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The Relationships of Childhood Trauma and Adulthood Prescription Pain Reliever Misuse and Injection Drug Use

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Abstract

Background—We examined associations between childhood trauma and adulthood prescription pain reliever misuse (PPRM) and injection drug use (IDU) in a nationally-representative U.S. sample to further understanding of factors associated with these epidemics.

Methods—National Longitudinal Study of Adolescent to Adult Health data (N=12,288) yielded nine childhood traumas: neglect; emotional, physical, sexual abuse; parental incarceration and binge drinking; witnessed, threatened with, and experienced violence. We estimated adjusted odds

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Conflict of Interest

The authors declare no conflict of interest.

Contributors

All authors are responsible for this reported research. K. Quinn conceptualized and designed the study, conducted the analyses, and drafted the manuscript. L. Boone, J. Scheidell, S. McGorray, N. Beharie and M. Khan helped conceptualize and design the study and interpret results. P. Mateu-Gelabert, L. Cottler, and M. Khan critically reviewed the manuscript. All authors reviewed and approved the submitted manuscript.

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ratios (AOR) and 95% confidence intervals for the association of each trauma and cumulative trauma and drug initiation in emerging and later adulthood.

Results—Outcome prevalences were 20% (PPRM) and 1% (IDU) in emerging adulthood and 10% PPRM in adulthood. We observed dose-response relationships that varied across outcomes. Cumulative trauma (referent=none) was associated with 34–79% greater odds of PPRM (emerging adulthood) across one to five+ trauma categories. The gradient was most consistent and associations strongest for adulthood PPRM: one trauma AOR=1.46(1.12, 1.91); two AOR=1.71(1.23, 2.36); three AOR=2.16(1.43, 2.36); four AOR=2.70(1.42, 5.62); five+ AOR=3.09(1.52, 6.30). Dose-response was less consistent for IDU, but 4 and 5+ traumas were associated with approximately seven and five times the odds of IDU. Neglect, emotional abuse, and parental incarceration and binge drinking were associated with 25–55% increased odds of PPRM. Sexual abuse and witnessed violence were associated with nearly 3 and 5 times the odds of IDU.

Conclusions—Associations between childhood trauma and PPRM/IDU highlight the need for trauma-informed interventions for drug users and early trauma screening and treatment for prevention of drug misuse over the life course.

Keywords

prescription pain relievers; injection drug use; childhood trauma; trauma-informed interventions

1. INTRODUCTION

Prescription pain reliever misuse (PPRM) is a serious public health problem in the United States that has contributed to a dramatic increase in overdoses and an overdose mortality rate that quadrupled from 1999–2008 (Paulozzi et al., 2011). Injection drug use (IDU) prevalence, estimated to be 2.6% in the United States, is alarming not only because of overdose risk but because IDU facilitates transmission of human immunodeficiency virus (HIV) and hepatitis C virus (HCV) (Lansky et al., 2014). Gender disparities are emerging: women are prescribed PPR at higher rates, higher doses, and for longer periods of time than men (Campbell et al., 2010; Williams et al., 2008). In 2010, PPR were involved in 71% of prescription drug deaths and 10% of suicides among women, contributing to a PPR mortality rate that increased by 415% (and 265% for men) from 1999–2010 (Centers for Disease Control and Prevention, 2013). While qualitative and quantitative data suggest, but have not thus far fully elucidated, a pathway from PPRM to IDU, a strong association is evident (Lankenau et al., 2012; Mars et al., 2014; Mateu-Gelabert et al., 2015; Muhuri et al., 2013; Young and Havens, 2012).

Childhood trauma is associated with substance abuse over the life course (Briere et al.; 2008, Dube et al., 2003; Felitti et al., 1998; Huang et al., 2011; Khoury et al., 2010; Kilpatrick et al., 2000; Widom et al., 2006). Limited research links some traumatic events in childhood to non-medical use of prescription drugs (Khoury et al., 2010; Lawson et al., 2013; McCauley et al., 2010), and IDU has been linked to sexual (Ompad et al., 2005; Roy et al., 2003) and physical abuse (Kerr et al.; 2009). A cumulative effect of trauma that extends past childhood has been documented (Dube et al., 2003; Felitti et al., 1998; Khoury et al., 2010). The

Adverse Childhood Events (ACE) study has made valuable contributions to understanding childhood trauma by examining ten distinct categories and documenting their associations with early initiation and lifetime use of illicit drugs (including IDU but not PPRM), and also by demonstrating a strong gradient for the relationship between cumulative trauma and drug-related outcomes from adolescence into adulthood (Dube et al., 2003). It is critical to better understand trauma's role in PPRM specifically given its high potential for addiction and strong correlation with heroin use and injection. Gender differences in the association of childhood trauma and drug misuse have not been clarified (Cottler et al., 2001; Danielson et al.; 2009, Khoury et al.; 2010, Widom et al.; 2006) and deserve urgent attention given the emerging PPR epidemic among women.

