.13)	21.5	(0.14)
Wave IV	28.1	(0.13)	28.2	(0.16)	27.9	(0.14)	27.9	(0.13)	28.0	(0.13)	28.0	(0.14)
Race/ethnicity*, %, n												
White, non-Hispanic	65.8	(1,341)	57.9	(474)	63.1	(1,555)	61.9	(573)	64.4	(2,896)	59.8	(1,047)
Black, non-Hispanic	13.6	(330)	14.5	(140)	15.1	(485)	12.9	(167)	14.4	(815)	13.7	(307)
Hispanic	12.1	(320)	15.5	(145)	14.0	(358)	13.0	(136)	13.0	(678)	14.4	(281)
Other, non-Hispanic	8.6	(188)	12.1	(108)	7.8	(223)	12.2	(111)	8.2	(411)	12.2	(219)
Family structure‡, %, n												
Two biological parents	65.7	(1,440)	52.4	(449)	67.2	(1,712)	51.4	(480)	66.5	(3,152)	51.9	(929)
Two parents, other	13.1	(289)	18.1	(159)	12.1	(331)	21.1	(214)	12.6	(620)	19.5	(373)
Single parent	18.6	(410)	25.1	(228)	18.1	(516)	24.5	(260)	18.4	(926)	24.8	(488)
Other	2.6	(40)	4.4	(31)	2.6	(62)	3.0	(33)	2.6	(102)	3.8	(64)
Parental alcoholism‡, %, n												
No	87.4	(1,905)	79.9	(689)	85.9	(2,234)	75.0	(735)	86.6	(4,139)	77.6	(1,424)
Yes	12.6	(274)	20.1	(178)	14.1	(387)	25.0	(252)	13.4	(661)	22.4	(430)
Parental educational level†, %, n												
Less than high school	7.8	(167)	9.5	(88)	10.8	(276)	9.2	(97)	9.3	(443)	9.3	(185)
High school graduate/GED	23.7	(478)	26.6	(215)	25.5	(655)	27.1	(260)	24.6	(1,133)	26.8	(475)
Some college	31.0	(677)	33.9	(284)	27.8	(752)	31.0	(304)	29.4	(1,429)	32.5	(588)
College graduate or beyond	37.5	(845)	30.0	(273)	35.9	(931)	32.8	(323)	36.7	(1,776)	31.3	(596)
Poverty‡, %, n												
Above the poverty line	89.1	(1,912)	82.2	(707)	85.4	(2,227)	83.4	(808)	87.2	(4,139)	82.8	(1,515)
At or below the poverty line	11.0	(255)	17.8	(153)	14.6	(387)	16.6	(176)	12.8	(642)	17.3	(329)

Note: percentages and means are weighted to yield nationally representative estimates. Abbreviations: CM, Child Maltreatment; %, weighted percent; SE, standard error of the mean; * p<0.05, † p<0.01, ‡ p<0.001

Table 3.3. Descriptive statistics for monthly alcohol use, past 30-day marijuana use, and past 30-day other substance use, by maltreatment status and biological sex (waves I-IV)

Characteristic	Wave I		Wave II		Wave III		Wave IV	
Alcohol use, drinks per month								
Males	No CM (n=1,921)	CM (n=739)	No CM (n=2,084)	CM† (n=825)	No CM (n=2,144)	CM (n=849)	No CM (n=2,167)	CM* (n=860)
Arithmetic mean (SE)	10.39 (1.52)	11.90 (1.66)	11.40 (1.21)	10.92 (1.32)	31.84 (1.49)	33.64 (3.17)	26.49 (1.48)	26.71 (2.76)
Geometric mean (SE)	0.10 (0.02)	0.11 (0.02)	0.09 (0.02)	0.10 (0.02)	2.37 (0.39)	1.65 (0.37)	2.33 (0.30)	1.53 (0.35)
Females	No CM (n=2,355)	CM† (n=878)	No CM (n=2,543)	CM (n=960)	No CM (n=2,590)	CM (n=966)	No CM (n=2,614)	CM (n=984)
Arithmetic mean (SE)	4.36 (0.46)	5.91 (0.90)	5.25 (0.50)	6.57 (0.80)	12.09 (0.80)	14.50 (1.85)	10.46 (0.68)	11.12 (0.81)
Geometric mean (SE)	0.07 (0.01)	0.10 (0.02)	0.07 (0.01)	0.11 (0.02)	0.78 (0.11)	0.93 (0.13)	0.64 (0.09)	0.74 (0.09)
Marijuana use, %, (n), past 30-days								
Males	No CM (n=2,144)	CM (n=839)	No CM (n=2,119)	CM† (n=836)	No CM (n=2,112)	CM (n=829)	No CM (n=2,179)	CM* (n=865)
None	88.6 (1,884)	85.5 (707)	85.9 (1,803)	79.8 (675)	73.8 (1,563)	70.8 (591)	78.7 (1,729)	76.2 (659)
One to three day per month	5.9 (142)	7.8 (70)	7.8 (162)	11.7 (82)	9.2 (198)	9.9 (82)	7.9 (170)	6.0 (51)
One to seven days per week	5.6 (118)	6.8 (62)	6.3 (154)	8.6 (79)	17.1 (351)	19.4 (156)	13.4 (280)	17.8 (155)
Females	No CM (n=2,604)	CM‡ (n=975)	No CM (n=2,588)	CM (n=963)	No CM† (n=2,578)	CM (n=966)	No CM (n=2,620)	CM† (n=986)
None	89.9 (2,346)	83.9 (817)	86.4 (2,262)	83.2 (801)	82.5 (2,137)	76.7 (750)	88.8 (2,336)	83.8 (833)
One to three day per month	6.0 (158)	9.0 (87)	8.1 (198)	9.7 (93)	8.9 (218)	9.9 (93)	5.1 (123)	6.0 (62)
One to seven days per week	4.1 (100)	7.1 (71)	5.5 (128)	7.2 (69)	8.7 (223)	13.4 (123)	6.1 (161)	10.2 (91)
Other substance use, %, (n), past 30-days‡								
Males	No CM (n=2,178)	CM* (n=865)	No CM (n=2,187)	CM (n=871)	No CM (n=2,168)	CM (n=863)	No CM (n=2,159)	CM* (n=859)
None	95.8 (2,088)	92.9 (807)	96.0 (2,101)	95.1 (829)	91.6 (2,002)	88.9 (767)	92.9 (2,006)	91.2 (776)
One to three day per month	2.8 (60)	4.8 (35)	2.9 (65)	4.1 (35)	5.9 (120)	7.2 (61)	4.6 (95)	4.0 (43)
One to seven days per week	1.4 (30)	2.3 (23)	1.1 (21)	0.8 (7)	2.4 (46)	3.9 (35)	2.6 (58)	4.8 (40)
Females	No CM (n=2,621)	CM (n=983)	No CM (n=2,628)	CM (n=988)	No CM (n=2,612)	CM (n=981)	No CM (n=2,600)	CM (n=975)
None	95.9 (2,525)	94.2 (923)	96.7 (2,551)	94.8 (944)	94.8 (2,481)	92.8 (910)	95.8 (2,497)	94.5 (917)
One to three day per month	2.7 (63)	4.1 (43)	2.7 (59)	4.3 (35)	3.6 (87)	4.8 (47)	2.4 (57)	3.1 (33)
One to seven days per week	1.4 (33)	1.7 (17)	0.6 (18)	10.0 (9)	1.6 (44)	2.4 (24)	1.8 (46)	2.5 (25)

Note: percentages and means are weighted to yield nationally representative estimates. Percentages may not sum to 100% due to rounding. Abbreviations: CM, child maltreatment; %, weighted percent; SE, standard error of the mean; * p<0.05; † p<0.01; ‡ p<0.001

Table 3.4. Multilevel models for change by maltreatment and child welfare services involvement on alcohol use (log-transformed) over time among males

	Monthly Alcohol use (log transformed) ^a								
	Any CM b (SE) GM	Physical Neglect b (SE) GM	Emotional Abuse b (SE) GM	Physical Abuse b (SE) GM	Sexual Abuse b (SE) GM	Poly-victimization b (SE) GM	CWS Investigation b (SE) GM	Removed b (SE) GM	
Fixed effects									
Maltreatment	0.60 (0.43) 1.83	0.96 (0.44) 2.62*	0.23 (0.56) 1.25	0.50 (0.78) 1.65	1.54 (1.62) 4.64			2.01 (0.93) 7.46*	1.52 (1.74) 4.59
1 type								0.18 (0.25) 1.20	
2 types								0.93 (0.77) 2.53	
3-4 types								1.41 (0.95) 4.11	
Rate of change									
Age	0.86 (0.09) 2.37‡	0.93 (0.10) 2.52‡	0.77 (0.08) 2.16‡	0.82 (0.09) 2.26‡	0.85 (0.09) 2.33‡	0.85 (0.09) 2.33‡	0.73 (0.17) 2.08‡	0.70 (0.17) 2.02‡	
Age*CM	-0.20 (0.12) 0.82	-0.41 (0.13) 0.66†	0.01 (0.13) 1.01	-0.06 (0.16) 0.95	-0.37 (0.42) 0.69	-0.10 (0.08) 0.90	-0.16 (0.21) 0.85	-0.14 (0.56) 0.87	
Quadratic Curve									
Age ²	-0.04 (0.00) 0.96‡	-0.04 (0.00) 0.96‡	-0.03 (0.00) 0.97‡	-0.04 (0.00) 0.96‡	-0.04 (0.00) 0.96‡	-0.04 (0.00) 0.96‡	-0.03 (0.01) 0.97‡	-0.03 (0.01) 0.97‡	
Age ² *CM	0.01 (0.01) 1.01	0.02 (0.01) 1.02†	-0.00 (0.01) 1.00	-0.00 (0.01) 1.00	0.02 (0.02) 1.02	0.00 (0.00) 1.00	0.01 (0.01) 1.01	0.00 (0.03) 1.00	
Race (referent – NH Caucasian)									
African American	-1.84 (0.22) 0.16‡	-1.83 (0.21) 0.16‡	-1.88 (0.24) 0.15‡	-1.79 (0.22) 0.17‡	-1.83 (0.24) 0.16‡	-1.84 (0.22) 0.16‡	-1.68 (0.38) 0.19‡	-1.69 (0.40) 0.18‡	
Hispanic	-0.07 (0.35) 0.94	0.11 (0.26) 1.11	0.03 (0.40) 1.03	0.27 (0.32) 1.31	0.39 (0.32) 1.48	-0.07 (0.34) 0.94	-0.66 (0.58) 0.52	-0.61 (0.62) 0.54	
Other	-0.70 (0.22) 0.50†	-0.62 (0.22) 0.54†	-0.79 (0.28) 0.45†	-0.80 (0.27) 0.45†	-0.71 (0.30) 0.49*	-0.71 (0.22) 0.49†	-0.64 (0.49) 0.53	-0.62 (0.47) 0.54	
Family structure (referent – two biological parents)									
Two parents, other	-0.02 (0.19) 0.98	-0.15 (0.17) 0.86	-0.03 (0.19) 0.97	-0.06 (0.19) 0.94	-0.13 (0.17) 0.88	-0.02 (0.19) 0.98	0.07 (0.44) 1.08	0.13 (0.44) 1.13	
Single parent	0.18 (0.15) 1.20	0.31 (0.15) 1.37*	0.23 (0.16) 1.26	0.18 (0.18) 1.19	0.34 (0.17) 1.41*	0.18 (0.15) 1.20	-0.40 (0.30) 0.67	-0.40 (0.30) 0.67	
Other	0.59 (0.45) 1.80	0.74 (0.48) 2.09	0.53 (0.55) 1.70	0.33 (0.61) 1.39	0.27 (0.63) 1.31	0.57 (0.45) 1.77	0.55 (0.76) 1.73	0.63 (0.73) 1.88	
Parental alcoholism	-0.05 (0.22) 0.95	0.10 (0.24) 1.10	-0.15 (0.26) 0.86	0.00 (0.26) 1.00	0.12 (0.25) 1.13	-0.05 (0.23) 0.95	-0.47 (0.35) 0.62	-0.46 (0.35) 0.63	
Parental education (referent – college or more)									
Less than high school	-0.51 (0.30) 0.60	-0.50 (0.31) 0.61	-0.37 (0.31) 0.69	-0.30 (0.37) 0.74	-0.47 (0.35) 0.62	-0.51 (0.29) 0.60	-0.25 (0.49) 0.78	-0.22 (0.54) 0.80	
High school	0.19 (0.19) 1.21	0.09 (0.18) 1.10	0.19 (0.19) 1.21	0.26 (0.21) 1.29	0.14 (0.21) 1.15	0.17 (0.19) 1.18	0.45 (0.45) 1.57	0.62 (0.57) 1.86	
Some college	0.13 (0.12) 1.14	0.17 (0.12) 1.19	0.01 (0.14) 1.01	0.04 (0.14) 1.04	0.01 (0.15) 1.01	0.12 (0.12) 1.13	0.58 (0.37) 1.78	0.64 (0.41) 1.91	
Poverty status	0.26 (0.23) 1.30	0.18 (0.24) 1.20	0.27 (0.25) 1.31	0.33 (0.28) 1.39	0.29 (0.25) 1.33	0.26 (0.24) 1.30	0.49 (0.37) 1.64	0.50 (0.37) 1.65	
Periods									
Wave II	-0.49 (0.11) 0.62‡	-0.53 (0.12) 0.59‡	-0.43 (0.14) 0.65†	-0.49 (0.14) 0.61†	-0.49 (0.14) 0.61‡	-0.49 (0.11) 0.61‡	-0.55 (0.17) 0.58†	-0.53 (0.17) 0.59	
Wave III	0.93 (0.43) 2.54*	0.67 (0.45) 1.96	1.37 (0.45) 3.95†	1.19 (0.47) 3.27*	1.07 (0.46) 2.90*	0.92 (0.43) 2.51*	0.46 (0.81) 1.58	0.55 (0.73) 1.74	
Wave IV	1.41 (0.69) 4.10*	1.19 (0.77) 3.28	1.97 (0.71) 7.17†	1.85 (0.76) 6.34*	1.74 (0.78) 5.70*	1.40 (0.69) 4.04*	0.23 (1.41) 1.26	0.42 (1.29) 1.52	
Intercept	-4.55 (0.26) 0.01‡	-4.73 (0.27) 0.01‡	-4.31 (0.23) 0.01‡	-4.49 (0.24) 0.01‡	-4.56 (0.25) 0.01‡	-4.50 (0.23) 0.01‡	-4.17 (0.45) 0.02	-4.10 (0.44) 0.02‡	
Random Effects (variance)									
Between schools	0.93	1.00	1.04	1.11	1.14	0.93	2.21	2.13	
Within persons									
Initial Status	6.76	6.68	6.59	6.43	6.31	6.71	7.08	7.28	
Rate of change	0.05†	0.05†	0.05†	0.05†	0.05†	0.05†	0.06†	0.06†	
Temporal change	6.14	6.15	5.88	5.91	5.97	6.15	6.80	6.79	
Number of observations	11,601	9,829	10,014	9,285	8,489	11,601	3,280	3,280	
Number of participants	3,070	2,600	2,642	2,456	2,2442	3,070	874	874	
Number of schools	132	132	132	132	132	132	129	129	

