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Adverse childhood experiences and stimulant use disorders among adults in the United States

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Abstract

Recent data indicate a resurgence of stimulant use and harms in the United States; thus, there is a need to identify risk factors to inform development of effective prevention strategies. Prior research suggests adverse childhood experiences (ACEs) are common among individuals using stimulants and may be an important target for prevention. National Epidemiological Survey on Alcohol and Related Conditions was used to estimate prevalence of ACEs among U.S. adults using amphetamine-type stimulants (ATS), cocaine, or both. Multivariable logistic regression examined associations between ACEs and stimulant use and use disorders. Among adults reporting lifetime ATS use, 22.1% had ≥4 ACEs, 24.9% had 2–3 ACEs, 22.4% had 1 ACE, 30.6% reported no ACEs. Among adults with lifetime ATS use disorder, 29.3% reported ≥4 ACEs, 28.7% reported 2–3 ACEs, 21.6% reported 1 ACE, and 20.4% reported no ACEs. Multivariable logistic regression found a significant relationship between number of ACEs and stimulant use and use disorders. In conclusion, we found a strong relationship between increasing ACE exposures and

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Declaration of Competing Interest

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Supplementary materials

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stimulant use and use disorders. Advancing comprehensive strategies to prevent ACEs and treating underlying trauma among those using stimulants holds great promise to reduce stimulant use and its health and social consequences in the United States.

Keywords

Cocaine use; Methamphetamine use; Stimulant use disorder; Adverse childhood experiences; Trauma; Trauma informed care

1. Introduction

Cocaine and amphetamine-type stimulants (ATS) such as methamphetamine are highly addictive and potent central nervous system stimulants (Ciccarone, 2011). Use of these substances, especially chronic use, is associated with a range of physical and psychological harms, including psychosis and other mental disorders, cognitive and neurologic deficits, cardiovascular and renal dysfunction, infectious disease transmission, and increased mortality (Barr et al., 2006; Butler et al., 2017; Cheng et al., 2010; Cunningham et al., 2015; Darke, et al., 2017; Darke et al., 2017; Hirsiger et al., 2019; Strathdee and Stockman, 2010; Voce et al., 2019; Wang et al., 2017). In recent years, the availability of stimulants, including cocaine and methamphetamine, throughout the U.S. has increased (Drug Enforcement Administration, 2019). Coincident with this increasing availability, indicators of use and harms have increased. In 2018, 5.5 million (2.0%) people aged 12 years or older reported past-year use of cocaine, up from 4.8 million (1.8%) in 2015; for methamphetamine, 1.9 million (0.7%) people aged 12 years or older reported past-year use in 2018, up from 1.4 million (0.5%) in 2016 (Substance Abuse and Mental Health Services Administration, 2019). Reporting use of methamphetamine at substance use treatment admission has nearly doubled, rising from 13.7% of drug-related treatment admissions in 2010 to 23.6% in 2017, with increases observed among males and females, all age groups, most racial/ethnic groups, and all U.S. census regions (Jones et al., 2020). Emergency department visits and overdose deaths involving cocaine or psychostimulants such as methamphetamine have also increased over the past decade (Hoots et al., 2020). In 2018, 14,666 overdose deaths involved cocaine, up from 4,350 deaths in 2009; 12,676 overdose deaths involved psychostimulants in 2018, up from 1,632 in 2009 (Hedegaard et al., 2020). Importantly, these increases in stimulant-related harms appear to be intertwined with the ongoing opioid overdose crisis in the U.S., posing new and complex prevention and treatment challenges (Cicero et al., 2020; Hoots et al., 2020; Jones, et al., 2020).

Given the substantial morbidity and mortality attributed to stimulant use, there is a critical need to identify risk factors that can inform the development of effective prevention and treatment strategies. Addressing adverse childhood experiences (ACEs) is a potentially powerful target for prevention of stimulant use and related harms. ACEs are preventable, potentially traumatic events that occur in childhood such as neglect, experiencing or witnessing violence, and having a family member with a suicide attempt or death by suicide. Also included are aspects of a child's environment that can undermine their sense of safety, stability, and bonding, such as growing up in a household with substance use, mental health

problems, or instability due to parental separation or incarceration of a parent, sibling, or other member of the household (Centers for Disease Control and Prevention, 2019). Decades of research have documented the impact of ACEs on health, wellbeing, and opportunity across the lifespan (Felitti et al., 1998; Hughes et al., 2017). Repeated exposure to ACEs, especially in the absence of protective factors, can lead to the development of toxic stress and chronic activation of the stress response system. This toxic stress response results in dysregulation of the limbic-hypothalamic-pituitary-adrenal axis, elevating levels of catecholamines such as cortisol, and pro-inflammatory cytokines, leading to cascading effects on the nervous, endocrine, and immune systems (De Bellis and Zisk, 2014). These changes can affect executive functioning and decision-making, attention, impulsive behaviors, brain reward systems, and emotion regulation and responses to stress throughout an individual's life (De Bellis and Zisk, 2014; Felitti et al., 1998; Hughes et al., 2017).