This analysis explores the hypothesis that childhood trauma is associated with adulthood PPRM and IDU. We use data from The National Longitudinal Study of Adolescent to Adult Health (Add Health) described at http://www.cpc.unc.edu/projects/addhealth (accessed May 16, 2016). We advance the scholarship on trauma in several ways: 1) Our main exposures are informed by a comprehensive perspective of childhood trauma that includes nine types; 2) In addition to identifying the main effect of each trauma by controlling for all others, we investigate dose-response relationships using a cumulative trauma score; 3) We examine relationships in emerging adulthood and adulthood, which is important since stress sensitivity resulting from trauma may vary over time and PPRM and IDU may emerge and peak during different stages of life; 4) We explore whether the associations of trauma and drug use differ by gender. Results will inform the development and timing of trauma-informed interventions with regard to providers' prescribing patterns; monitoring of PPR use and associated morbidity and mortality; screening and treatment for target populations such as youth, women of childbearing age, those with pain, and for mental health issues; and ultimately, prevention of misuse, addiction, and mortality.

2. MATERIAL AND METHODS

2.1. Study population and design

The Institutional Review Boards at the University of Florida and NYU Langone School of Medicine approved this study. We analyzed Add Health survey data, a nationally-representative, stratified, random sample of 20,745 U.S. middle school and high school students, including Waves I (adolescence, 11–21 years), III (emerging adulthood, 18–28 years), and IV (adulthood, 24–34 years). Analyses included 12,228 participants in the restricted-use dataset who had sample weights at each Wave. We used a cross-sectional study design to characterize the relationships between childhood traumas and onset of: 1) PPRM in emerging adulthood; 2) PPRM in adulthood; and 3) IDU in emerging adulthood.

2.2. Analytic strategy

Survey procedures in SAS 9.4 (SAS Institute Inc., Cary, North Carolina, USA) accounted for the complex survey design. We conducted univariable and bivariable analyses to estimate weighted prevalence of the individual traumas, trauma scores, sociodemographic covariates, and three drug use outcomes in the entire sample and within gender. Logistic regression yielded estimates for unadjusted (OR) and adjusted (AOR) odds ratios and 95% confidence

intervals (CIs) for associations of covariates and outcomes and for each of nine traumas and the number of traumas experienced and outcomes. We evaluated the predictive importance of each trauma exposure by the magnitude of the OR and the width of the CI. We included interaction terms for gender and trauma exposures to assess gender modification; when the p-value for an interaction term coefficient was less than 0.10 we presented the gender-specific estimates in table footnotes.

2.2.1. Trauma exposures

2.2.1.1. Individual traumas: Using Waves I, III and IV data, we created nine dichotomous (referent=no trauma) measures of self-reported (except parent-reported binge drinking) traumatic experiences occurring before age 18, defined as: Neglect (left alone when adult should have been present and/or basic needs unmet ≥ six times); emotional abuse (adult caregiver said hurtful things feelings or made child feel unloved ≥ six times); physical abuse (slapped, hit, kicked, or thrown by adult caregiver ≥ six times); sexual abuse (adult caregiver touched child or forced the child to touch him/her in sexual way); parental incarceration (parent/parent figure spent time in jail or prison); witnessed violence (saw someone shot or stabbed); threatened with violence (knife or gun on pulled on child); experienced violence (child shot or cut/stabbed); and parental binge drinking (≥five drinks on one occasion in the past month). Estimates of the effect of each individual trauma were adjusted for each other trauma to get the independent effect.

2.2.1.2. Cumulative trauma: We summed nine dichotomous traumas to create an ordinal variable representing 1, 2, 3, 4, and 5–9 total traumas (referent=zero). Analyses included only cases with no missing data for all nine individual traumas (n=9,569).

2.2.2. Drug misuse outcomes—We used Waves III and IV self-report data to create three dichotomous outcomes reflecting drug misuse (referent=none) among new users, that is, initiates since the previous Wave. Previous users were excluded, yielding different sample sizes for each outcome. Survey questions were not identical across Waves. Outcomes are defined as: 1) PPRM in emerging adulthood (pain killers such as Darvon, Demerol, Percodan or Tylenol with codeine without a doctor's permission since June 1995); 2) PPRM in adulthood, excluding Wave III users (pain killers or opioids such as Vicodin, OxyContin, Percocet, Demerol, Percodan or Tylenol with codeine not prescribed, taken in larger amounts than prescribed, more often than prescribed, for longer periods than prescribed, or taken only for the feeling or the experience they caused); and 3) IDU in emerging adulthood (injected or shot up with a needle any illegal drug such as heroin or cocaine since 1995). Wave I outcomes were not included because PPRM was not included in that survey. Waves I and IV IDU were not included because of very small sample sizes.

2.2.3. Sociodemographic covariates—Adjusted models used self-report data to control for ordinal age, gender (male (referent), female), and race/ethnicity (non-Hispanic white (referent), non-Hispanic black, Hispanic, other) at Wave I; proxy measures of poverty defined as concern about paying bills at Wave I (parent-reported) and Wave III (referent=no); and education at Wave IV (less than high school (referent), high school graduate, some or completed college or vocational training).

3. RESULTS

3.1. Univariable and bivariable descriptives

The majority (65%) of the analytic sample were white, and three-quarters had more than high school education (Table 1). The proxy for poverty was low and similar in childhood and emerging adulthood (17% vs. 14%, respectively), and the sample was equally distributed by gender. Covariates were very similar for males and females with the exception of females having a somewhat higher percentage with post-high school education.