Abbreviations: CM (Child Maltreatment), CWS (Child Welfare Services), SE (Standard Error), GM (Geometric Mean), NH (non-Hispanic), * p<0.05; † p<0.01; ‡ p<0.001

^a Coefficients and geometric means based on weighted data. All models adjusted for age, family structure, parental alcoholism, parental education, and poverty status.

Table 3.5. Multilevel models for change by maltreatment and child welfare services involvement on alcohol use (log-transformed) over time among females

	Monthly Alcohol use (log transformed) ^a															
	Any CM		Physical Neglect		Emotional Abuse		Physical Abuse		Sexual Abuse		Poly-victimization		CWS Investigation		Removed	
	b (SE)	GM	b (SE)	GM	b (SE)	GM	b (SE)	GM	b (SE)	GM	b (SE)	GM	b (SE)	GM	b (SE)	GM
Fixed effects																
Maltreatment	0.82 (0.24)	2.26†	1.68 (0.41)	5.35‡	0.35 (0.25)	1.43	0.93 (0.53)	2.54	0.99 (0.47)	2.69*			1.83 (0.63)	6.26†	2.73 (0.97)	15.31†
1 type											0.43 (0.18)	1.54*				
2 types											1.02 (0.35)	2.78†				
3-4 types											1.37 (0.58)	3.94*				
Rate of change																
Age	0.69 (0.08)	1.99‡	0.68 (0.09)	1.98‡	0.69 (0.08)	1.99‡	0.69 (0.08)	1.99‡	0.67 (0.08)	1.96‡	0.68 (0.08)	1.98‡	0.70 (0.12)	2.01‡	0.68 (0.13)	1.97‡
Age*CM	-0.12 (0.07)	0.89	-0.34 (0.12)	0.71†	-0.02 (0.07)	0.98	-0.03 (0.10)	0.97	-0.21 (0.13)	0.81	-0.06 (0.03)	0.94	-0.33 (0.18)	0.72	-0.43 (0.26)	0.65
Quadratic Curve																
Age ²	-0.03 (0.00)	0.97‡	-0.03 (0.00)	0.97‡	-0.03 (0.00)	0.97‡	-0.03 (0.00)	0.97‡	-0.03 (0.00)	0.97‡	-0.03 (0.00)	0.97‡	-0.03 (0.00)	0.97‡	-0.03 (0.00)	0.97‡
Age ² *CM	0.00 (0.00)	1.00	0.01 (0.01)	1.01*	-0.00 (0.00)	1.00	-0.00 (0.00)	1.00	0.01 (0.01)	1.01	0.00 (0.00)	1.00	0.01 (0.01)	1.01	0.01 (0.01)	1.01
Race (referent – NH Caucasian)																
African American	-1.02 (0.16)	0.36‡	-1.03 (0.17)	0.36‡	-1.02 (0.18)	0.36‡	-1.03 (0.20)	0.36‡	-1.11 (0.19)	0.33‡	-1.00 (0.16)	0.37‡	-0.55 (0.34)	0.57	-0.58 (0.33)	0.56
Hispanic	0.28 (0.23)	1.33	0.32 (0.29)	1.38	0.31 (0.25)	1.36	0.30 (0.27)	1.34	0.23 (0.30)	1.25	0.30 (0.23)	1.36	0.32 (0.28)	1.38	0.31 (0.28)	1.36
Other	-0.74 (0.19)	0.48‡	-0.89 (0.19)	0.41‡	-0.57 (0.20)	0.57†	-0.74 (0.19)	0.48‡	-0.85 (0.19)	0.43‡	-0.74 (0.19)	0.48‡	-0.72 (0.37)	0.49	-0.72 (0.37)	0.49
Family structure (referent – two biological parents)																
Two parents, other	0.16 (0.17)	1.18	0.05 (0.19)	1.05	0.15 (0.17)	1.16	0.21 (0.18)	1.23	0.18 (0.20)	1.20	0.16 (0.16)	1.17	0.57 (0.25)	1.77*	0.55 (0.25)	1.74*
Single parent	0.48 (0.12)	1.61‡	0.50 (0.14)	1.65‡	0.46 (0.12)	1.59‡	0.44 (0.14)	1.55†	0.48 (0.14)	1.61†	0.47 (0.12)	1.60‡	0.41 (0.27)	1.50	0.42 (0.27)	1.53
Other	0.14 (0.32)	1.15	0.44 (0.36)	1.55	0.17 (0.36)	1.19	0.30 (0.40)	1.34	0.39 (0.39)	1.48	0.12 (0.32)	1.13	-0.80 (0.65)	0.45	-0.75 (0.63)	0.47
Parental alcoholism	0.04 (0.20)	1.04	0.04 (0.25)	1.04	0.00 (0.23)	1.00	-0.09 (0.25)	0.92	-0.11 (0.25)	0.89	0.04 (0.21)	1.04	0.20 (0.22)	1.23	0.20 (0.22)	1.23
Parental education (referent – college or more)																
Less than high school	-0.35 (0.24)	0.70	-0.52 (0.26)	0.59*	-0.35 (0.25)	0.70	-0.30 (0.25)	0.74	-0.52 (0.25)	0.59*	-0.35 (0.24)	0.70	-0.19 (0.54)	0.83	-0.22 (0.51)	0.80
High school	-0.09 (0.13)	0.92	-0.17 (0.15)	0.85	-0.10 (0.14)	0.90	-0.08 (0.15)	0.93	-0.12 (0.14)	0.89	-0.09 (0.13)	0.91	0.08 (0.27)	1.09	0.07 (0.28)	1.07
Some college	0.12 (0.13)	1.12	0.16 (0.15)	1.17	0.15 (0.14)	1.16	0.19 (0.14)	1.21	0.18 (0.15)	1.20	0.11 (0.13)	1.12	-0.23 (0.23)	0.80	-0.23 (0.24)	0.80
Poverty status	-0.32 (0.16)	0.72*	-0.41 (0.18)	0.66*	-0.35 (0.17)	0.70*	-0.50 (0.18)	0.61†	-0.55 (0.19)	0.58†	-0.34 (0.15)	0.71*	0.10 (0.23)	1.11	0.10 (0.24)	1.10
Periods																
Wave II	-0.06 (0.20)	0.94	-0.10 (0.21)	0.91	-0.05 (0.22)	0.95	-0.07 (0.21)	0.93	-0.08 (0.21)	0.92	-0.06 (0.20)	0.94	-0.01 (0.21)	0.99	0.00 (0.22)	1.00
Wave III	0.98 (0.39)	2.65*	1.02 (0.42)	2.77*	0.98 (0.40)	2.66*	0.99 (0.41)	2.70*	1.03 (0.43)	2.81*	0.97 (0.39)	2.65*	0.42 (0.64)	1.53	0.43 (0.65)	1.53
Wave IV	1.79 (0.61)	5.99†	1.88 (0.64)	6.56†	1.73 (0.60)	5.64†	1.78 (0.61)	5.93†	1.77 (0.66)	5.88†	1.79 (0.61)	5.98†	0.94 (1.10)	2.57	0.92 (1.11)	2.50
Intercept	-4.54 (0.26)	0.01‡	-4.44 (0.27)	0.01‡	-4.53 (0.27)	0.01‡	-4.51 (0.27)	0.01‡	-4.39 (0.27)	0.01	-4.49 (0.26)	0.01‡	-4.37 (0.39)	0.01‡	-4.26 (0.39)	0.01‡
Random Effects (variance)																
Between schools		0.70		0.72		0.70		0.69		0.68		0.70		1.54		1.54
Within persons																
Initial Status		4.12		3.98		4.16		4.11		3.96		4.14		3.46		3.52
Rate of change		0.03†		0.03†		0.03†		0.03†		0.03†		0.03†		0.03†		0.03†
Temporal change		6.02		6.12		5.82		5.91		6.01		6.02		6.09		6.08
Number of observations		13,900		11,181		12,605		11,057		10,786		13,900		3,791		3,791
Number of participants		3,625		2,916		3,284		2,882		2,813		3,625		991		991
Number of schools		131		131		131		131		131		131		129		129

Abbreviations: CM (Child Maltreatment), CWS (Child Welfare Services), SE (Standard Error), GM (Geometric Mean), NH (non-Hispanic), * p<0.05; † p<0.01; ‡ p<0.001

^a Coefficients and geometric means based on weighted data. All models adjusted for age, race, family structure, parental alcoholism, parental education, and poverty status.

Figure 3.1. Developmental Trajectories of Monthly Alcohol Use Among Males: Physical Neglect (PN) and Child Welfare Services (CWS) Investigation.

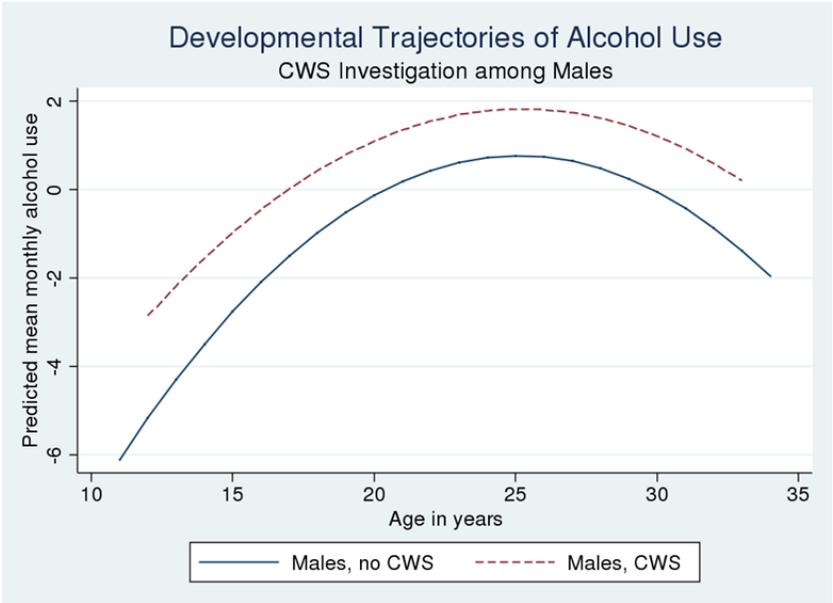
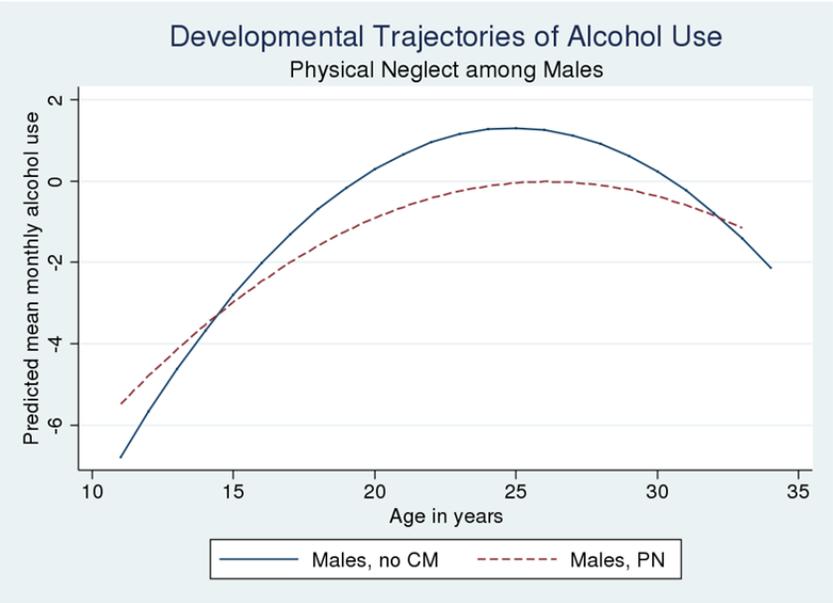


Figure 3.2. Developmental Trajectories of Monthly Alcohol Use Among Females: Any Maltreatment (CM), Physical Neglect (PN), Sexual Abuse (SA), Polyvictimization, Child Welfare Services (CWS) Investigation, and Removed from the Home and Child Welfare Services Investigation by Biological Sex.