ACEs have consistently been associated with increased risk for substance use, including initiating use at an early age and the development of substance use disorders (Banducci et al., 2014; Felitti et al., 1998; Hughes et al., 2017; Rhee et al., 2019; Scheidell et al., 2018; Svingen et al., 2016). Further, research has shown that individuals who have been exposed to ACEs, especially those exposed to multiple ACEs, are at increased risk for more severe substance use, initiating injection drug use at a younger age, transitioning to regular injecting, and experiencing an overdose (Banducci et al., 2014; Debeck et al., 2013; Felitti et al., 1998; Marshall et al., 2011; Scheidell et al., 2018; Stein et al., 2017; Svingen et al., 2016). Specific to stimulants, high prevalence of ACEs has been documented among people who use cocaine, methamphetamine, and other stimulants (Banducci et al., 2014; Christian et al., 2007; Marshall et al., 2011; Scheidell et al., 2018; Svingen et al., 2016; Zapolski et al., 2016). In a study of adults with methamphetamine dependence, 52% reported having experienced lifetime physical abuse and 20% reported having experienced lifetime sexual abuse (Christian et al., 2007). Among adults reporting cocaine use, 29.0% had been exposed to 4 or more ACEs, with 25.9% reporting they had experienced violence, 22.2% had experienced emotional abuse, and 20.0% had experienced sexual abuse (Scheidell et al., 2018).

Although prior research provides important insights into the association between ACEs and stimulant use, studies have generally included small convenience samples of specific populations such as people entering substance use treatment or high-risk youth in limited geographic areas, and often included only a subset of ACEs such as child abuse and neglect or sexual abuse (Banducci et al., 2014; Christian et al., 2007; Marshall et al., 2011; Scheidell et al., 2018; Svingen et al., 2016; Zapolski et al., 2016). To our knowledge no study has examined the full spectrum of ACEs and the associations of ACEs with stimulant use and stimulant use disorders using nationally representative data. To address this research gap, we used data from the National Epidemiological Survey on Alcohol and Related Conditions to estimate the prevalence of ACEs among adults using stimulants and with stimulant use disorders as well as the association of ACEs with stimulant use and use disorders in the United States.

2. Methods

2.1. Data and study sample

Data were from Wave 3 of the National Epidemiological Survey on Alcohol and Related Conditions (NESARC-III) conducted in 2012–2013 in person by the National Institute on Alcohol Abuse and Alcoholism (NIAAA). The NESARC-III is a nationally representative sample of the non-institutionalized adult population 18 years old or older in the United States (N=36,309). The NESARC-III collected information on participants' substance use (tobacco and alcohol use, illicit drug use, and prescription drug misuse), mental disorders, and physical health conditions. It is the only national survey that has the full complement of ACEs questions along with a wide range of substance use questions. Data were adjusted for oversampling (e.g., minority groups) and nonresponse, and then weighted to represent the noninstitutionalized U.S. civilian adult population. The overall survey response rate was 60.1% (Grant et al., 2014; Grant et al., 2015). This study utilized existing deidentified data and was deemed exempt from the Institutional Review Board review by the author's institution. Additional details on the NESARC-III survey design and description are available elsewhere (Grant et al., 2014).

2.2. Measures

2.2.1. Adverse childhood experiences—The NESARC-III assessed respondents' exposure to ACEs based on responses to a series of questions adopted from validated instruments (Bernstein et al., 1994; Felitti et al., 1998; Fink et al., 1995; Straus, 1979; Wyatt, 1985). The ACE score variable was created based on twenty-nine questions regarding 10 ACEs categories (see Appendix A): 1) emotional abuse, 2) physical abuse, 3) sexual abuse, 4) physical neglect, 5) emotional neglect, 6) witnessing domestic violence, 7) household substance use, 8) incarcerated household member, 9) household mental illness, and 10) parental separation or divorce. Following the same method for ACEs coding by Dong et al., questions were collapsed for each ACE category, and respondents were coded as a "1" if they were exposed to that category of ACE (Dong et al., 2004). We then summed the number of ACEs categories each respondent was exposed to (score ranged from 0 to 10). Each respondent was classified into one of the following categories: zero ACEs, one ACE, two or three ACEs, and four or more ACEs based on their exposure history.

2.2.2. Amphetamine-type stimulant (ATS) use, cocaine use, any stimulant use—The NESARC-III includes a series of questions to capture lifetime (ever before) and past-year (in the past 12 months) use of specific illicit and prescription drugs. Respondents were told "Now I'd like to ask you about your experiences with medicines and other kinds of drugs that you may have used on your own – that is, either without a doctor's prescription; in greater amounts, more often, or longer than prescribed; or for a reason other than a doctor said you should use them. People use these medicines and drugs on their own to feel more alert, to relax or quiet their nerves, to feel better, to enjoy themselves, to get high or just to see how they work," and then they are presented with a flashcard with specific categories of drugs to facilitate their reporting of the substances they used.

For the analysis, ATS use was defined as responding yes to using "stimulants, for example……Adderall, Concerta, Sylert, Provigil, Ritalin or Dexedrine, speed, amphetamine, methamphetamine, uppers, bennies, pep pills, crystal, crank." Cocaine use was defined as responding yes to "cocaine or crack, for example…blow, rock, snow." Any stimulant use was defined as reporting either ATS use, cocaine use, or both.