Prevalence of the individual exposures ranged from 5.13% (experienced violence) to 16.37% (emotional abuse; Table 1). Females relative to males had somewhat higher prevalence of emotional abuse (19.37% versus 13.43%) and sexual abuse (9.82% versus 6.68%) while males had nearly double the prevalence of all three violence variables compared to females. Slightly more than one-quarter of the experienced at least one trauma while less than 2% experienced five or more. Cumulative trauma scores were similar across gender.

Approximately one-fifth of the sample initiated PPRM between Waves I and III, with an additional 10% initiating PPRM between Waves III and IV (Table 1). Initiation of IDU in emerging adulthood was low (1.24%). Males had higher odds of all drug use outcomes relative to females (Table 2). Relative to the age group of 11–13 years, the older groups generally had lower odds of PPRM at both time points, but age was not predictive of IDU. Associations of race/ethnicity and outcomes were quite strong. Relative to the non-Hispanic white group, non-Hispanic black race was associated with lower odds of all three outcomes, and Hispanic ethnicity was associated with lower odds of PPRM at both time points. Poverty in adolescence was not an important predictor of any outcome while poverty in emerging adulthood was associated with higher odds of PPRM at both time points.

3.2. Multivariable models

3.2.1. Individual traumas and cumulative trauma and PPRM in emerging adulthood—Neglect and emotional, physical, and sexual abuse were associated with 35–58% increased odds of PPRM in emerging adulthood (Table 3). Adjusted associations weakened somewhat for neglect [AOR=1.35(95% CI:1.10, 1.66)] and emotional abuse [AOR=1.25(95% CI:1.04, 1.51)]. Associations for physical and sexual abuse, though of moderately large magnitude, became null with adjustment: physical abuse AOR=1.27(95% CI:0.99, 1.60) and sexual abuse AOR=1.26(95% CI:0.97, 1.64). Parental incarceration predicted PPRM [OR=1.24(95%CI:1.04,1.47)], though the AOR was null. Parental binge drinking was not independently predictive of PPRM. Witnessed violence was not an independent predictor of PPRM. Threatened with violence and experienced violence were associated with 23% and 37% increased odds of PPRM, respectively, but AORs were null.

In unadjusted and adjusted models, cumulative trauma was strongly associated in a dose-response fashion with emerging adulthood PPRM (Table 4). With adjustment, the increase in odds of PPRM was 34%, 50%, 70%, 217%, and 179% for one, two, three, four, and five or more traumas, respectively. 3.2.2. Individual traumas and cumulative trauma and PPRM in adulthood

Neglect was not predictive of PPRM in unadjusted or adjusted models, while emotional and physical abuse was associated with more than 70% increased odds (Table 3). In adjusted models, the association weakened slightly for emotional abuse [AOR=1.55(95% CI:1.19, 2.02)] and somewhat more for physical abuse [AOR=1.44 (95% CI:0.97, 2.13)]. Sexual abuse was not predictive of adulthood PPRM.

In unadjusted and adjusted models, parental incarceration and binge drinking were moderately associated with PPRM: incarceration AOR=1.39(95% CI:1.01, 1.92) and binge drinking AOR=1.40(95% CI:1.09, 1.80). Witnessed and threatened with violence were not predictive of adulthood PPRM. Experienced violence was associated with nearly 50% increased odds, but the AOR was null.

Cumulative trauma was strongly associated in a dose-response fashion with adulthood PPRM in unadjusted and adjusted models, associations that were even stronger than in emerging adulthood (Table 4). Experiencing one or two traumas was associated with about 50% increased odds of PPRM [one trauma AOR=1.46(95% CI:1.12, 1.91), two traumas AOR=1.71(95% CI:1.23, 2.36)]; three traumas with more than twice the odds [AOR=2.16(95% CI:1.43, 3.26)]; and four or five or more traumas with about three times the odds [four traumas AOR=2.70(95% CI:1.62, 4.52), five+ traumas AOR=3.09(95% CI: 1.52, 6.30)]. 3.2.3. Individual traumas and cumulative trauma and IDU in emerging adulthood

Neglect was not correlated with emerging adulthood IDU. Emotional and physical abuse were associated with nearly twice the odds of IDU, though in adjusted models the associations became null. Sexual abuse was very strongly associated with IDU in unadjusted and adjusted models [AOR=4.77(95% CI:2.44, 9.34)], and we observed marked gender modification. Sexual abuse was a strong predictor of IDU among males [AOR=9.74(95% CI:4.61, 20.58)] but not females [AOR=1.30(95% CI:0.49, 3.44)].

Parental incarceration and binge drinking were not predictive of emerging adulthood IDU. In unadjusted and adjusted models, witnessed violence was associated with almost three times the odds of emerging adulthood IDU [AOR=2.82(95% CI:1.24, 6.44)], but the other two violence traumas were not independent correlates of IDU.

Cumulative trauma was associated in a somewhat dose-response fashion with IDU in unadjusted and adjusted models; however, the relationship was less consistent than with the PPRM outcomes. The one and three trauma groups were not predictive of IDU in adjusted models. The AOR for two traumas and five or more traumas were well over four times the odds of the no trauma group while the four traumas score was of the largest magnitude [AOR=6.49(95% CI:2.56, 16.44)].