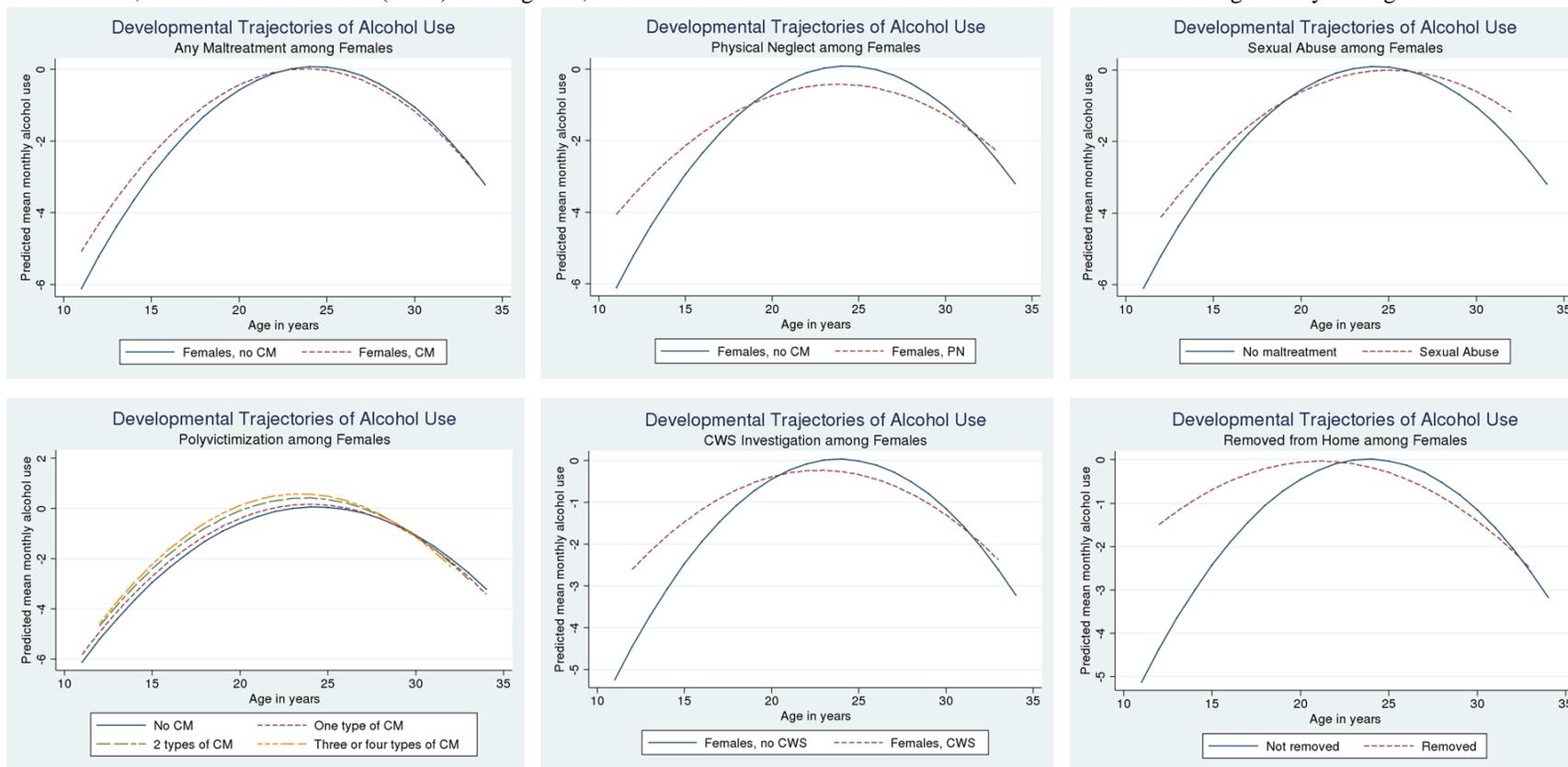


Table 3.6. Multilevel models for change by maltreatment and child welfare services involvement on past 30-day marijuana use over time among males

	Past 30 Day Marijuana Use ^a															
	Any CM		Physical Neglect		Emotional Abuse		Physical Abuse		Sexual Abuse		Poly-victimization		CWS Investigation		Removed	
	b	OR (95% CI)	b	OR (95% CI)	b	OR (95% CI)	b	OR (95% CI)	b	OR (95% CI)	b	OR (95% CI)	b	OR (95% CI)	b	OR (95% CI)
Fixed effects																
Maltreatment	0.85	2.33* (1.06, 5.11)	0.91	2.49* (1.08, 5.70)	1.24	3.44* (1.01, 11.73)	0.37	1.45 (0.27, 7.95)	3.71	40.99† (4.25, 395.26)			- 0.40	0.67 (0.07, 6.69)	- 0.61	0.54 (0.01, 20.31)
1 type											0.45	1.57 (0.79, 3.10)				
2 types											0.93	2.54 (0.81, 7.91)				
3-4 types											2.64	14.07† (2.71, 73.00)				
Rate of change																
Age	0.71	2.03‡ (1.74, 2.36)	0.66	1.93‡ (1.64, 2.28)	0.75	2.11‡ (1.75, 2.54)	0.71	2.04‡ (1.70, 2.45)	0.67	1.95‡ (1.76, 2.16)	0.71	2.04‡ (1.72, 2.42)	0.64	1.91‡ (1.44, 2.51)	0.67	1.96‡ (1.41, 2.74)
Age*CM	-0.12	0.89 (0.73, 1.08)	- 0.12	0.89 (0.70, 0.97)	- 0.30	0.74* (0.56, 0.97)	- 0.01	0.99 (0.66, 1.48)	- 0.82	0.44† (0.25, 0.77)	- 0.10	0.90 (0.80, 1.02)	0.25	1.29 (0.71, 2.34)	0.62	1.86 (0.67, 5.15)
Quadratic Curve																
Age ²	-0.04	0.96‡ (0.95, 0.97)	- 0.04	0.96‡ (0.95, 0.97)	- 0.04	0.96‡ (0.95, 0.97)	- 0.04	0.96‡ (0.95, 0.97)	- 0.04	0.96‡ (0.95, 0.96)	- 0.04	0.96‡ (0.95, 0.97)	- 0.04	0.96‡ (0.94, 0.98)	- 0.05	0.95‡ (0.93, 0.98)
Age ² *CM	0.01	1.01 (1.00, 1.02)	0.00	1.00 (0.99, 1.02)	0.01	1.01 (1.00, 1.03)	0.00	1.00 (0.98, 1.03)	0.04	1.04† (1.01, 1.07)	0.01	1.01 (1.00, 1.01)	- 0.00	1.00 (0.97, 1.02)	- 0.03	0.97 (0.93, 1.01)
Race (referent – NH Caucasian)																
African American	-0.45	0.64* (0.45, 0.90)	- 0.17	0.84 (0.62, 1.14)	- 0.68	0.50‡ (0.35, 0.73)	- 0.43	0.65† (0.48, 0.88)	- 0.34	0.71 (0.46, 1.09)	- 0.69	0.50‡ (0.37, 0.68)	0.71	2.03† (1.20, 3.44)	- 0.45	0.64 (0.36, 1.12)
Hispanic	0.67	1.95 (0.81, 4.66)	0.33	1.39 (0.75, 2.58)	0.79	2.21* (1.14, 4.28)	1.11	3.03* (1.18, 7.75)	0.95	2.59 (0.66, 10.20)	0.34	1.40 (0.38, 5.21)	0.01	1.01 (0.59, 1.71)	0.29	1.34 (0.82, 2.19)
Other	-0.16	0.85 (0.49, 1.49)	- 0.16	0.85 (0.50, 1.46)	- 0.38	0.68 (0.39, 1.20)	- 0.29	0.75 (0.42, 1.35)	- 0.15	0.86 (0.46, 1.60)	- 0.10	0.90 (0.49, 1.67)	0.21	1.24 (0.63, 2.43)	0.60	1.82 (0.71, 4.64)
Family structure (referent – two biological parents)																
Two parents, other	0.26	1.29 (0.77, 2.17)	0.08	1.08 (0.70, 1.67)	0.54	1.71* (1.03, 2.84)	0.33	1.39 (0.82, 2.37)	0.58	1.78 (1.00, 3.18)	0.35	1.42 (0.73, 2.74)	0.46	1.59* (1.03, 2.45)	0.62	1.85† (1.23, 2.80)
Single parent	0.54	1.72† (1.23, 2.40)	0.54	1.72† (1.23, 2.41)	0.84	2.33‡ (1.46, 3.71)	0.40	1.50* (1.06, 2.13)	0.39	1.47* (1.01, 2.15)	0.30	1.35 (0.81, 2.24)	0.14	1.15 (0.62, 2.13)	0.02	1.02 (0.52, 2.00)
Other	0.43	1.54	0.53	1.70*	0.76	2.14* (1.04, 4.41)	0.48	1.62	0.73	2.07 (0.84, 5.11)	0.04	1.04 (0.52, 2.09)	0.19	1.21	1.84	6.31‡

Parental alcoholism	0.17	(0.89, 2.67)	0.01	(1.06, 2.73)	0.33	1.39	(0.76, 2.54)	0.69	1.99*	(1.15, 3.45)	0.44	1.56	(0.98, 2.48)	0.47	1.60	(1.00, 2.56)	-	0.95	(0.59, 1.55)	0.42	(2.53, 15.73)	-	0.66	(0.34, 1.28)	
Parental education (referent – college or more)																									
Less than high school	-0.74	0.48*	-	0.62	0.49	(0.26, 0.89)	0.49	(0.34, 1.10)	1.15	0.32†	(0.15, 0.66)	1.05	(0.15, 0.81)	1.15	0.32†	(0.15, 0.67)	0.10	1.10	(0.51, 2.36)	0.27	1.31	(0.59, 2.90)	0.87	2.40	(0.94, 6.09)
High school	-0.02	0.98	-	0.94	0.06	(0.63, 1.52)	0.06	(0.67, 1.31)	0.10	0.91	(0.54, 1.51)	0.26	1.29	0.12	0.88	(0.53, 1.46)	-	0.92	(0.56, 1.52)	-	0.90	(0.50, 1.63)	-	0.65	(0.33, 1.27)
Some college	-0.22	0.80	-	0.62	0.48	(0.51, 1.26)	0.48	(0.38, 1.00)	0.21	0.81	(0.43, 1.51)	0.13	0.88	0.62	0.54*	(0.30, 0.95)	-	0.71	(0.44, 1.15)	0.02	1.02	(0.66, 1.58)	-	0.97	(0.71, 1.33)
Poverty status	0.48	1.62*	0.28	1.33	0.69	(1.03, 2.54)	0.28	(0.85, 2.06)	0.69	2.00*	(1.12, 3.58)	0.27	1.32	0.15	1.16	(0.62, 2.16)	0.58	1.78*	(1.13, 2.80)	0.50	1.65	(0.96, 2.83)	0.87	2.38*	(1.16, 4.90)
Periods																									
Wave II	0.22	1.25	0.23	1.26	0.26	(0.94, 1.65)	0.23	(0.92, 1.73)	0.26	1.30	(0.93, 1.81)	0.17	1.18	0.23	1.26	(0.93, 1.71)	0.24	1.27	(0.94, 1.71)	0.14	1.15	(0.70, 1.91)	0.17	1.18	(0.68, 2.04)
Wave III	0.77	2.15*	0.99	2.69†	0.94	(1.08, 4.31)	0.99	(1.48, 4.87)	0.94	2.56*	(1.25, 5.26)	0.45	1.57	0.88	2.42†	(1.36, 4.31)	0.77	2.15*	(1.03, 4.51)	0.46	1.58	(0.65, 3.80)	0.87	2.39	(0.83, 6.87)
Wave IV	0.84	2.33	1.11	3.04	1.12	(0.57, 9.50)	1.11	(0.99, 9.39)	1.12	3.06	(0.70, 13.36)	0.13	1.13	1.05	2.86	(0.82, 9.97)	0.73	2.07	(0.43, 9.94)	0.07	1.07	(0.17, 6.65)	1.45	4.26	(0.67, 27.12)
Random Effects (variance)																									
Between schools	0.39		0.45		0.74				0.54			0.39*		0.66			1.58			1.67					
Within persons																									
Initial Status	6.97		6.66		9.51				6.83			5.42		7.13			6.37			7.55					
Rate of change	0.13*		0.16*		0.09*				0.19*			0.15*		0.13*			0.21*			0.23					
Number of observations	11,935		10,111		10,286				9,566			8,734		11,935			3,376			3,376					
Number of individuals	3,071		2,601		2,643				2,457			2,243		3,071			874			874					
Number of schools	132		132		132				132			132		132			129			129					

Abbreviations: OR (Odds Ratio), CI (Confidence Interval), CM (Child Maltreatment), CWS (Child Welfare Services), NH (non-Hispanic), * p<0.05; † p<0.01; ‡ p<0.001

^a Coefficients and odds ratios based on weighted data. All models adjusted for age, race, family structure, parental alcoholism, parental education, and poverty status.