2.2.3. ATS use disorder, cocaine use disorder, any stimulant use disorder—

The NESARC-III categorized individuals as having lifetime (ever before) and past-year (in the past 12 months) ATS use disorders or cocaine use disorders using questions (Grant et al., 2015) based on the individual diagnostic criteria contained in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-V). Any stimulant use disorder was defined as meeting DSM-V diagnostic criteria for either ATS use disorder, cocaine use disorder, or both.

2.2.4. Demographic measures—

The NESARC-III captured demographic information of respondents, including sex, age, race/ethnicity, educational status, marital status, region, and employment status.

2.3. Statistical analyses

First, we estimated the weighted number of individuals as well as prevalence and corresponding 95% confidence intervals (CIs) for lifetime and past-year ATS use, cocaine use and any stimulant use, ATS use disorder, cocaine use disorder, and any stimulant use disorder by number of ACE exposures. Second, we calculated the percentage of individuals by each ACE category who reported lifetime and past-year ATS use and cocaine use, and lifetime and past-year ATS use disorder and cocaine use disorder. Third, we estimated the age of first ATS and cocaine use and compared the mean and 95% CIs of the ACE score by categories of the age of first-time use. Fourth, we estimated weighted prevalence and 95% CIs of the ten specific types of ACEs for each of the stimulant use and use disorder measure.

Finally, two series of individual weighted multivariable logistic regression models were performed to examine the association between ACE score and each stimulant use and use disorder measure. In the first series of models, all models were adjusted for sex, age, race/ethnicity, education, marital status, region, employment status, and the three most prevalent substances in the U.S. (including lifetime cannabis use, lifetime use of at least 100 cigarettes, and past-year binge drinking). In the second series of models, we adjusted for the same demographic variables, lifetime cannabis use, lifetime use of at least 100 cigarettes, and past-year binge drinking, and lifetime prescription opioid misuse and lifetime heroin use in order to further control for the use of opioids, the drug classes that accounted for the majority of overdose morbidity and mortality at the time of data collection. All statistical analyses were conducted using Stata SE 15 (College Station, TX) to account for the complex survey design and weights of the NESARC-III.

3. Results

Based on the weighted respondents of the 2012–2013 NESARC-III, the estimated number and prevalence of adults reporting lifetime ATS use was 19,588,798 (8.3%), 23,416,166

(10.0%) reported lifetime cocaine use, and 31,084,221 (13.2%) reported lifetime any stimulant use. Past-year use of ATS was reported by 2,890,714 (1.2%) adults, 2,397,649 (1.0%) reported past-year cocaine use, and 4,573,019 (2.0%) reported past-year any stimulant use. For stimulant use disorders, 4,034,672 (1.7%) and 754,282 (0.3%) adults reported lifetime and past-year ATS use disorders; 5,640,881 (2.4%) and 820,841 (0.3%) adults reported lifetime and past-year cocaine use disorders; and 8,164,412 (3.5%) and 1,440,806 (0.6%) reported lifetime any stimulant use disorders.

Across all stimulant use and use disorder measures, the prevalence of each measure increased as the number of ACEs increased (Table 1). For example, the prevalence of lifetime ATS use was 5.3% (95% CI=4.8%−5.8%) among respondents reporting no exposure to ACEs, 7.9% (95% CI=7.3%−8.7%) among respondents reporting 1 ACE, 11.8% (95% CI=10.8–13.0%) among respondents reporting 2–3 ACEs, and 17.6% (95% CI=16.0% −19.4%) among respondents reporting 4 or more ACEs. Similarly, for cocaine, the prevalence of lifetime cocaine use was 6.3% (95% CI=5.8%−6.8%) among respondents reporting no exposure to ACEs, 10.4% (95% CI=9.5%−11.3%) among those reporting 1 ACE, 13.8% (95% CI=12.8%−14.9%) among those reporting 2–3 ACEs, and 19.8% (95% CI=18.0%−21.7%) among those reporting 4 or more ACEs.

Adults reporting ACE exposures consistently accounted for the bulk of individuals reporting use of ATS or cocaine, and for reporting ATS or cocaine use disorders (Fig. 1). Among adults reporting lifetime use of ATS, an estimated 22.1% reported 4 or more ACEs, 24.9% 2–3 ACEs, and 22.4% 1 ACE; less than one-third (30.6%) reported no ACE exposure. Similar patterns are seen for lifetime cocaine use as well as past-year use of ATS and cocaine. The influence of ACEs is even more pronounced for the use disorder outcomes. Among those reporting lifetime ATS use disorder, an estimated 29.3% reported 4 or more ACEs, 28.7% 2–3 ACEs, 21.6% 1 ACE, and 20.4% no ACEs. For past-year ATS use disorder, an estimated 33.0% reported 4 or more ACEs, 31.7% 2–3 ACEs, 18.3% 1 ACE, and 17.0% no ACEs. The distribution patterns by ACE score of lifetime cocaine use disorder and past-year cocaine use disorder were similar to those of ATS use disorder.