4. DISCUSSION

A strong and consistent dose-response relationship emerged for the PPRM drug outcomes when cumulative number of traumas was examined. There is evidence that the cumulative trauma load (Cohen et al., 1995) during stress-sensitive childhood has negative effects on well-being (Kaysen et al.; 2009, Khoury et al., 2010; Neuner et al., 2004; Weber et al.,

2008). Furthermore, easy availability of illicit drugs and experimentation among adolescents in the course of normal developmental processes likely contribute to high prevalence of illicit drug use among adolescents aged 12 to 17 (8.8%) and 18 to 25 year olds (21.5%) (Substance Abuse and Mental Health Services Administration (SAMHSA), 2014). Risk may be higher among youth with a history of acute and chronic stressors for whom resulting psychological stress may influence psychologic and physiologic functioning and behavior (Cohen et al., 1995). The current opioid and IDU epidemics necessitate that evidence-based treatment options, including naloxone for overdose, are accessible to address morbidity and mortality. However, to prevent addiction and drug injection, we must identify upstream determinants of drug initiation and develop strategies to mitigate their influence, including well-timed trauma-informed screening and intervention throughout the life course.

These secondary analyses made novel use of the rich Add Health dataset to advance our understanding of the influence of early life trauma on illicit drug use later in life. We found high prevalence of PPRM in this sample; 28% had ever used by early adulthood, a percentage that could only increase over the life course. Other analyses of Add Health data have documented high prevalence; 16% had misused prescription drugs of any type at Wave IV (Broman et al., 2015; Dollar and Hendrix, 2015). One of these studies documented 13% ever PPRM at Wave IV among the full sample of 15,701 (Dollar and Hendrix, 2015) and noted that higher prevalence of prescription drug use among Add Health respondents relative to the nationally representative National Survey on Drug Use and Health is likely due to Add Health's younger sample. Our lower finding of 10% represents only new PPRM at Wave IV. Differences may also be due to our analytical dataset which included only those with sample weights at all Waves. Nonetheless, both surveys document high prevalence among young adults and pain relievers as the most common prescription drug misused (SAMHSA, 2014). Despite potential measurement issues across data sources, the epidemic is clear. Epidemiologic data coupled with our findings that childhood trauma predicts PPRM underscore not only the public health importance of treatment for drug use but the need to address the reasons why people use opioids non-medically.

When comparing the odds of PPRM across the two time-points, we observed associations of even greater magnitude for adults than for emerging adults. Trauma appears to have a persistent relationship with drug use that may become stronger over time, exacerbating the link between drug use in youth and in later life. Data also indicate that trauma's relationship with drug use can manifest *after* emerging adulthood, a phenomenon that is understudied and poorly understood. Widom et al (1999) did not find that adverse events in childhood predicted lifetime drug abuse and/or dependence in young adulthood (approximate mean age 29 years) but in a subsequent analysis found that those with physical and sexual abuse in childhood were 1.5 times as likely to have past year illicit drug use in middle adulthood (mean age 40 years) as well as use a greater number of drugs and have more drug-related problems relative to those reporting no abuse (Widom et al., 2006). They proposed that abused individuals were less likely to "mature out of substance abuse" and that contextual factors, such as neighborhoods with greater exposure to drugs and other stressors and fewer resources for coping with such challenges, influenced drug use (Widom et al., 2006). Differences were perhaps not observed in early adulthood because rates of substance use are high among younger age groups generally. Future research would make a valuable

contribution by attempting to identify mechanisms that trigger the initiation of PPRM at different stages of adulthood, especially important given recent findings of increasing mortality rates among middle-aged white Americans (Case and Deaton, 2015). Furthermore, examining future waves of Add Health data, ideally including IDU data, may illuminate whether the trauma association persists through the life course.

This analysis advances our knowledge of trauma by including a comprehensive range and investigating cumulative trauma load. Most research focuses on a narrow set of traumas (e.g., sexual abuse and neglect) or on composite categories and does not include non-traditional but potentially influential types (e.g., household dysfunction and parental substance abuse) or control for all traumas to identify the independent effect of each trauma. Broader and deeper consideration of trauma is important since traumatic experiences in childhood appear to be prevalent in the United States (Sacks et al., 2014). Nationally-representative prevalence of children's traumatic experiences is challenging to estimate because data are often obtained from the legal system or in clinical settings and trauma is narrowly defined. At least one trauma (28%) was experienced before 18 years of age in this sample, important to document because of trauma's link to not only substance use but sexual and criminal risk behaviors (Haydon et al., 2011; Kalichman and Simbayi, 2004; Messina and Grella, 2006; Senn et al., 2008). Nonetheless, these data are subject to bias, including child and parent bias due to recall, legal repercussions, social desirability, and subjective perspectives on adversity.