Table 3.7. Multilevel models for change by maltreatment and child welfare services involvement on past 30-day marijuana use over time among females

	Past 30 Day Marijuana Use ^a								
	Any CM	Physical Neglect	Emotional Abuse	Physical Abuse	Sexual Abuse	Poly-victimization	CWS Investigation	Removed	
	b OR (95% CI)	b OR (95% CI)	b OR (95% CI)	b OR (95% CI)	b OR (95% CI)	b OR (95% CI)	b OR (95% CI)	b OR (95% CI)	b OR (95% CI)
Fixed effects									
Maltreatment	0.89 2.44† (1.25, 4.74)	1.02 2.77 (0.90, 8.51)	0.37 1.44 (0.76, 2.74)	1.66 5.24* (1.50, 18.33)	1.13 3.08 (0.99, 9.56)			1.58 4.86 (0.29, 80.33)	6.19 487.79† (12.09, 16878.21)
1 type						0.75 2.12† (1.29, 3.50)			
2 types						1.50 4.49† (1.82, 11.07)			
3-4 types						0.53 1.70 (0.46, 6.36)			
Rate of change									
Age	0.41 1.50‡ (1.22, 1.86)	0.27 1.31* (1.05, 1.64)	0.31 1.36† (1.09, 1.69)	0.30 1.35* (1.06, 1.72)	0.31 1.36† (1.09, 1.70)	0.40 1.50‡ (1.22, 1.83)	0.72 2.06‡ (1.48, 2.86)	0.68 1.98‡ (1.39, 2.81)	
Age*CM	-0.17 0.84 (0.69, 1.03)	-0.17 0.84 (0.58, 1.22)	-0.11 0.90 (0.76, 1.06)	-0.45 0.64† (0.49, 0.82)	-0.16 0.85 (0.63, 1.16)	-0.12 0.88* (0.79, 0.99)	-0.12 0.89 (0.44, 1.80)	-1.15 0.32* (0.10, 0.96)	
Quadratic Curve									
Age ²	-0.03 0.97‡ (0.96, 0.98)	-0.03 0.97‡ (0.96, 0.98)	-0.03 0.97‡ (0.96, 0.98)	-0.03 0.97‡ (0.96, 0.98)	-0.03 0.97‡ (0.96, 0.98)	-0.03 0.97‡ (0.96, 0.98)	-0.05 0.95‡ (0.94, 0.97)	-0.04 0.96‡ (0.94, 0.97)	
Age ² *CM	0.01 1.01* (1.00, 1.02)	0.01 1.01 (0.99, 1.03)	0.01 1.01* (1.00, 1.02)	0.03 1.03‡ (1.02, 1.04)	0.01 1.01 (0.99, 1.02)	0.01 1.01† (1.00, 1.02)	-0.01 0.99 (0.96, 1.03)	0.04 1.04 (0.98, 1.10)	
Race (referent – NH Caucasian)									
African American	-0.69 0.50† (0.32, 0.78)	-0.47 0.62* (0.39, 0.98)	-0.71 0.49‡ (0.35, 0.70)	-0.70 0.50† (0.31, 0.81)	-0.76 0.47‡ (0.31, 0.70)	-0.68 0.51† (0.33, 0.77)	-0.66 0.52 (0.24, 1.14)	-0.57 0.56 (0.28, 1.14)	
Hispanic	-0.05 0.95 (0.68, 1.32)	0.19 1.21 (0.71, 2.05)	-0.04 0.96 (0.61, 1.52)	0.06 1.06 (0.63, 1.76)	0.13 1.14 (0.68, 1.92)	-0.04 0.96 (0.67, 1.39)	-0.36 0.70 (0.32, 1.52)	-0.26 0.77 (0.46, 1.30)	
Other	0.08 1.09 (0.77, 1.54)	-0.13 0.88 (0.60, 1.30)	0.03 1.03 (0.68, 1.56)	-0.14 0.87 (0.56, 1.36)	-0.12 0.88 (0.59, 1.31)	0.12 1.13 (0.78, 1.63)	0.37 1.45 (0.77, 2.72)	0.41 1.51 (0.84, 2.71)	
Family structure (referent – two biological parents)									
Two parents, other	0.41 1.51 (0.98, 2.33)	0.39 1.48 (0.84, 2.59)	0.61 1.85* (1.13, 3.03)	0.71 2.03* (1.16, 3.55)	0.61 1.84* (1.09, 3.09)	0.45 1.57* (1.03, 2.39)	-0.06 0.94 (0.60, 1.47)	-0.19 0.82 (0.53, 1.28)	
Single parent	0.48 1.62† (1.21, 2.17)	0.50 1.64† (1.14, 2.37)	0.64 1.90‡ (1.37, 2.64)	0.54 1.71† (1.24, 2.37)	0.51 1.66† (1.18, 2.35)	0.50 1.65† (1.21, 2.25)	0.44 1.56 (0.88, 2.77)	0.73 2.08* (1.07, 4.06)	
Other	0.86 2.35† (1.24, 4.47)	1.44 4.20† (1.54, 11.44)	1.31 3.71† (1.74, 7.89)	1.41 4.11† (1.43, 11.79)	1.43 4.20* (1.10, 15.95)	0.86 2.37† (1.25, 4.49)	-0.65 0.52* (0.29, 0.93)	-0.17 0.84 (0.40, 1.76)	
Parental alcoholism	-0.05 0.95 (0.56, 1.61)	0.13 1.13 (0.54, 2.39)	-0.19 0.83 (0.52, 1.32)	-0.26 0.77 (0.39, 1.53)	-0.19 0.83 (0.42, 1.64)	-0.11 0.89 (0.53, 1.49)	-0.08 0.92 (0.64, 1.31)	0.02 1.02 (0.73, 1.43)	
Parental education (referent – college or more)									
Less than high school	-0.11 0.89 (0.57, 1.40)	-0.52 0.60* (0.36, 1.00)	-0.02 0.98 (0.56, 1.74)	-0.19 0.83 (0.43, 1.61)	-0.64 0.53* (0.30, 0.93)	-0.11 0.90 (0.57, 1.42)	0.15 1.16 (0.57, 2.37)	-0.37 0.69 (0.35, 1.36)	
High school	0.03 1.03 (0.67, 1.60)	-0.26 0.77 (0.55, 1.07)	0.09 1.09 (0.71, 1.68)	0.11 1.11 (0.72, 1.72)	-0.13 0.88 (0.64, 1.22)	0.11 1.12 (0.73, 1.73)	0.20 1.22 (0.78, 1.92)	0.14 1.15 (0.75, 1.77)	
Some college	0.31 1.37 (0.97, 1.91)	0.33 1.40 (0.91, 2.14)	0.38 1.46* (1.01, 2.11)	0.38 1.46 (0.92, 2.31)	0.38 1.46 (0.92, 2.31)	0.38 1.46* (1.06, 2.02)	-0.14 0.87 (0.54, 1.39)	-0.03 0.97 (0.65, 1.46)	
Poverty status	0.26 1.29 (0.89, 1.89)	0.28 1.33 (0.78, 2.25)	0.35 1.42 (0.87, 2.31)	0.37 1.45 (0.85, 2.48)	0.24 1.27 (0.75, 2.15)	0.27 1.30 (0.89, 1.91)	-0.37 0.69 (0.34, 1.38)	-0.62 0.54 (0.26, 1.12)	

Periods																
Wave II	0.44	1.55*	0.72	2.05†	0.54	1.71*	0.62	1.87*	0.70	2.02†	0.45	1.56*	-0.22	0.80	-0.18	0.84
		(1.04, 2.33)		(1.27, 3.32)		(1.10, 2.66)		(1.15, 3.04)		(1.25, 3.27)		(1.04, 2.35)		(0.51, 1.27)		(0.51, 1.36)
Wave III	1.09	2.97*	1.81	6.08‡	1.60	4.95‡	1.58	4.86‡	1.57	4.82‡	1.13	3.10†	-0.31	0.73	-0.45	0.64
		(1.51, 5.82)		(2.71, 13.67)		(2.46, 9.95)		(2.06, 11.48)		(2.16, 10.77)		(1.61, 5.99)		(0.23, 2.33)		(0.21, 1.97)
Wave IV	1.48	4.38*	2.62	13.75‡	2.27	9.65‡	2.31	10.07†	1.87	6.51†	1.55	4.72*	0.22	1.24	-0.49	0.62
		(1.26, 15.17)		(3.58, 52.88)		(3.01, 30.99)		(2.15, 47.12)		(1.72, 24.67)		(1.43, 15.57)		(0.18, 8.61)		(0.11, 3.33)
Random Effects (variance)																
Between schools	0.56		0.52		0.47*		0.75		0.80		0.53		1.75		1.32	
Within persons																
Initial Status	4.25		3.40		4.49		3.64		4.08		4.33		7.83		7.62	
Rate of change	0.05†		0.04†		0.04†		0.04†		0.04†		0.05†		0.19*		0.18*	
Number of observations	14,291		11,498		12,958		11,370		11,907		14,291		3,894		3,894	
Number of individuals	3,625		2,916		3,284		2,882		2,813		3,625		991		991	
Number of schools	131		131		131		131		131		131		129		129	

Abbreviations: OR (Odds Ratio), CI (Confidence Interval), CM (Child Maltreatment), CWS (Child Welfare Services), NH (non-Hispanic), * p<0.05; † p<0.01; ‡ p<0.001

^a Coefficients and odds ratios based on weighted data. All models adjusted for age, race, family structure, parental alcoholism, parental education, and poverty status.

Figure 3.3. Developmental Trajectories of Predicted Probabilities of Past 30-Day Marijuana Use among Males: Any Maltreatment (CM), Physical Neglect (PN), Emotional Abuse (EA), Sexual Abuse (SA), and Poly-victimization.