Average ACE score by age of first ATS use and cocaine use are presented in Table 2. The results show that adults with earlier age of first use have greater numbers of ACEs as reflected by the mean ACE scores. For example, adults who reported using ATS at age 14 or younger had a mean ACE score of 2.8 (95% CI=2.4–3.2) and those who reported using cocaine at age 14 or younger had a mean ACE score of 3.4 (95% CI=2.8–4.0), compared to those who began using at age 25 or older (mean ACE score=1.9; 95% CI=1.7–2.2) for ATS and mean ACE score=1.8 (95% CI=1.6–2.0) for cocaine, as well as compared to those who reported no lifetime use (mean ACE score=1.1; 95% CI=1.1–1.2) among those reporting no lifetime use of ATS and mean ACE score=1.1 (95% CI=1.1–1.1) for those reporting no lifetime cocaine use.

Table 3 presents the prevalence of 10 specific types of ACEs for each stimulant use measure. Across all of these measures, prevalence of each ACE was higher among adults reporting use or a use disorder compared to those not reporting use or a use disorder. Generally, the highest prevalence across each of the stimulant measures was found among those exposed

household substance use or parental divorce/separation. For example, the two most prevalent ACEs among adults reporting lifetime ATS use were household substance use (43.1%,95% CI=40.9%−45.4%) and parental divorce or separation (35.4%, 95% CI=33.0%−37.9%). The same pattern was seen among respondents reporting past-year ATS use, past-year and lifetime ATS use disorder.

After controlling for sociodemographic characteristics and lifetime use of cannabis and tobacco, and past-year binge drinking, a significant relationship between the number of ACEs and stimulant use and use disorder outcomes was found, with the highest adjusted odds ratios found among adults with 4 or more ACEs compared to those with no exposure to ACEs (Table 4). Compared to adults with no exposure to ACEs, respondents with 4 or more ACEs have greater adjusted odds of: life time ATS use (adjusted odds ratio (AOR)=2.1, 95% CI=1.7–2.5), past-year ATS use (AOR=1.6, 95% CI=1.2–2.2), lifetime cocaine use (AOR=1.9, 95% CI=1.6–2.3), past-year cocaine use (AOR=1.9, 95% CI=1.2–2.9), any lifetime any stimulant use (AOR=2.0, 95% CI=1.7–2.3), and past-year any stimulant use (AOR=1.7, 95% CI:1.3–2.3). Notably, the adjusted odds ratios for DSM-V use disorders were larger when the number of ACEs increased. For instance, compared to adults with no exposure to ACEs, respondents with 4 or more ACEs have greater odds of reporting lifetime (AOR=2.7, 95% CI=2.1–3.6) and past-year (AOR=3.3, 95% CI=1.8–5.9) ATS use disorder; lifetime (AOR=2.5, 95% CI=2.0–3.2) and past-year (AOR=2.4, 95% CI = 1.2–4.9) cocaine use disorder; and lifetime (AOR=2.5, 95% CI=2.1–3.1) and past-year (AOR=2.5, 95% CI=1.5–4.0) any stimulant use disorder. Generally, the pattern of having larger adjusted odds ratios as the number of ACEs increased for the stimulant use measures was similar in the second series of multivariable logistic regression models which included additional controls for lifetime prescription opioid misuse and lifetime heroin use, with the exception of the non-significant relationships between past-year ATS use and adults with 4 or more ACEs, past-year cocaine use and adults with 4 or more ACEs, past-year cocaine use disorder and adults with 4 or more ACEs, and past-year any stimulant use and adults with 4 or more ACEs.

4. Discussion

Adverse childhood experiences were common among adults who reported use of stimulants or had stimulant use disorders in our study. In particular, exposure to parental substance use, parental divorce or separation, sexual abuse, and witnessing domestic violence were the most commonly reported ACEs. Further, adults exposed to ACEs accounted for the majority of individuals who reported lifetime or past-year stimulant use or use disorders, with approximately 1 in 3 adults with past-year ATS use disorder or cocaine use disorder reporting exposure to 4 or more ACEs. Importantly, we found that the relationship between an increased number of ACEs and elevated risk of stimulant use outcomes remained even after accounting for other substance use, including prescription opioid misuse and heroin use. In the context of rising stimulant availability and harms, these findings provide important new insights into potential underlying contributors to stimulant use and a scientific roadmap to inform stimulant prevention and treatment efforts through expansion of comprehensive prevention of both ACEs and substance use.