Our analyses documented little modification by gender other than for the associations of sexual abuse with both outcomes in emerging adulthood, which were stronger for males than for females. While research suggests that the psychological impact of trauma of and reactions to trauma may be different for boys and girls (Rasmussen et al., 2004; Reese et al., 2001; Suglia et al., 2008), studies have not clarified gender differences in the association of trauma and drug misuse. Even studies focused on child sexual abuse have inconsistent findings (Dube et al., 2003; Hayatbakhsh et al., 2009; Hyman et al., 2008). Despite slightly higher prevalence of drug use for males compared to females in this sample, overall findings that trauma and drug use are associated for both genders are compelling. We must continue to explore drivers of rising drug use among U.S. women (Centers for Disease Control and Prevention (CDC), 2013). Though medical conditions affecting women, such as higher prevalence of the most common forms of pain and more intense and longer pain duration, may account for some of the gender difference in prescription pain reliever prescribing rates (Fillingim et al., 2009; Unruh, 1996), women face potential complications such as faster progression to dependence (Hernandez-Avila et al., 2004) and higher rate of "doctor shopping" (CDC, 2013) and negative consequences among infants born to and breastfed by women who use prescription pain killers (Broussard et al., 2011; Patrick et al., 2012).

Research documents a strong association between PPRM and IDU (Lankenau et al., 2012; Mateu-Gelabert et al., 2015; Muhuri et al., 2013; Young and Havens, 2012). Our findings add to the limited research linking physical trauma to IDU (Kerr et al., 2009) by documenting IDU's associations with several traumas (particularly strong for sexual abuse) and cumulative trauma load. There is a need to better understand age at initiation of IDU to inform drug treatment programs, specifically, the need to focus on both addiction and

trauma. Furthermore, there is a pressing need for unbiased, longitudinal data that allow us to document not only the correlation of PPRM and IDU but the escalation to IDU. While our IDU outcome is not drug-specific, all injecting behavior is of concern because of increased risk of viral infections such as HIV and Hepatitis and serious bacterial infections (CDC, 2015). Heroin injection, however, is especially risky because it is highly addictive and because most heroin users use other drugs and alcohol which increases overdose risk (CDC, 2015). The percentage of heroin users who were also addicted to prescription pain relievers more than doubled to 45% from 2002–2013 (CDC, 2015).

The cross-sectional design limits our ability to show causation, and changes in the survey questions across Waves pose a challenge to measuring identical outcomes over time. For example, Wave III did not include OxyContin or Vicodin as examples of prescription pain relievers, and Wave IV included more detail about what constitutes misuse. The IDU question gave cocaine and heroin as examples, whereas an opioid-specific question would have been valuable given the emerging epidemic. Descriptive analyses highlighted problems due to recall bias and/or social desirability; more than half of those reporting IDU at Wave III denied ever injecting an illegal drug at Wave IV, and 70% of those reporting PPRM at Wave III denied it at Wave IV. While our analyses were not directly affected by this issue since our outcomes were incident drug use at each Wave, we acknowledge the challenges in using self-report data about sensitive topics. Very low prevalence of IDU may have led to a somewhat unsteady relationship with trauma score, particularly since the highest trauma scores also had very low prevalence. Some overlap in age occurs across Waves as a result of the original Wave I cohort including participants up to age 21. We conducted sensitivity analyses excluding the overlapping ages and observed few differences in results, none of which would change our overall interpretations; therefore, we present results for the full sample which better represents the original Add Health study design.

While the strength of the associations of individual traumas with drug use outcomes varied, dose-response relationships were observed across outcomes. Trauma load in childhood needs to be ascertained early and interventions also need to be provided early since drug use is high in adolescence and early adulthood generally and specifically for with those with experiences of trauma. Drug treatment programs should consider the possibility of drug use as a coping mechanism to manage trauma's long-term effects. To address relapse, treatment should promote healthy alternatives to drugs and focus on psychological care. With regard to the growing opioid epidemic, prescribing patterns and PPRM must be carefully monitored. While prescription pain relievers remain in the arsenal of treatment options for pain and other conditions, screening and treatment of populations such as at-risk youth, mentally ill persons, and women, especially those bearing children and breastfeeding, are necessary for prevention of PPRM, addiction, and mortality as well as escalation to other drugs such as heroin and high-risk behaviors such as injecting drugs.

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Highlights

- Prevalence of prescription pain reliever misuse was 28% by adulthood.
- Injection drug use prevalence was 1.24% by emerging adulthood.
- 28% reported at least one of nine traumatic events before age 18.
- Increasing number of childhood traumas is associated with drug misuse in adulthood.

Table 1

Descriptive statistics for sociodemographic characteristics, trauma exposures, and drug use outcomes by gender for study population (those with sample weights in Waves I, III, and IV)