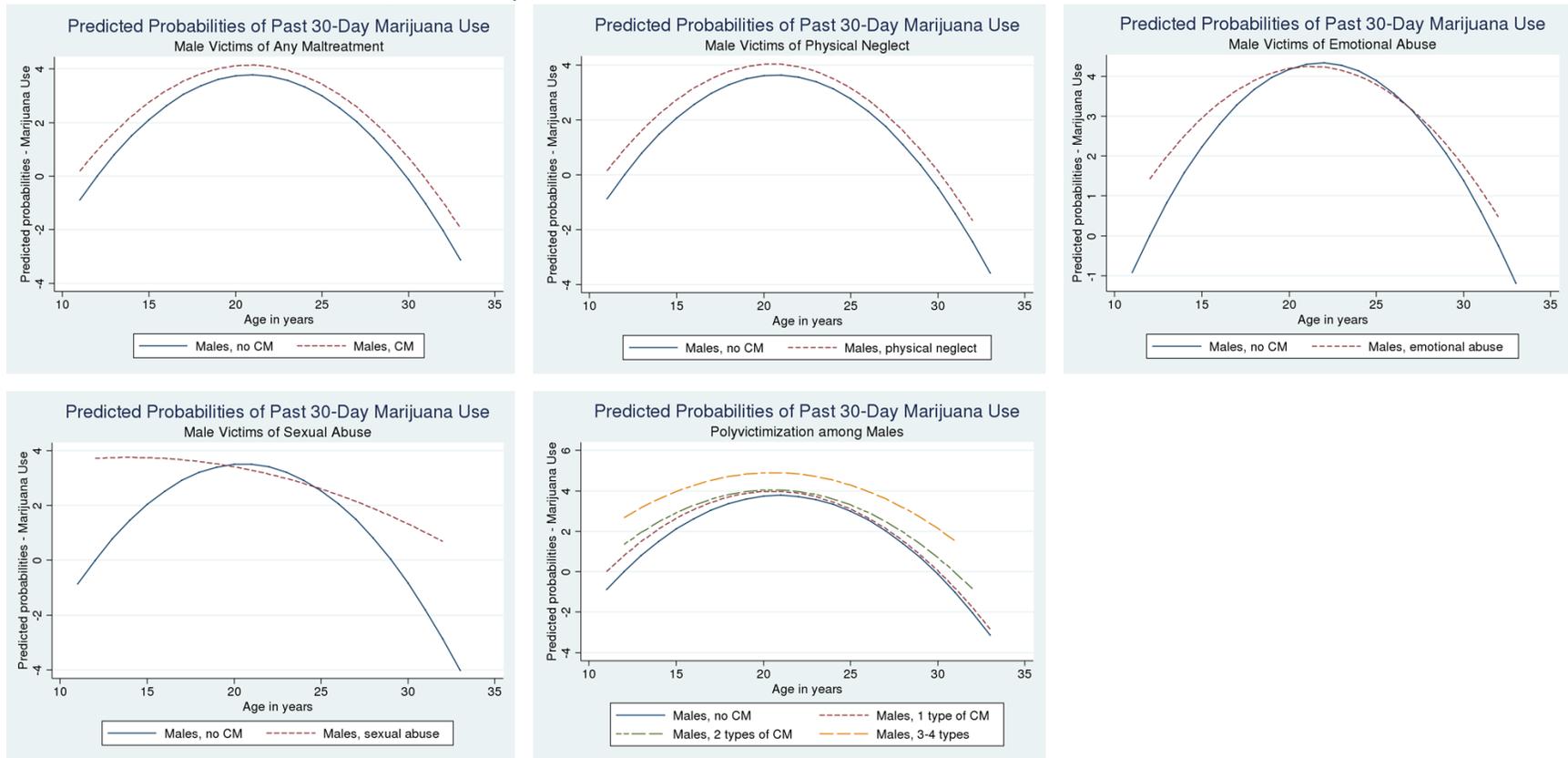


Figure 3.4. Developmental Trajectories of Predicted Probabilities of Past 30-Day Marijuana Use among Females: Any Maltreatment (CM), Physical Abuse (PA), Poly-Victimization, and Removal from the Home.

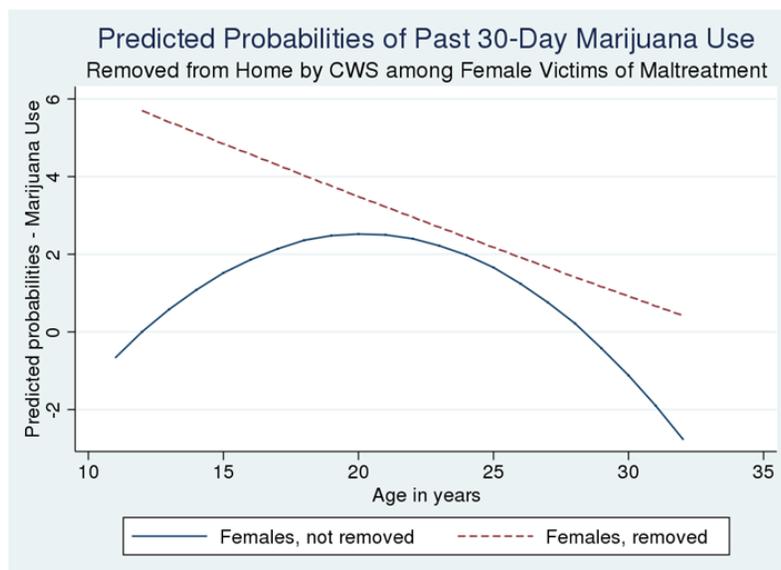
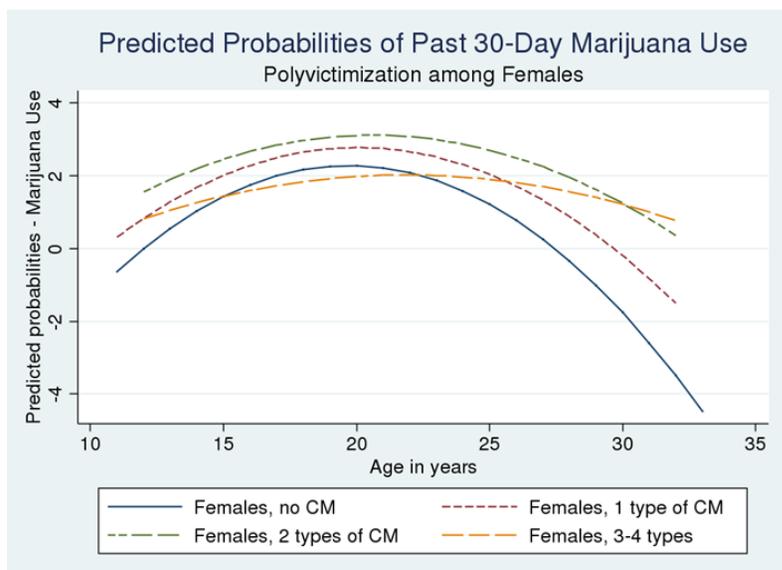
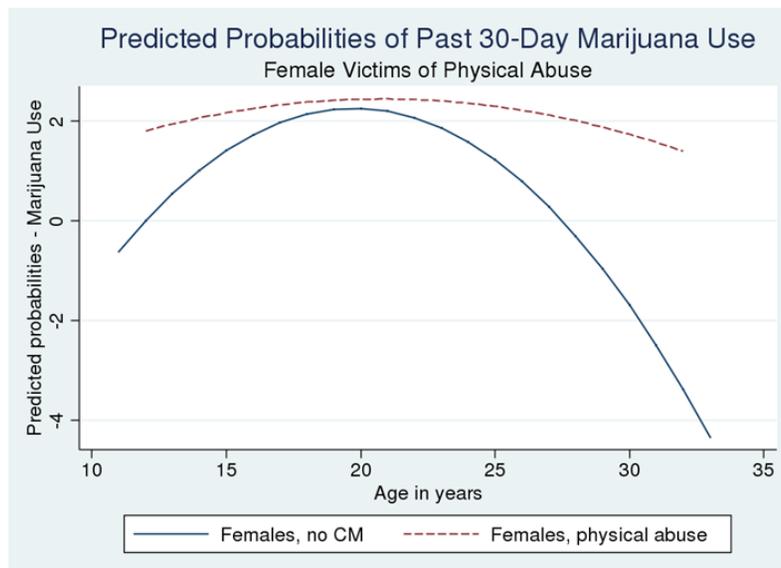
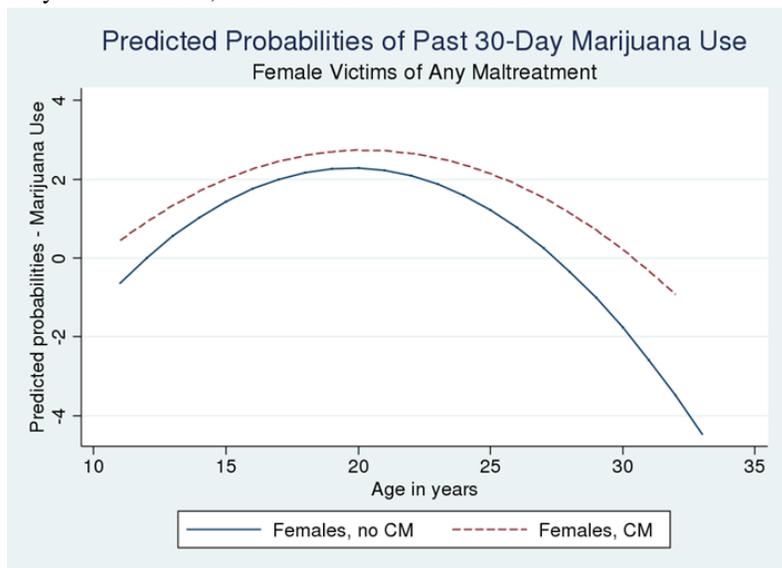


Table 3.8. Multilevel models for change by maltreatment and child welfare services involvement on past 30-day other substance use over time among males

	Past 30 Day Other Substance Use ^a								
	Any CM b OR (95% CI)	Physical Neglect b OR (95% CI)	Emotional Abuse b OR (95% CI)	Physical Abuse b OR (95% CI)	Sexual Abuse§ b OR (95% CI)	Poly-victimization b OR (95% CI)	CWS Investigation b OR (95% CI)	Removed b OR (95% CI)	
Fixed effects									
Maltreatment	1.67 5.32*	2.15 8.63*	1.95 7.03*	1.00 2.71	8.81 3320.69‡		-4.68 0.01	-2.64 0.07	
	(1.14, 24.73)	(1.50, 49.58)	(1.40, 35.20)	(0.35, 20.92)	(263.82, 41796.60)		(0.00, 1.25)	(0.00, 1.82)	
1 type						1.31 3.72*			
						(1.27, 10.96)			
2 types						1.51 4.52*			
						(1.25, 16.33)			
3-4 types						2.11 8.25			
						(0.88, 76.98)			
Rate of change									
Age	1.17 3.21‡	1.04 2.84‡	1.33 3.77‡	1.01 2.74‡	1.16 3.18‡	1.23 3.42‡	1.18 3.24‡	1.87 6.51‡	
	(2.34, 4.40)	(2.14, 3.76)	(3.00, 4.73)	(1.99, 3.76)	(2.25, 4.50)	(2.36, 4.95)	(1.58, 6.64)	(3.40, 12.47)	
Age*CM	-0.21 0.81	-0.22 0.80	-0.40 0.67*	-0.18 0.84	-1.28 0.28‡	-0.14 0.87	1.12 3.08*	1.18 3.26*	
	(0.59, 1.11)	(0.55, 1.17)	(0.48, 0.94)	(0.50, 1.41)	(0.17, 0.46)	(0.73, 1.03)	(1.12, 8.43)	(1.11, 9.55)	
Quadratic Curve									
Age ²	-0.07 0.93‡	-0.06 0.94‡	-0.08 0.93‡	-0.06 0.94‡	-0.06 0.94‡	-0.07 0.93‡	-0.07 0.94‡	-0.10 0.91‡	
	(0.91, 0.95)	(0.93, 0.96)	(0.91, 0.94)	(0.92, 0.97)	(0.92, 0.96)	(0.91, 0.95)	(0.90, 0.97)	(0.88, 0.94)	
Age ² *CM	0.01 1.01	0.01 1.01	0.03 1.03‡	0.02 1.02	0.06 1.06‡	0.01 1.01*	-0.04 0.96	-0.07 0.93*	
	(1.00, 1.03)	(0.99, 1.03)	(1.01, 1.04)	(0.99, 1.05)	(1.03, 1.08)	(1.00, 1.02)	(0.90, 1.03)	(0.87, 0.99)	
Race (referent – NH Caucasian)									
African American	-2.53 0.08‡	-2.17 0.11‡	-2.77 0.06‡	-2.60 0.07‡	-2.19 0.11‡	-2.34 0.10‡	-1.30 0.27‡	-2.96 0.05‡	
	(0.04, 0.15)	(0.05, 0.24)	(0.03, 0.13)	(0.04, 0.14)	(0.05, 0.26)	(0.05, 0.20)	(0.12, 0.60)	(0.01, 0.20)	
Hispanic	-0.30 0.74	0.05 1.05	0.13 1.14	-0.05 0.95	0.77 2.17	-0.38 0.69	-0.15 0.86	0.18 1.20	
	(0.47, 1.17)	(0.58, 1.92)	(0.69, 1.88)	(0.60, 1.52)	(0.61, 7.69)	(0.43, 1.09)	(0.48, 1.53)	(0.58, 2.51)	
Other	-0.77 0.46*	-0.83 0.44*	-0.61 0.54	-0.66 0.52	-0.73 0.48	-0.77 0.46*	-0.14 0.87	-0.64 0.53	
	(0.23, 0.95)	(0.19, 0.98)	(0.26, 1.12)	(0.22, 1.22)	(0.15, 1.51)	(0.22, 0.99)	(0.29, 2.63)	(0.22, 1.27)	
Family structure (referent – two biological parents)									
Two parents, other	-0.16 0.85	-0.33 0.72	-0.46 0.63	0.20 1.22	0.16 1.17	0.00 1.00	-0.19 0.83	-0.22 0.80	
	(0.46, 1.56)	(0.36, 1.44)	(0.32, 1.24)	(0.55, 2.73)	(0.42, 3.31)	(0.55, 1.83)	(0.25, 2.71)	(0.36, 1.81)	
Single parent	0.46 1.59	0.66 1.93*	0.58 1.79*	0.71 2.04‡	0.90 2.47‡	0.58 1.79*	0.07 1.07	-0.26 0.77	
	(0.92, 2.75)	(1.10, 3.40)	(1.10, 2.90)	(1.31, 3.18)	(1.45, 4.19)	(1.10, 2.91)	(0.33, 3.49)	(0.32, 1.89)	
Other	-0.05 0.95	0.37 1.45	-0.15 0.86	-0.12 0.89	-0.27 0.76	-0.24 0.79	0.62 1.87	0.20 1.22	
	(0.44, 2.04)	(0.57, 3.66)	(0.30, 2.50)	(0.29, 2.76)	(0.16, 3.55)	(0.37, 1.65)	(0.57, 6.08)	(0.53, 2.77)	
Parental alcoholism	0.48 1.62	1.00 2.73	0.82 2.27	0.58 1.78	1.10 3.01	0.49 1.63	-0.17 0.84	0.34 1.41	
	(0.72, 3.62)	(0.64, 11.65)	(0.95, 5.45)	(0.67, 4.73)	(0.90, 10.08)	(0.74, 3.60)	(0.40, 1.80)	(0.74, 2.67)	
Parental education (referent – college or more)									
Less than high school	-0.13 0.88	-1.05 0.35	0.23 1.26	-0.23 0.79	-0.93 0.39	-0.24 0.78	0.41 1.50	-0.77 0.46	
	(0.33, 2.34)	(0.11, 1.10)	(0.54, 2.94)	(0.42, 1.49)	(0.08, 1.88)	(0.30, 2.07)	(0.52, 4.30)	(0.17, 1.30)	
High school	-0.04 0.96	-0.45 0.64	-0.19 0.83	-0.12 0.89	-0.98 0.38‡	-0.19 0.83	0.33 1.39	0.60 1.82*	
	(0.58, 1.57)	(0.38, 1.08)	(0.53, 1.30)	(0.60, 1.32)	(0.19, 0.74)	(0.50, 1.36)	(0.43, 4.47)	(1.02, 3.25)	
Some college	-0.46 0.63	-0.64 0.53*	-0.50 0.61	-0.76 0.47*	-0.84 0.43*	-0.57 0.57*	-0.00 1.00	0.19 1.21	
	(0.40, 1.01)	(0.30, 0.93)	(0.35, 1.04)	(0.23, 0.95)	(0.20, 0.91)	(0.35, 0.93)	(0.45, 2.21)	(0.58, 2.52)	
Poverty status	-0.63 0.54	-0.64 0.53	-1.06 0.35‡	-1.00 0.37*	-0.60 0.55	-0.69 0.50	0.58 1.78	0.26 1.30	
	(0.25, 1.13)	(0.17, 1.63)	(0.16, 0.74)	(0.14, 0.93)	(0.14, 2.12)	(0.24, 1.05)	(0.73, 4.35)	(0.55, 3.05)	
Periods									