The finding of high prevalence of ACEs among adults using ATS and cocaine along with the finding that early age of initiation of ATS or cocaine use was associated with higher mean ACEs scores, highlighting the potential impact of ACEs prevention as a key strategy to address rising stimulant use and harms in the U.S. Fundamental to ACEs prevention is the creation of safe, stable, nurturing relationships and environments for all children and families. CDC recently developed an ACEs prevention resource, *Preventing Adverse Childhood Experiences (ACEs): Leveraging the Best Available Evidence* (Centers for Disease Control and Prevention, 2019), to assist states and communities in developing a comprehensive approach to preventing ACEs. The document provides six strategies that reflect the best available evidence and includes discussion of specific policies and programmatic initiatives that can be implemented to prevent ACEs, including: strengthening economic supports for families (e.g., earned income tax credits, family-friendly work policies); promoting social norms that protect against violence and adversity (e.g., public education campaigns to support parents and positive parenting, bystander approaches to support healthy relationship behaviors); ensuring a strong start for children (e.g., early childhood home visitation, high quality child care, preschool enrichment programs); enhancing skills to help parents and youths handle stress, manage emotions, and tackle everyday challenges (e.g., social emotional learning programs, safe dating and healthy relationship skill programs, parenting skill and family relationship approaches); connecting youths to caring adults and activities (e.g., mentoring and after school programs); and intervening to lessen immediate and long-term harms (e.g., enhanced primary care to screen, refer, and provide support, victim-centered services, and trauma-informed care).

Of particular importance to stimulant use prevention, several of the strategies identified by CDC have demonstrated lasting protective effects for substance use, including prevention of cocaine and methamphetamine use, and are therefore particularly important in light of the findings in this study. For example, social-emotional learning programs have been associated with both decreased violence as well as decreased youth substance use. One study found that first and second graders who received the Good Behavior Game curriculum were less likely at ages 19–21 to report substance use compared to students in other cohorts (Kellam et al., 2008). The Promoting School-community-university Partnerships to Enhance Resilience (PROSPER) program is an example of a delivery system for communities to implement evidence-based programs for preventing youth substance use and other health risk behaviors. Studies of PROSPER's impact have shown significant and lasting community-wide reductions in illicit drug use initiation, including reductions in methamphetamine and cocaine use, with the strongest effects evident for the higher-risk youth (Spoth et al., 2007; Spoth et al., 2017; Svingen et al., 2016).

Another important finding from this study was the high prevalence of parental substance use among those reporting stimulant use and use disorders, a finding consistent with prior research (Houtepen et al., 2020; Madras et al., 2019; Svingen et al., 2016). For example, Houtepen et al., reported that parental substance use, in addition to other ACEs, was associated with illicit drug use (Houtepen et al., 2020). Svingen et al., found that age of substance use initiation occurred earlier when participants exposed to parental substance use were also physically abused (Svingen et al., 2016). Taken together, these findings underscore the need for prevention that focuses not only on substance use, but on the dynamics in the

home contributing to ACEs and substance use risk. Strategies to disrupt this generational cycle include screening families for substance use and intervening early with home visitation programs or other positive parenting programs that can mitigate the impact of current ACEs and prevent future ACEs (Centers for Disease Control and Prevention, 2019). Home visitation programs such as the Nurse Family Partnership, which has been shown to reduce multiple ACEs, including child maltreatment, intimate partner violence, and maternal substance use, are a particularly impactful strategy (Olds et al., 1997). One study projected up to 42,000 child maltreatment incidents, 41,000 person-years of youth substance use, 36,000 intimate partner violence incidents, and 594,000 property and public order crimes would be prevented via home visitation programs in place between 1996–2014 (Miller, 2015). Other strategies that improve economic supports to families such as earned income tax credits and childcare subsidies have been shown to be associated with reduced parental stress and also may have a positive impact on ACEs and substance use (Centers for Disease Control and Prevention, 2019; Gordon et al., 2011; Klevens et al., 2017; Milligan and Stabile, 2011).

In addition to informing stimulant use prevention efforts, this study has important implications for stimulant use disorder treatment and recovery. In our analysis, we found that the vast majority of adults with lifetime or past-year ATS use disorder or cocaine use disorder had experienced ACEs, with approximately 65% of adults with past-year ATS use disorder and nearly 60% of adults with past-year cocaine use disorder reporting 2 or more ACEs. Further, the likelihood of stimulant use disorders was substantially elevated among those with more ACEs, even after accounting for demographic and other substance use characteristics. This finding points to the importance of integrating the impact of ACEs and trauma informed care into ongoing treatment and recovery support services. Trauma-informed care is a framework that involves recognizing and understanding the prevalence of trauma and adversity, responding by ensuring that care is rendered in accordance with trauma-informed principles, avoiding retraumatizing a client or patient, and ensuring that all policies and practices of an organization reflect a core understanding of trauma (The National Child Traumatic Stress Network 2020). In addition, specific therapeutic strategies such as family-centered treatment for substance use disorders, trauma-focused cognitive behavioral therapy, and multisystemic therapy can be provided in conjunction with substance use treatment (Cary and McMillen, 2012; Centers for Disease Control and Prevention, 2019; van der Stouwe et al., 2014). Finally, ensuring connection to recovery support services such as recovery coaches, vocational and educational training, transportation, and social services is an important component to sustaining substance use recovery (Center for Substance Abuse Treatment, 2009).