	Total n=12,288	Male n=5,604	Females n=6,684
	Number (Weighted Percent)	Number (Weighted Percent)	Number (Weighted Percent)
Sociodemographics *			
Adolescent age			
11	1 (0.03)	1 (0.03)	0 (0.00)
12	20 (0.16)	3 (0.05)	17 (0.11)
13	1,026 (10.55)	417 (4.97)	609 (5.57)
14	1,559 15.34)	678 (7.68)	881 (7.66)
15	1,942 (16.67)	845 (8.45)	1,097 (8.22)
16	2,351 (16.97)	1,085 (8.16)	1,266 (8.80)
17	2,372 (15.83)	1,102 (8.05)	1,270 (7.78)
18	2,211 (17.39)	1,049 (9.18)	1,162 (8.22)
19	721 (6.18)	370 (3.43)	351 (2.75)
20	66 (0.65)	42 (0.49)	24 (0.16)
21	14 (0.23)	8 (0.11)	6 (0.13)
Adolescent race/ethnicity			
White	6,597 (65.62)	3,032 (65.11)	3,565 (66.15)
Black	2,609 (15.98)	1,069 (15.64)	1,540 (16.33)
Hispanic	1,913 (11.91)	917 (12.32)	996 (11.50)
Other	1,162 (6.48)	584 (6.92)	578 (6.02)
Poverty status adolescence	1,849 (17.02)	799 (16.44)	1,050 (17.62)
Poverty status emerging adulthood	720 (14.13)	668 (11.87)	1,052 (16.43)
Education attainment			
Less than high school	896 (8.47)	496 (9.91)	400 (6.99)
High school graduate	1,934 (17.51)	1,052 (20.86)	882 (14.08)
More than high school	9,458 (74.02)	4,056 (69.23)	5,402 (78.93)
Individual trauma exposures			
Neglect	1,550 (12.73)	756 (13.34)	794 (12.11)
Emotional abuse	1,981 (16.37)	722 (13.43)	1,259 (19.37)
Physical abuse	1,477 (12.24)	714 (12.58)	763 (11.91)
Sexual abuse	984 (8.25)	339 (6.68)	645 (9.82)
Parent incarceration	1,279 (10.43)	556 (10.23)	723 (10.63)

	Total n=12,288	Male n=5,604	Females n=6,684
	Number (Weighted Percent)	**Number (Weighted Percent)**	**Number (Weighted Percent)**
Parent binge drinking	1,271 (13.06)	580 (13.86)	691 (12.21)
Witnessed violence	1,445 (10.95)	802 (13.12)	643 (8.73)
Threatened with violence	1,490 (12.14)	1058 (17.84)	432 (6.31)
Experienced violence	619 (5.13)	416 (7.29)	203 (2.91)
Cumulative trauma score exposures (n=9569) **			
None	4,477 (47.17)	2,591 (25.09)	1,886 (22.08)
One	2,677 (28.08)	1,455 (13.49)	1,222 (14.59)
Two	1,307 (13.26)	697 (6.50)	610 (6.76)
Three	646 (6.70)	298 (2.92)	348 (3.78)
Four	297 (3.03)	155 (1.55)	142 (1.48)
Five to nine	165 (1.77)	78 (0.63)	87 (1.13)
Drug use outcomes †			
Prescription pain reliever misuse emerging adulthood (n=12,111)	2,337 (20.25)	1,134 (21.82)	1,203 (18.63)
Prescription pain reliever misuse adulthood (n=9938)	912 (10.46)	493 (12.26)	419 (8.69)
Injection drug use emerging adulthood (n=12,141)	122 (1.24)	72 (1.54)	50 (0.93)

* Wave I data used for adolescent age, race/ethnicity and poverty status; Wave III data used for emerging adulthood poverty status; Wave IV data used for educational attainment

** Cumulative trauma scores include only cases with no missing trauma data

† Outcomes include only new users since previous Wave

Table 2

Unadjusted odds ratios (OR) and 95% confidence intervals (CI) for the associations of study population sociodemographic characteristics and drug use outcomes

	Drug use outcomes					
	Prescription pain reliever misuse				Injection drug use	
	Emerging adulthood n=12,111		Adulthood n=9,938		Emerging adulthood n=12,141	
Sociodemographics*	**# (wt %)** with outcome**	**OR (95% CI)**	**# (wt %)** with outcome**	**OR (95% CI)**	**# (wt %)** with outcome**	**OR (95% CI)**
Total population	2,337 (20.25)	--	912 (10.46)	--	122 (1.24)	--
Gender						
*Female (ref)***	1,203 (18.63)	--	419 (8.69)	--	50 (0.93)	--
Male	1,134 (21.82)	1.22 (1.08–1.38)	493 (12.26)	1.47 (1.23–1.75)	72 (1.54)	1.68 (1.06–0.64)
Age						
*11–13 (ref)***	229 (24.44)	--	90 (12.90)	--	10 (1.32)	--
14–16	1,141 (20.72)	0.81 (0.66–0.99)	475 (11.42)	0.87 (0.66–1.15)	57 (1.080	0.81 (0.39–1.71)
17–18	828 (18.61)	0.71 (0.55–0.90)	297 (8.61)	0.64 (0.46–0.88)	49 (1.49)	1.13 (0.49–2.60)
19–21	138 (18.37)	0.70 (0.50–0.96)	49 (8.89)	0.66 (0.40–1.09)	6 (1.03)	0.78 (0.22–2.78)
Race/ethnicity						
*White (ref)***	1,424 (22.50)	--	636 (12.72)	--	90 (1.52)	--
Black	378 (14.05)	0.56 (0.46–0.69)	83 (3.24)	0.23 (0.16–0.33)	9 (0.24)	0.16 (0.06–0.45)
Hispanic	298 (15.07)	0.61 (0.50–0.75)	109 (7.69)	0.57 (0.41–0.80)	15 (1.11)	0.73 (0.40–1.32)
Other	234 (22.06)	0.98 (0.77–1.23)	84 (12.70)	0.99 (0.68–1.46)	8 (1.10)	0.73 (0.28–1.87)
Poverty status in adolescence						
*No poverty (ref)***	1,619 (20.07)	--	661 (10.64)	--	91 (1.33)	--
Poverty	346 (19.78)	0.98 (0.83–1.17)	129 (9.69)	0.90 (0.70–1.16)	16 (1.17)	0.88 (0.43–1.79)
Poverty status in emerging adulthood						
*No poverty (ref)***	1,871 (18.980	--	759 (10.14)	--	94 (1.16)	--