Wave II	-0.41 0.67 (0.41, 1.09)	-0.39 0.67 (0.39, 1.16)	-0.24 0.79 (0.46, 1.35)	-0.28 0.75 (0.44, 1.30)	-0.25 0.78 (0.39, 1.56)	-0.42 0.65 (0.39, 1.10)	-0.93 0.40 (0.12, 1.26)	-1.11 0.33 (0.11, 1.01)
Wave III	0.24 1.27 (0.60, 2.69)	0.40 1.49 (0.54, 4.12)	0.52 1.68 (0.66, 4.29)	0.64 1.89 (0.66, 5.41)	0.53 1.71 (0.58, 4.99)	0.20 1.22 (0.54, 2.78)	-1.14 0.32 (0.05, 2.05)	-2.26 0.10† (0.02, 0.53)
Wave IV	0.88 2.42 (0.77, 7.64)	0.43 1.53 (0.63, 3.71)	1.10 3.01 (0.73, 12.35)	1.09 2.96 (0.44, 19.99)	-0.06 0.94 (0.24, 3.73)	0.93 2.54 (0.91, 7.09)	-0.37 0.69 (0.14, 3.39)	-1.98 0.14* (0.03, 0.66)
Random Effects (variance)								
Between schools	0.84	0.42	1.15	0.89	1.35	0.91	2.96	3.14
Within persons								
Initial Status	16.05	14.92	23.41	17.72	24.45	18.01	14.45	32.49
Rate of change	0.18*	0.17*	0.26*	0.15*	0.28	0.19*	0.21	0.52
Number of observations	12,162	10,296	10,470	9,728	8,879	12,162	3,465	3,465
Number of individuals	3,071	2,601	2,643	2,457	2,243	3,071	874	874
Number of schools	132	132	132	132	132	132	129	129

Abbreviations: OR (Odds Ratio), CI (Confidence Interval), CM (Child Maltreatment), CWS (Child Welfare Services), NH (non-Hispanic), * p<0.05; † p<0.01; ‡ p<0.001

^a Coefficients and odds ratios based on weighted data. All models adjusted for age, race, family structure, parental alcoholism, parental education, and poverty status.

§ Due to small numbers, child sexual abuse among males was evaluated as a dichotomous variable: 0 = no use, 1 = at least once over the past 30 days

Table 3.9. Multilevel models for change by maltreatment and child welfare services involvement on past 30-day other substance use over time among females

	Past 30 Day Other Substance Use ^a															
	Any CM		Physical Neglect		Emotional Abuse		Physical Abuse		Sexual Abuse		Poly-victimization		CWS Investigation		Removed	
	b	OR (95% CI)	b	OR (95% CI)	b	OR (95% CI)	b	OR (95% CI)	b	OR (95% CI)	b	OR (95% CI)	b	OR (95% CI)	b	OR (95% CI)
Fixed effects																
Maltreatment	0.21	1.24 (0.35, 4.39)	0.50	1.65 (0.23, 12.04)	-0.17	0.85 (0.17, 4.21)	-0.27	0.76 (0.10, 5.92)	0.82	2.27 (0.39, 13.13)			1.97	7.16* (1.20, 42.81)	4.60	99.84† (4.52, 2204.06)
1 type												-0.09	0.91 (0.34, 2.47)			
2 types												0.71	2.04 (0.34, 12.28)			
3-4 types												-0.74	0.48 (0.07, 3.32)			
Rate of change																
Age	-0.02	0.98 (0.75, 1.28)	-0.12	0.89 (0.73, 1.09)	-0.01	0.99 (0.74, 1.33)	-0.08	0.92 (0.72, 1.18)	0.04	1.04 (0.82, 1.31)	-0.01	0.99 (0.78, 1.25)	0.29	1.33 (0.97, 1.84)	0.08	1.09 (0.82, 1.45)
Age*CM	0.08	1.08 (0.73, 1.59)	0.07	1.07 (0.50, 2.29)	0.21	1.24 (0.77, 2.01)	0.37	1.45 (0.72, 2.94)	-0.16	0.85 (0.57, 1.28)	0.10	1.10 (0.83, 1.46)	-0.37	0.69 (0.44, 1.08)	-0.79	0.45 (0.18, 1.11)
Quadratic Curve																
Age ²	-0.02	0.98† (0.97, 1.00)	-0.01	0.99* (0.97, 1.00)	-0.02	0.98† (0.97, 0.99)	-0.02	0.98† (0.97, 0.99)	-0.02	0.98‡ (0.97, 0.99)	-0.01	0.99† (0.97, 1.00)	-0.02	0.98 (0.96, 1.00)	-0.02	0.98 (0.97, 1.00)
Age ² *CM	-0.00	1.00 (0.97, 1.02)	0.00	1.00 (0.95, 1.04)	-0.01	0.99 (0.96, 1.02)	-0.02	0.98 (0.94, 1.02)	0.01	1.01 (0.99, 1.03)	-0.01	0.99 (0.98, 1.01)	0.02	1.02 (1.00, 1.04)	0.04	1.04 (0.99, 1.08)
Race (referent – NH Caucasian)																
African American	-1.50	0.22‡ (0.12, 0.42)	1.72	0.18‡ (0.09, 0.35)	-1.36	0.26† (0.11, 0.58)	-1.56	0.21‡ (0.10, 0.44)	-1.38	0.25‡ (0.12, 0.51)	-1.55	0.21‡ (0.11, 0.42)	-1.88	0.15‡ (0.06, 0.40)	-1.73	0.18‡ (0.08, 0.41)
Hispanic	-0.13	0.88 (0.40, 1.92)	0.43	1.53 (0.83, 2.84)	-0.33	0.72 (0.29, 1.81)	-0.01	0.99 (0.55, 1.78)	0.08	1.08 (0.58, 2.02)	-0.25	0.78 (0.40, 1.53)	-0.25	0.78 (0.36, 1.72)	-0.52	0.59 (0.29, 1.22)
Other	-0.16	0.85 (0.52, 1.39)	0.49	0.61 (0.33, 1.14)	-0.01	0.99 (0.58, 1.71)	-0.33	0.72 (0.36, 1.44)	-0.64	0.53* (0.30, 0.95)	-0.19	0.83 (0.51, 1.36)	-0.01	0.99 (0.52, 1.91)	0.07	1.07 (0.55, 2.08)
Family structure (referent – two biological parents)																
Two parents, other	-0.04	0.97 (0.57, 1.65)	0.16	0.86 (0.48, 1.51)	0.10	1.11 (0.62, 1.97)	-0.20	0.82 (0.45, 1.52)	-0.26	0.77 (0.40, 1.48)	-0.13	0.88 (0.52, 1.46)	-0.15	0.86 (0.51, 1.47)	-0.11	0.99 (0.51, 1.58)
Single parent	0.30	1.35 (0.82, 2.22)	0.01	0.99 (0.55, 1.79)	0.43	1.54 (0.97, 2.44)	-0.09	0.91 (0.51, 1.65)	-0.13	0.88 (0.51, 1.53)	0.28	1.32 (0.83, 2.11)	0.80	2.22† (1.31, 3.75)	0.87	2.40† (1.33, 4.33)
Other	1.12	3.05	1.50	4.47†	1.38	3.97* (1.38, 11.39)	1.61	5.01†	1.60	4.98* (1.46, 16.97)	1.08	2.94* (1.04, 8.29)	0.08	1.09	-0.18	0.84

Parental alcoholism	-0.47	(0.82, 11.35)	0.63	(0.32, 1.21)	-	0.64	(0.20, 2.01)	-0.55	0.58	(0.28, 1.17)	-0.34	0.71	(1.76, 14.25)	(0.31, 1.63)	-0.42	0.66	(0.27, 1.63)	-0.47	0.62	(0.33, 1.17)	-0.73	0.48*	(0.26, 0.90)	-0.69	0.50*	(0.28, 0.88)		
Parental education (referent – college or more)																												
Less than high school	0.11	1.11	(0.61, 2.04)	0.67	-	0.51*	(0.27, 0.99)	-0.07	0.93	(0.48, 1.81)	-0.37	0.69	(0.29, 1.64)	(0.29, 1.64)	-1.25	0.29†	(0.12, 0.67)	-0.10	0.91	(0.50, 1.64)	0.76	2.14*	(1.05, 4.33)	1.22	3.38†	(1.65, 6.93)		
High school	-0.03	0.97	(0.61, 1.56)	0.34	-	0.71	(0.40, 1.24)	-0.01	0.99	(0.60, 1.63)	0.00	1.00	(0.55, 1.83)	(0.55, 1.83)	-0.34	0.71	(0.42, 1.19)	-0.14	0.87	(0.54, 1.42)	0.31	1.36	(0.77, 2.40)	0.54	1.72	(0.83, 3.56)		
Some college	0.22	1.25	(0.75, 2.08)	0.16	1.17	(0.67, 2.06)	0.26	1.29	(0.74, 2.25)	0.37	1.45	(0.82, 2.56)	(0.82, 2.56)	0.37	1.45	(0.82, 2.58)	0.21	1.24	(0.76, 2.03)	-0.25	0.78	(0.46, 1.30)	0.08	1.08	(0.58, 1.99)			
Poverty status	0.16	1.17	(0.55, 2.50)	0.26	1.29	(0.66, 2.56)	-0.04	0.96	(0.41, 2.27)	0.22	1.24	(0.59, 2.62)	(0.59, 2.62)	0.13	1.14	(0.50, 2.63)	0.07	1.07	(0.53, 2.14)	-0.37	0.69	(0.36, 1.34)	-0.49	0.61	(0.33, 1.13)			
Periods																												
Wave II	0.25	1.29	(0.68, 2.45)	0.34	1.40	(0.65, 3.05)	0.36	1.44	(0.74, 2.79)	0.34	1.41	(0.66, 3.00)	(0.66, 3.00)	0.36	1.44	(0.65, 3.16)	0.23	1.26	(0.66, 2.38)	-0.31	0.73	(0.45, 1.20)	-0.12	0.89	(0.53, 1.48)			
Wave III	1.55	4.71‡	(2.01, 11.05)	1.92	6.80	(2.33, 19.85)	1.59	4.90‡	(2.13, 11.27)	1.67	5.30†	(2.05, 13.69)	(2.05, 13.69)	1.10	2.99*	(1.22, 7.31)	1.38	3.96‡	(2.08, 7.53)	0.72	2.06	(0.73, 5.81)	1.85	6.35†	(1.81, 22.25)			
Wave IV	3.53	34.23†	(4.34, 270.18)	4.36	78.29	(3.46, 1769.86)	3.79	44.15‡	(5.46, 357.03)	4.10	60.44†	(4.65, 785.94)	(4.65, 785.94)	3.02	20.56*	(1.45, 291.59)	3.25	25.75†	(3.90, 170.00)	0.95	2.59	(0.56, 12.04)	2.98	19.73†	(3.40, 114.49)			
Random Effects (variance)																												
Between schools	0.29		0.48		0.38		0.65		0.57		0.38		1.00		1.11													
Within persons																												
Initial Status	3.36		2.53		3.44		2.14		2.54		3.06		3.67		3.48													
Rate of change	0.02*		0.02†		0.03*		0.02†		0.02†		0.04*		0.04*		0.04*													
Number of observations	14,399		11,581		13,054		11,451		11,171		14,399		3,931		3,931													
Number of individuals	3,625		2,916		3,284		2,882		2,813		3,625		991		991													
Number of schools	131		131		131		131		131		131		131		129		129											