This study is subject to limitations. First, NESARC-III data are self-reported and subject to recall and social desirability biases. Second, because the survey is cross-sectional, inferring causality from the observed associations between ACE exposures and stimulant use measures is not possible. Third, NESARC-III does not include certain populations (e.g., institutionalized or homeless persons); thus, substance use and ACEs estimates in this study might not be generalizable to the total U.S. population. Fourth, NESARC-III provides estimates of persons meeting diagnostic criteria for substance use disorders based on self-reported responses to the individual questions that make up the DSM-V diagnostic criteria

for specific substance use disorders, not estimates of the number of persons receiving a diagnosis from a health care provider. Finally, NESARC-III was conducted in 2012–2013, and thus our findings may not fully capture the most recent changes in ATS and cocaine use in the U.S.

5. Conclusion

The United States is experiencing a resurgence of stimulant-related use and harms that is intertwined with the ongoing opioid crisis posing unique prevention and treatment challenges (Hoots et al., 2020). Our analysis found a strong relationship between exposure to adverse childhood experiences and using stimulants and having stimulant use disorders. Advancing comprehensive strategies to prevent adverse childhood experiences and treating underlying trauma among those using stimulants holds great promise to reduce stimulant use and its health and social consequences in the United States.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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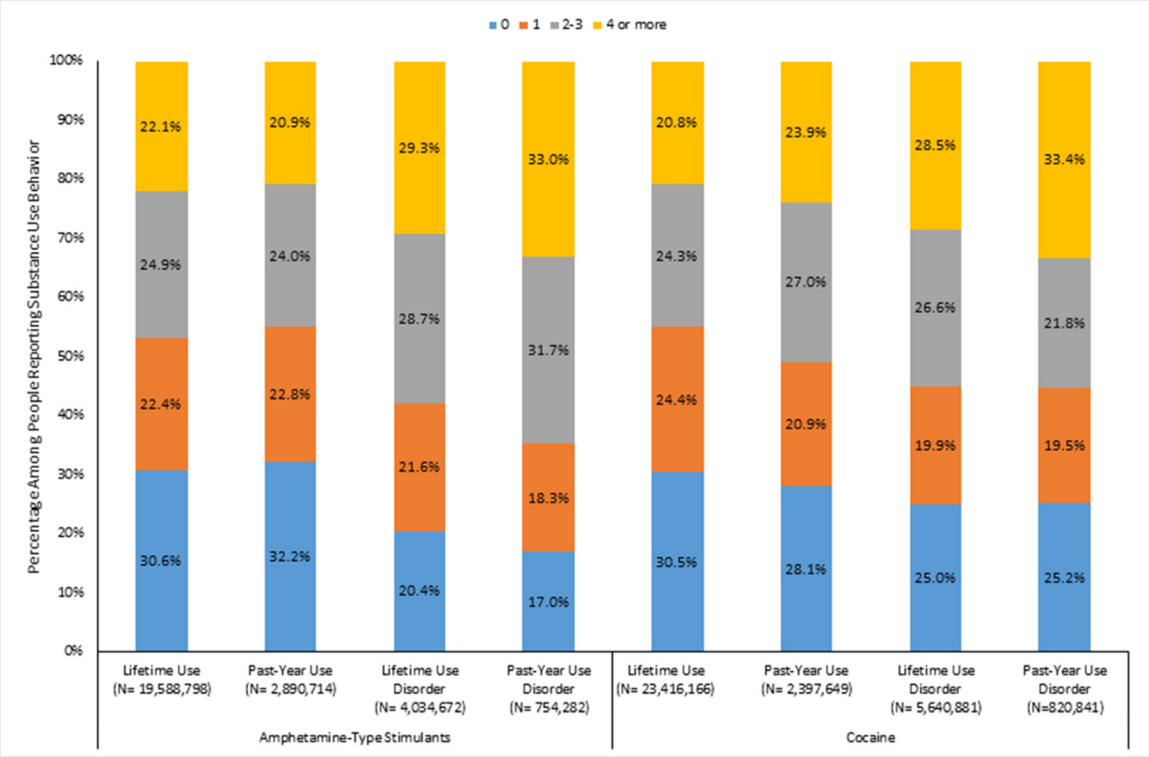

Fig. 1.

Percentage of Each Adverse Childhood Experience Score Category by Amphetamine-Type Stimulant or Cocaine Use Measures[abcd]

[a] Adverse childhood experience (ACE) score is calculated based on the number of exposures to 10 ACE categories.

[b] Weighted counts are provided under each measure.

[c] Lifetime use indicates a respondent reporting ever use of substance.

[d] Use disorder is assessed based on self-reported questions that correspond to DSM-V diagnosis criteria.

Source: National Epidemiological Survey on Alcohol and Related Conditions, United States, 2012–2013 (n = 36,309).

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Table 1

Amphetamine-type stimulant, cocaine, and any stimulant use and use disorder by adverse childhood experience score.