	Drug use outcomes					
	Prescription pain reliever misuse				Injection drug use	
	Emerging adulthood n=12,111		Adulthood n=9,938		Emerging adulthood n=12,141	
Sociodemographics*	**# (wt %)** with outcome**	**OR (95% CI)**	**# (wt %)** with outcome**	**OR (95% CI)**	**# (wt %)** with outcome**	**OR (95% CI)**
Poverty	446 (27.73)	1.69 (1.41–2.02)	148 (13.24)	1.42 (1.11–1.83)	25 (1.70)	1.55 (0.87–2.75)
Education attainment by adulthood						
*Less than high school (ref)***	179 (19.23)	--	73 (10.58)	--	17 (1.92)	--
High school graduate	386 (20.38)	1.08 (0.81–1.43)	132 (9.91)	0.93 (0.62–1.39)	26 (1.42)	0.74 (0.35–1.58)
More than high school	1,772 (20.33)	1.07 (0.81–1.41)	707 (10.58)	1.00 (0.72–1.39)	79 (1.12)	0.58 (0.31–0.10)

*Wave I data used for adolescent age, race/ethnicity and poverty status; Wave III data used for emerging adulthood poverty status; Wave IV data used for educational attainment

**#: number; wt. %: weighted percent; ref: referent group

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Table 3

Unadjusted (OR) and adjusted (AOR) odds ratios and 95% confidence intervals (CI) for the associations of childhood traumas and drug use outcomes in emerging adulthood and adulthood

Trauma *Ref=none*[*]	Prescription pain reliever misuse						Injection drug use		
	Emerging adulthood n=12,111			Adulthood n=9,938			Emerging adulthood n=12,141		
	# (wt %)[*] with outcome	OR (95% CI)	AOR (95% CI)[**]	# (wt %)[*] with outcome	OR (95% CI)	AOR (95% CI)[**]	# (wt %)[*] with outcome	OR (95% CI)	AOR (95% CI)[**]
Neglect	384 (27.31)	1.58 (1.35–1.86)	1.35 (1.10–1.66)	112 (12.46)	1.26 (0.97–1.65)	1.04 (0.77–1.41)	23 (1.26)	1.03 (0.56–1.88)	0.75 (0.34–1.69)
None	1,903 (19.18)	--	--	770 (10.12)	--	--	95 (1.23)	--	--
Emotional Abuse	472 (27.57)	1.53 (1.32–1.76)	1.25 (1.04–1.51)	224 (15.77)	1.77 (1.44–2.16)	1.55 (1.19–2.02)	32 (2.11)	1.96 (1.18–3.24	1.53 (0.81–2.87)
None	1,843 (19.19)	--	--	678 (9.59)	--	--	86 (1.09)	--	-
Physical Abuse	379 (27.03)	1.56 (1.30–1.86)	1.27 (0.99–1.60)	145 (16.00)	1.76 (1.30–2.37)	1.44 (0.97–2.13)	31 (2.11)	1.94 (1.13–3.34)	1.36 (0.71–2.60
None	1,843 (19.25)	--	--	717 (9.79)	--	--	82 (1.10)	--	--
Sexual Abuse	220 (25.02)	1.35 (1.09–1.68)	1.26 (0.97–1.64)[†]	72 (11.98)	1.19 (0.83–1.71)[††]	1.04 (0.69–1.57)	38 (4.10)	4.47 (2.61–7.66)[‡]	4.77 (2.44–9.34)[‡‡]
None	2045 (19.80)	--	--	802 (10.28)	--	--	75 (0.95)	--	--
Parent Incarceration	280 (23.60)	1.24 (1.04–1.47)	1.09 (0.84–1.40)	127 (15.76)	1.70 (1.31–2.21)	1.39 (1.01–1.92)	16 (1.23)	0.99 (0.44–2.26)	0.74 (0.26–2.09)
None	2,013 (19.96)	--	--	767 (9.92)	--	--	104 (1.24)	--	--
Parent Binge Drinking	271 (21.15)	1.07 (.90–1.29)	1.03 (0.84–1.27)	114 (14.45)		1.40 (1.09–1.80)	15 (1.50)	1.22 (0.64–2.32)	1.07 (0.53–2.15)
None	1,741 (19.94)	--	--	684 (9.74)	1.57 (1.26–1.94)	--	91 (1.23)	--	--
Witnessed Violence	275 (21.25)	1.07 (.89–1.29)	1.04 (0.82–1.32)	109 (11.59)	1.13 (0.86–1.48)	1.47 (0.96–2.25)	29 (2.65)	2.53 (1.48–4.35)	2.82 (1.24–6.44)
None	2,050 (20.15)	--	--	800 (10.40)	--	--	92 (1.06)	--	--