Abbreviations: OR (Odds Ratio), CI (Confidence Interval), CM (Child Maltreatment), CWS (Child Welfare Services), NH (non-Hispanic), * p<0.05; † p<0.01; ‡ p<0.001

^a Coefficients and odds ratios based on weighted data. All models adjusted for age, race, family structure, parental alcoholism, parental education, and poverty status.

Figure 3.5. Developmental Trajectories of Predicted Probabilities of Past 30-Day Other Substance Use among Males: Any Maltreatment (CM), Physical Neglect (PN), Emotional Abuse (EA), Sexual Abuse (SA), and Poly-Victimization among Males.

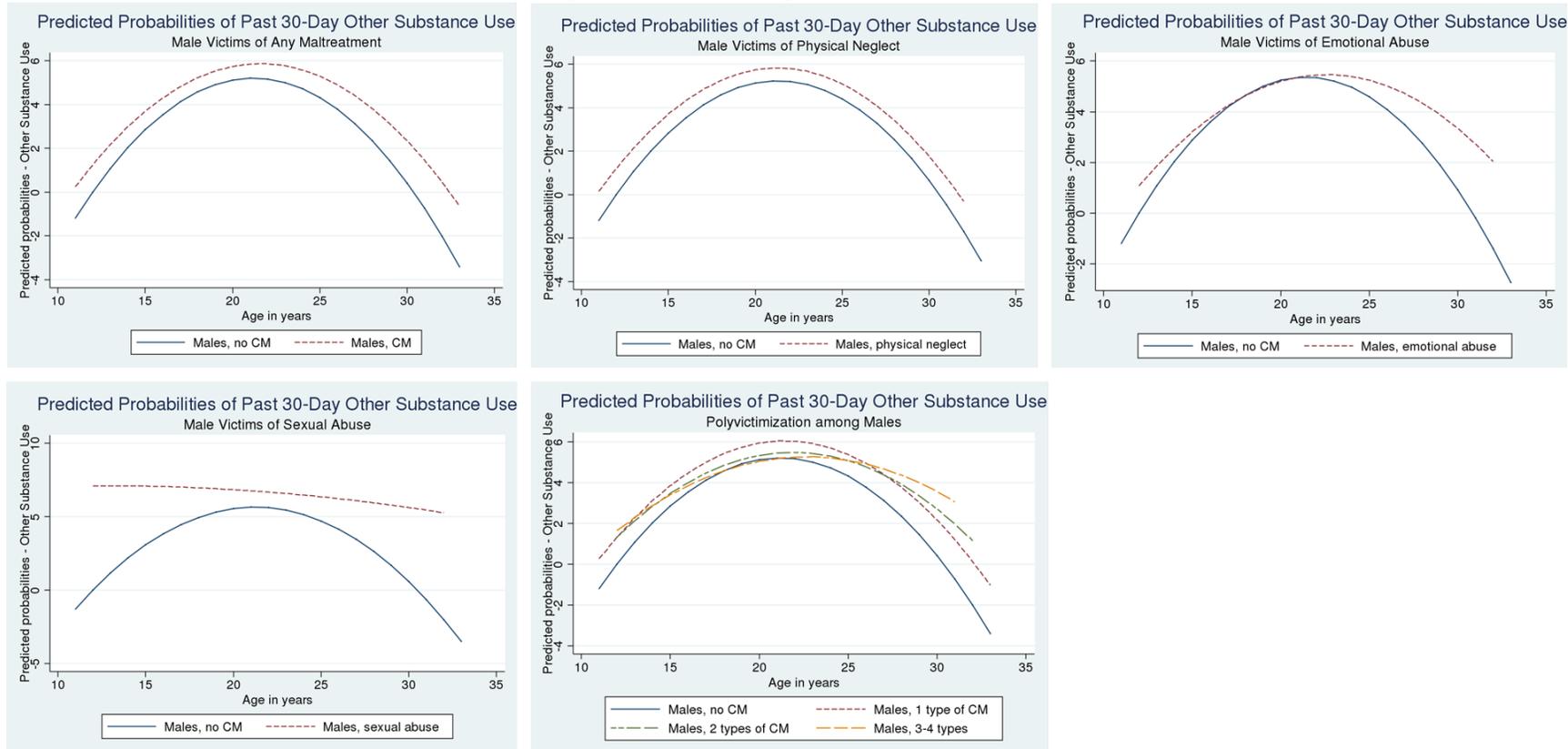
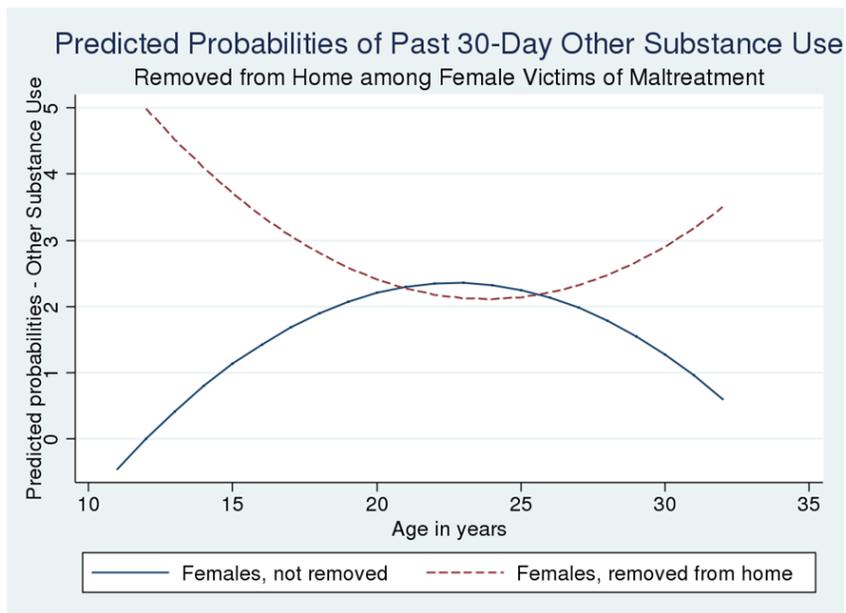
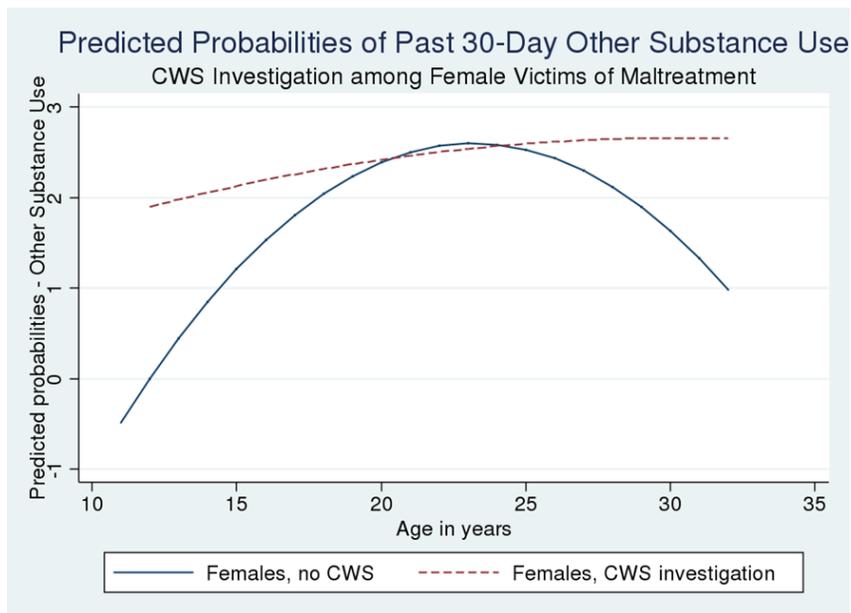


Figure 3.6. Developmental Trajectories of Predicted Probabilities of Past 30-Day Other Substance Use among Females: Child Welfare Services (CWS) Investigation and Removal from the Home by CWS.



CHAPTER 4. CONCLUSIONS

Overview of Findings

This dissertation had two main goals. First, we investigated the long-term impact of child maltreatment and involvement of child welfare services (CWS) on alcohol, marijuana and other substance use in young adulthood. Next we examined differences between males and females on the effect of child maltreatment and CWS involvement on patterns of alcohol, marijuana and other substance use from adolescence into young adulthood.

Findings on the relationship between maltreatment and CWS involvement on alcohol, marijuana, and other substance use in young adulthood (Chapter 2) show that experiences of maltreatment and CWS involvement influence alcohol and substance use. There was a statistically significant relationship between maltreatment and monthly alcohol use among victims of poly-victimization. Also, gender differences by the levels of use and types of substances used in adulthood were observed. More specifically, female victims of poly-victimization consumed more alcohol per month than non-victims, but male victims of poly-victimization consumed less than non-victims of maltreatment. Patterns were more similar between the sexes for marijuana and other substance use. Females had a higher odds of using marijuana at higher levels if they were victims of any type of maltreatment, emotional abuse, physical abuse and two types of maltreatment. For males, the odds of using marijuana at higher levels was increased for victims of any maltreatment, emotional abuse, physical abuse, and victims of two types of maltreatment. Both males and females who were victims of physical neglect and one type of maltreatment had higher odds of using marijuana more frequently.

Similar to the findings for marijuana use, victims of two types of maltreatment and victims with a CWS investigation had higher odds of using other substances at higher levels, but these relationships were not modified by gender. Given these findings that self-reported child maltreatment is associated with alcohol and substance use in young adulthood, in subsequent analyses, we explored the effect of maltreatment on patterns of use starting in adolescence and into young adulthood.

In Chapter 3, we examined the association between self-reported childhood maltreatment victimization and involvement of child welfare on trajectories of alcohol, marijuana, and other substance use from adolescence into young adulthood. Results from these analyses show that overall, maltreatment is associated with higher initial levels of alcohol use and higher initial odds of using marijuana and other substances at higher levels for both males and females.

Developmental trajectories for all participants revealed patterns of increasing use of alcohol, marijuana, and other substances into late adolescence and emerging adulthood (18-26 years of age). Thereafter, a gradual decrease in use was observed as participants aged into young adulthood (24-32 years of age); although some differences by maltreatment or CWS status in the use of alcohol, marijuana, and other substances persisted into adulthood.

Males and females showed differences in the type of substance used according to the type of maltreatment or CWS experiences. Males showed consistent vulnerability to physical neglect for alcohol, marijuana, and other substance use, while there were associations between experiencing different types of maltreatment and increased odds of using marijuana and other substance use at higher levels. Because of the small number of observations, the association with sexual abuse and other substance use among males should be interpreted with caution. For females, individual types of maltreatment influence patterns of alcohol and marijuana use but not

other substance use. However, both males and females showed exposure-response relationships with increasing levels of poly-victimization. Among females, experiencing poly-victimization was associated with alcohol and marijuana use, and among males, experiencing poly-victimization was associated with marijuana and other substance use. Female victims appeared to be particularly vulnerable to using substances at higher levels if they were also involved with CWS, both investigations and removal from the home. Because of the small number of observations, the association with removal from the home and other substance use among females should be interpreted with caution.