Substance Variable	Adverse Childhood Experience (ACE) Score[a]							
	0		1		2–3		>=4	
	No.[b]	%[c] (95% CI)	No.[b]	%[c] (95% CI)	No.[b]	%[c] (95% CI)	No.[b]	%[c] (95% CI)
Amphetamine-Type Stimulants								
Lifetime[d] use								
Yes	777	5.3% (4.8%, 5.8%)	595	7.9% (7.3%, 8.7%)	688	11.8% (10.8%, 13.0%)	654	17.6% (16.0%, 19.4%)
No	16,158	94.7% (94.2%, 95.2%)	8,024	92.1% (91.3%, 92.7%)	6,000	88.2% (87.0%, 89.2%)	3,360	82.4% (80.6%, 84.0%)
Past-year use								
Yes	124	0.8% (0.7%, 1.0%)	85	1.2% (0.9%, 1.6%)	104	1.7% (1.4%, 2.1%)	95	2.5% (2.0%, 3.1%)
No	16,787	99.2% (99.0%, 99.3%)	8,523	98.8% (98.4%, 99.1%)	6,565	98.3% (97.9%, 98.6%)	3,898	97.5% (96.9%, 98.0%)
Lifetime[d] use disorder[e]								
Yes	111	0.7% (0.6%, 0.9%)	108	1.6% (1.3%, 1.9%)	163	2.8% (2.3%, 3.4%)	185	4.8% (4.0%, 5.7%)
No	16,849	99.3% (99.1%, 99.4%)	8,524	98.4% (98.1%, 98.7%)	6,535	97.2% (96.6%, 97.7%)	3,834	95.2% (94.3%, 96.0%)
Past-year use disorder[e]								
Yes	20	0.1% (0.1%, 0.2%)	20	0.2% (0.1%, 0.4%)	34	0.6% (0.4%, 0.8%)	38	1.0% (0.7%, 1.5%)
No	16,940	99.9% (99.8%, 99.9%)	8,612	99.8% (99.6%, 99.9%)	6,664	99.4% (99.2%, 99.6%)	3,981	99.0% (98.5%, 99.3%)
Cocaine								
Lifetime[d] use								
Yes	1,029	6.3% (5.8%, 6.8%)	834	10.4% (9.5%, 11.3%)	905	13.8% (12.8%, 14.9%)	775	19.8% (18.0%, 21.7%)
No	15,907	93.7% (93.2%, 94.2%)	7,782	89.6% (88.7%, 90.5%)	5,783	86.2% (85.1%, 87.2%)	3,240	80.2% (78.3%, 82.0%)
Past-year use								
Yes	113	0.6% (0.5%, 0.7%)	93	0.9% (0.7%, 1.2%)	117	1.6% (1.2%, 2.1%)	96	2.3% (1.8%, 3.1%)
No	16,800	99.4% (99.3%, 99.5%)	8,506	99.1% (98.8%, 99.3%)	6,556	98.4% (97.9%, 98.8%)	3,910	97.7% (96.9%, 98.2%)
Lifetime[d] use disorder[e]								
Yes	197	1.2% (1.1%, 1.5%)	178	2.0% (1.7%, 2.4%)	244	3.6% (3.1%, 4.2%)	252	6.5% (5.6%, 7.6%)
No	16,763	98.8% (98.5%, 99.0%)	8,454	98.0% (97.6%, 98.3%)	6,454	96.4% (95.8%, 96.9%)	3,767	93.5% (92.4%, 94.4%)
Past-year use disorder[e]								

Substance Variable	Adverse Childhood Experience (ACE) Score[a]							
	0		1		2–3		>=4	
	No.[b]	%[c] (95% CI)	No.[b]	%[c] (95% CI)	No.[b]	%[c] (95% CI)	No.[b]	%[c] (95% CI)
Yes	37	0.2% (0.1%, 0.3%)	28	0.3% (0.2%, 0.5%)	41	0.4% (0.3%, 0.6%)	46	1.1% (0.8%, 1.6%)
No	16,923	99.8% (99.7%, 99,9%)	8,604	99.7% (99.5%, 99.8%)	6,657	99.6% (99.4%, 99.7%)	3,973	98.9% (98.4%, 99.2%)
Any Stimulant[f]								
Lifetime[d] use								
Yes	1,349	8.6% (8.0%, 9.2%)	1,067	13.6% (12.6%, 14.6%)	1,160	18.3% (17.1%, 19.6%)	989	25.5% (23.6%, 27.6%)
No	15,585	91.4% (90.8%, 92.0%)	7,549	86.4% (85.4%, 87.4%)	5,528	81.7% (80.4%, 82.9%)	3,024	74.5% (72.4%, 76.4%)
Past-year use								
Yes	208	1.2% (1.0%, 1.5%)	154	1.8% (1.5%, 2.2%)	191	2.8% (2.3%, 3.4%)	167	4.1% (3.3%, 5.0%)
No	16,691	98.8% (98.5%, 99.0%)	8,442	98.2% (97.8%, 98.5%)	6,471	97.2% (96.6%, 97.7%)	3,821	95.9% (95.0%, 96.7%)
Lifetime[d] use disorder[e]								
Yes	271	1.7% (1.5%, 2.0%)	250	3.1% (2.6%, 3.6%)	354	5.5% (4.8%, 6.2%)	371	9.2% (8.2%, 10.3%)
No	16,689	98.3% (98.0%, 98.5%)	8,382	96.9% (96.4%, 97.4%)	6,344	94.5% (93.8%, 95.2%)	3,648	90.8% (89.7%, 91.8%)
Past-year use disorder[e]								
Yes	55	0.3% (0.2%, 0.4%)	44	0.5% (0.3%, 0.7%)	70	1.0% (0.7%, 1.2%)	76	1.9% (1.4%, 2.5%)
No	16,905	99.7% (99.6%, 99.8%)	8,588	99.5% (99.3%, 99.7%)	6,628	99.0% (98.8%, 99.3%)	3,943	98.1% (97.5%, 98.6%)

[a] Adverse childhood experience (ACE) score is calculated based on the number of exposures to 10 ACE categories.