Trauma *Ref=none*[*]	Prescription pain reliever misuse						Injection drug use		
	Emerging adulthood n=12,111			Adulthood n=9,938			Emerging adulthood n=12,141		
	# (wt %)[*] with outcome	OR (95% CI)	AOR (95% CI)[**]	# (wt %)[*] with outcome	OR (95% CI)	AOR (95% CI)[**]	# (wt %)[*] with outcome	OR (95% CI)	AOR (95% CI)[**]
Threatened with Violence	325 (23.29)	1.23 (1.01–1.48)	1.09 (0.86–1.39)	118 (11.33)	1.10 (0.84–1.45)	0.82 (0.54–1.25)	31 (2.37)	2.18 (1.26–3.80)	1.51 (0.57–3.98)
None	2,001 (19.85)	--	--	792 (10.41)	--	--	90 (1.08)	--	--
Experienced Violence	156 (25.55)	1.37 (1.04–1.82)	1.18 (0.84–1.68)	55 (14.56)	1.48 (1.01–2.16)	1.06 (0.64–1.75)	15 (1.85)	1.55 (0.68–3.51)	0.64 (0.20–2.02)
None	2,172 (19.99)	--	--	856 (10.32)	--	-	106 (1.20)	--	--

[*] #: number; wt %: weighted percent; ref: referent group

[**] Adjusted for sociodemographic covariates including adolescent age, race/ethnicity, and poverty at Wave I, Wave III poverty, Wave IV education, and each other individual trauma

[†] p-value <0.10 for gender and sexual abuse interaction term; male OR=1.60 (95% CI: 1.07–2.40); female OR= 1.05 (95% CI: 0.76–1.44)

[††] p-value <0.10 for gender and sexual abuse interaction term ; male OR=0.79 (95% CI: 0.44–1.42); female OR= 1.72 (95% CI: 1.11–2.66)

[‡] p-value <0.10 for gender and sexual abuse interaction term; male OR=7.93 (95% CI: 4.16–15.10); female OR= 1.93 (95% CI: 0.81–4.61)

[‡‡] p-value <0.10 for gender and sexual abuse interaction; male OR=9.74 (95% CI:4.61–20.58); female OR= 1.30 (95% CI:0.49–3.44)

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Table 4

Unadjusted (OR) and adjusted (AOR) odds ratios and 95% confidence intervals (CI) for the associations of cumulative childhood trauma score and drug use outcomes in emerging adulthood and adulthood

	Prescription pain reliever misuse						Injection drug use Emerging adulthood n=9,539		
	Emerging adulthood n=9,528			Adulthood n=7,744					
Cumulative trauma score Ref=none	**# (wt %)* with outcome**	**OR (95% CI)**	**AOR (95% CI)****	**# (wt %)* with outcome**	**OR (95% CI)**	**AOR (95% CI)****	**# (wt %)* with outcome**	**OR (95% CI)**	**AOR (95% CI)****
One	522 (21.09)	1.30 (1.12–1.53)†	1.34 (1.14–1.58)†	214 (11.02)	1.37 (1.06–1.79)†	1.46 (1.12–1.91)†	21 (1.19)	1.90 (0.93–3.88)†	1.94 (0.96–3.94)†
None	740 (17.01)	--	--	278 (8.27)	--	--	18 (0.63)	--	--
Two	276 (23.22)	1.48 (1.19–1.83)	1.58 (1.25–1.99)	122 (12.04)	1.52 (1.11–2.07)	1.71 (1.23–2.36)	24 (2.60)	4.22 (2.02–8.79)	4.32 (1.98–9.45)
None	740 (17.01)	--	--	278 (8.27)	--	--	18 (0.63)	--	--
Three	159 (26.40)	1.75 (1.36–2.25)	1.70 (1.29–2.25)	56 (15.43)	2.02 (1.35–3.03)†	2.16 (1.43–3.26)†	13 (1.58)	2.53 (0.97–6.55)	2.64 (0.97–7.19)
None	740 (17.01)	--	--	278 (8.27)	--	--	18 (0.63)	--	--
Four	82 (30.32)	2.12 (1.51–2.98)	2.17 (1.49–3.15)	35 (17.69)	2.38 (1.47–3.86)	2.70 (1.62–4.52)	10 (4.18)	6.88 (2.74–17.27)	7.15 (2.65–19.29)
None	740 (17.01)	--	--	278 (8.27)	--	--	18 (0.63)	--	--
Five-nine	45 (26.54)	1.76 (1.01–3.08)	1.79 (1.05–3.07)	14 (17.61)	2.37 (1.29–4.35)	3.09 (1.52–6.30)	5 (2.88)	4.68 (1.26–17.37)	4.67 (1.22–17.87)
None	740 (17.01)	--	--	278 (8.27)	--	--	18 (0.63)	--	--

*#: number; wt %: weighted percent; ref: referent group

**Adjusted for sociodemographic covariates including adolescent age, race/ethnicity, and poverty status at Wave I, Wave III poverty, and Wave IV education

†p-value <0.10 for gender and trauma interaction term (estimates for models not shown)