The results from both aims (Chapters 2 and 3) show that victims of self-reported maltreatment and victims involved with CWS use alcohol and substances at higher levels than non-victims and victims not involved with CWS, respectively, in adolescence and adulthood. Both studies also show that male and female victims of maltreatment tend to use substances differently, and that the experiences of different types of maltreatment influence the type of substance used.

It is important to recognize that the aims of this dissertation measured alcohol as an index variable to measure average monthly consumption, and marijuana and other substance use were ordinal variables, focusing on increasing levels of use. These measures allowed for an investigation of the use of substances potentially before they become problematic or develop into substance use disorders. Findings from Aim 2 show that victims of maltreatment have higher initial levels of alcohol and substance use than non-victims, and this difference can persist into young adulthood. Thus, substance abuse prevention efforts will be more effective when provided before adolescence. On the other hand, the findings from Aim 1 show that maltreatment victims who may not have been identified by CWS would benefit from treatment services even in

adulthood. The average age of treatment admission to facilities that receive state or federal funding for all substances is 35 years (115); thus, young adulthood may also be an ideal time to focus health education and treatment outreach efforts to reach this population in order to facilitate treatment for problematic substance use. Understanding whether and when victims of maltreatment are using substances at higher levels than non-victims can inform intervention and prevention efforts to identify crucial times or ages at which to provide services to attenuate alcohol or substance use.

Use of the Add Health Dataset to Study the Impact of Child Maltreatment and CWS Involvement on Alcohol, Marijuana, and Other Substance Use

Most of the research on the relationship between child maltreatment and alcohol or substance use utilizes clinical samples or administrative data from child welfare agencies. These data sources limit the ability to examine the impact of the full scale of child maltreatment on alcohol and substance use in the general population. This dissertation used the Add Health dataset, which is a nationally representative sample of adolescents who were followed over time into young adulthood. The Add Health study gathered multiple measures of self-reported experiences of child maltreatment victimization and CWS involvement. Additionally, the Add Health study consistently captured alcohol, marijuana and other substance use over four time points, which allows for the examination of patterns of alcohol and substance use over time.

The primary limitations of using the Add Health dataset to investigate the relationship between maltreatment and alcohol and substance use include the reliance on retrospective self-reports of childhood maltreatment victimization and the age of participants at the beginning of the study, which succeeds onset of alcohol or substance use for some study participants. Even though retrospective self-reports of childhood maltreatment tend to be a better predictor of

prevalence of maltreatment than CWS reports, previous studies have found that self-reported childhood physical abuse (94) and sexual abuse (95) tend to be underreported (96), which may be due to not remembering the abuse or not wanting to report it. Due to the tendency of maltreatment victims to underreport their experiences, comparisons based on this measure are likely to create underestimates of the impact of maltreatment on alcohol or substance use since some actual victims of maltreatment are considered non-victims in the analyses.

Additionally, the Add Health study initially selected participants from middle and high schools; thus, the youngest participants were 12 years of age. Even at this age, some participants were already using substances. Consequently, this study was unable to completely track patterns of use from age of onset into young adulthood. Having this additional information could better inform substance abuse prevention efforts about the ideal age to provide prevention efforts for both victims and non-victims of maltreatment.

Concordance between the Findings, Theories and Existing Literature

Two theories have informed the aims of this dissertation research: coping theory and the life course perspective. The concept of coping is understood as a mechanism for the management of demands that stress or overwhelm the person's existing resources (48-51). In terms of understanding the relationship between childhood maltreatment and substance use, coping theory posits that adolescents and young adults would use substances as a form of coping with the stress and trauma related to the maltreatment experience or that the use of substances serve as a way to avoid any unwanted emotions or reactions to the traumatic experience of maltreatment (52). This study found, after controlling for relevant sociodemographic and familial factors, maltreatment was associated with higher levels of alcohol, marijuana, and other substance use. This observation indicates that substances were potentially used as a form of coping with the

psychological aftermath of maltreatment. Similarly, other studies have shown that females are typically motivated to use alcohol as a coping mechanism (112, 113). This trend was found among female victims of maltreatment, and an exposure-response relationship was found among victims of poly-victimization, where in adolescence victims of two and three or four types of maltreatment used alcohol at higher levels initially, and among adults, female victims of two types of maltreatment used alcohol at higher levels than non-victims.

The life course perspective helps to explain how maltreatment experienced in childhood continues to affect health outcomes into adolescence and adulthood. Founded in developmental, social, and health sciences, the life course perspective postulates that experiences early in life, such as child maltreatment, can affect future outcomes through accumulation and interaction with other experiences or sequences of experiences (57). The findings from this dissertation demonstrate that maltreatment experienced in childhood impacts use of alcohol, marijuana and other substances in adolescence. For many maltreatment experiences, using alcohol and substances at higher levels persists into adulthood. Thus, this research provides empirical support for the need for interventions to prevent child maltreatment or mitigate the impact of child maltreatment on alcohol and substance use in adolescence in order to prevent problematic substance use in later adolescence and adulthood.

The results of this research support findings from previous studies examining the relationship between maltreatment and alcohol or substance use. In the first analysis (Chapter 2) we conducted a retrospective cohort study examining the impact of child maltreatment and CWS involvement on alcohol, marijuana, and other substance use in young adulthood. For the statistically significant associations, we found a larger effect of maltreatment on alcohol or marijuana use in young adulthood for females, compared to males. These findings align with the

self-medication theory for the relationship between maltreatment and alcohol and substance use and the previous research on females' motivation for alcohol and substance use (112, 113).

When examining patterns of use from adolescence into young adulthood for Aim 2 (Chapter 3), we continued to observe differences in the impact of child maltreatment and alcohol or substance use by biological sex. We found more associations between types of maltreatment and CWS involvement and alcohol use among females than males, and we saw different associations between marijuana and other substance use by types of maltreatment for males and females. The gender differences found in this study may be related to the differential coping methods used by males and females, in general. Other studies have shown that victims' reactions to child maltreatment experiences as well as strategies used to cope with the abuse or neglect differ by gender. One study that examined the differential impact of child sexual abuse by gender found that female victims showed more distress and self-blame, as well as using withdrawal coping strategies and trying to forget their experiences as compared to male victims (116). Another study revealed family conflict was associated with increased odds of having a substance use disorder among female adolescents but not males, and this association was likely related to the propensity to use avoidant coping styles among females (117).

The findings from this study confirm previous results that have found effects of maltreatment on substance use among females in adolescence or emerging adulthood (74) and in middle adulthood (44). These effects were not found for males in these studies. On the other hand, our findings from the second aim indicate that males who are victims of physical neglect or sexual abuse may be more susceptible to using alcohol or substances than non-victims of maltreatment. Similar to the findings from this dissertation research, another longitudinal study found that substance use in adolescence increased significantly for male victims compared to

female victims of child sexual abuse (118), but the study did not find an association between neglect and increased substance use among males, as was found in this dissertation research.

These differences in associations between maltreatment and alcohol, marijuana and other substance use indicate that males and females respond differently to specific types of maltreatment, and their reasons for using substances and type of specific substances may also vary. Our findings confirm previous analyses that have found associations with maltreatment and alcohol or substance use and use disorders among victims of CWS-identified maltreatment in adolescence (109, 119) and adulthood (120), among self-reported victims of maltreatment in substance abuse treatment populations (121), and among nationally representative samples for alcohol or substance use in adolescence (27, 74), illicit drug use and drug-related problems in adulthood (47, 122), and binge drinking in adolescence (45, 89) and into young adulthood (46). Differences between the findings from this dissertation research and other studies may be due to a number of factors.

First, this dissertation utilized a nationally representative sample over multiple time points from adolescence into young adulthood. Most studies examining the relationship between maltreatment and alcohol or substance use measure the outcome at only one point in time or they use non-representative samples, such as clinic samples or region-specific samples. Studies that have used longitudinal measures of alcohol or substance use typically use measures of maltreatment that rely on official records or identification by CWS, which results in overlooking a large proportion of maltreatment victims identified through self-report of victimization. Finally no other known study has measured levels of alcohol and substance use, comparing self-reported victims of specific types of maltreatment and poly-victimization, as well as comparing self-reported victims of maltreatment who have or have not received some form of CWS

involvement. Despite these differences, the findings from this dissertation research confirm previous findings and contribute to our understanding of the impact of maltreatment and CWS involvement on patterns of alcohol or substance use for males and females in adolescence and adulthood.

Implications

This study has implications for future research and practice development. This is the first known study to examine the impact of self-reported child maltreatment and CWS involvement on alcohol, marijuana and other substance use from adolescence into young adulthood, using a nationally representative sample. Previous studies have determined child maltreatment is associated with alcohol or substance use, and our findings confirm their results.

Given the findings from this study and previous research, future studies should examine patterns of alcohol and substance use among a nationally representative sample starting earlier in childhood in order to gather information on age on onset of alcohol and substance use. Studies have demonstrated that early age of onset of alcohol and substance use is associated with heavier use or substance use disorders in adolescence and adulthood (123, 124). A nationally representative study that measures patterns of alcohol and substance use earlier in life would help confirm these findings and help determine when and how to ideally target substance use prevention efforts that incorporate information on the impact of maltreatment and related traumas. In addition, research that compares poly-substance use among victims and non-victims in a nationally representative sample would be pertinent to designing effective interventions for this population. Thirty five percent of admissions to state- or federally-funded substance abuse treatment facilities were for persons using both alcohol and another substance (115); and poly-substance is associated with physical and mental health consequences (125, 126). This

dissertation research was unable to account for simultaneous or concurrent poly-substance use; thus, future research should investigate this relationship to further understand the full impact of child maltreatment on health outcomes. Finally, future research that investigates the relationship between child maltreatment and alcohol or substance use should consider differences by biological sex. Findings from this dissertation research and some prior studies (44, 74, 106, 118) have found differences by the type of maltreatment experienced or CWS involvement and the substance used, which suggests that biological sex is an important factor to consider when examining this relationship.

Moreover, findings from this research support the need for modifications to prevention and intervention efforts related to substance use. While prevention of child maltreatment would help prevent or mitigate a number of health and mental health consequences and illnesses, among those children who have been maltreated, it will be important to provide secondary prevention in which children receive interventions designed to reduce the likelihood of developing chronic illnesses, such as substance use disorders. Estimates that rely on CWS reports indicate that only 1% of children in the United States were maltreated in 2012 (25), yet self-reported estimates from this study identified over 25% of the population as having experienced at least one instance of maltreatment before the age of 12. Accordingly, substance use prevention and intervention efforts should consider the role of maltreatment and related trauma on substance use in the general population. Currently, persons not identified by community professionals or CWS as maltreated may still feel the effect of such maltreatment, which may result in higher levels of alcohol and substance use, but they do not receive any benefit of service provision provided through CWS that identified victims may receive. Additionally, findings from this study show that female victims of maltreatment who are in CWS

care have a particular vulnerability to using alcohol and substances at higher levels than victims not involved with CWS. This confirms previous findings that female youths in foster care have an increased risk for engaging in substance abuse behaviors (127). Therefore, CWS agencies should thoroughly screen for alcohol and substance use among this population and seek substance use treatment that incorporates information on trauma and coping methods specific to the needs of female maltreatment victims. Finally, findings from this study support the integration of trauma-informed care with substance abuse treatment across adolescence and young adulthood for both males and females. Given the high prevalence of child maltreatment in the general population and its lasting effects up through young adulthood, treatment services should continue to consider the impact that maltreatment and related trauma have on associated alcohol and substance use.

APPENDIX A GRADUATED FREQUENCY INDEX – ALCOHOL USE

The index measure is based on the following three variables:

- (1) Frequency of alcohol use was assessed by asking participants who reported any lifetime alcohol use about use over the past 12 months. Responses were measured on a 7-point Likert scale from 0 = none to 6 = every day or almost every day;
- (2) Quantity of alcohol typically consumed was assessed by asking participants who reported any alcohol use over the past 12 months about their typical amount of use. Responses ranged from one to 18 drinks per drinking session; and
- (3) Frequency of heavy drinking was assessed by asking study participants who reported any alcohol use over the past 12 months about the frequency of binge drinking episodes, at least five consecutive drinks for males and at least four drinks in a row for females, which is consistent with recommendations from the National Institute of Alcohol Abuse and Alcoholism (70, 71).

To create the index measure, heavy quantity drinking, five drinks in a row for men and four for women, was first separated out from the typical use reported by study participants. Then the frequency of alcohol use over the past 12 months was multiplied by the quantity of alcohol typically consumed per occasion over the past 12 months. Finally, the frequency of heavy quantity drinking was added back to the adjusted measure of quantity-frequency measure of alcohol use. However, for those participants who reported that their typical quantity of use was heavy quantity drinking, the final average daily alcohol consumption equation did not separate the heavy quantity drinking factors from the typical use. These respondents were considered heavy drinkers who were not excluding episodic binge drinking from their report of average use (68). The final score is then divided by 12 to obtain monthly alcohol use. A higher score on the alcohol GF index indicates higher average monthly alcohol consumption.

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