[b] Unweighted number of individuals

[c] The percentages are weighted estimates.

[d] Lifetime use indicates a respondent reporting ever use of the substance.

[e] Use disorder is assessed based on self-reported questions that correspond to DSM-V diagnosis criteria.

[f] Amphetamine-type stimulants and/or cocaine.

Source: National Epidemiological Survey on Alcohol and Related Conditions, United States, 2012–2013 (n = 36,309)

Table 2

Average adverse childhood experience score by age of first use of amphetamine-type stimulants or cocaine[a]

	Adverse Childhood Experience Score			
	Amphetamine-Type Stimulant Use		Cocaine Use	
Age First Use of Substance	Mean[b]	(95% CI)	Mean[b]	(95% CI)
14 or younger	2.8	(2.4, 3.2)	3.4	(2.8, 4.0)
15 – 17	2.4	(2.2, 2.6)	2.5	(2.2, 2.7)
18 – 20	1.8	(1.6, 1.9)	1.9	(1.7, 2.0)
21 – 24	1.8	(1.5, 2.0)	1.7	(1.6, 1.9)
25 or older	1.9	(1.7, 2.2)	1.8	(1.6, 2.0)
Never misused	1.1	(1.1, 1.2)	1.1	(1.1, 1.1)

[a]Adverse childhood experience (ACE) score is calculated based on the number of exposures to 10 ACE categories.

[b]The means are weighted estimates.

Source: National Epidemiological Survey on Alcohol and Related Conditions, United States, 2012–2013 (n = 36, 309).

Table 3

Prevalence of specific types of adverse childhood experiences among adults by amphetamine-type stimulants or cocaine use and use disorder status.

Substance Variable	Adverse Childhood Experience Category									
	Emotional abuse	Physical abuse	Sexual abuse	Emotional neglect	Physical neglect	Witnessing Domestic Violence	Household Substance Use	Incarcerated household member	Household mental illness	Parental divorce or separation
	Prevalence, %[a] (95% CI)	Prevalence, %[a] (95% CI)	Prevalence, %[a] (95% CI)	Prevalence, %[a] (95% CI)	Prevalence, %[a] (95% CI)	Prevalence, %[a] (95% CI)	Prevalence, %[a] (95% CI)	Prevalence, %[a] (95% CI)	Prevalence, %[a] (95% CI)	Prevalence, %[a] (95% CI)
Amphetamine-Type Stimulants										
Lifetime[b] use										
Yes	18.3% (16.8%, 20.0%)	19.2% (17.6%, 21.0%)	20.1% (18.2%, 22.2%)	15.5% (13.9%, 17.2%)	13.6% (12.2%, 15.2%)	19.2% (17.8%, 20.6%)	43.1% (40.9%, 45.4%)	13.4% (11.7%, 15.2%)	11.5% (10.3%, 12.8%)	35.4% (33.0%, 37.9%)
No	8.2% (7.8%, 8.6%)	9.5% (9.0%, 10.0%)	10.5% (10.0%, 11.0%)	9.4% (8.9%, 9.9%)	8.0% (7.6%, 8.4%)	11.7% (11.2%, 12.3%)	23.2% (22.4%, 23.9%)	7.2% (6.8%, 7.6%)	6.5% (6.2%, 6.8%)	21.8% (21.0%, 22.6%)
Past-year use										
Yes	17.7% (12.7%, 24.1%)	16.7% (13.2%, 20.9%)	18.2% (14.2%, 23.0%)	13.6% (10.4%, 17.6%)	12.4% (9.0%, 16.9%)	17.8% (13.8%, 22.7%)	40.5% (35.1%, 46.1%)	15.3% (11.7%, 19.8%)	12.2% (8.8%, 16.6%)	39.6% (33.5%, 46.1%)
No	8.9% (8.4%, 9.3%)	10.2% (9.6%, 10.7%)	11.1% (10.6%, 11.7%)	9.8% (9.4%, 10.3%)	8.4% (8.0%, 8.8%)	12.3% (11, 7%, 12.8%)	24.6% (23.8%, 25.3%)	7.6% (7.2%, 8.0%)	6.8% (6.5%, 7.2%)	22.7% (21.9%, 23.5%)
Lifetime[b] use disorder[c]										
Yes	26.1% (21.6%, 31.0%)	26.7% (22.2%, 31.8%)	29.1% (24.9%, 33.8%)	17.4% (13.7%, 21.8%)	17.5% (13.8%, 22.1%)	23.32% (19.6%, 27.5%)	51.2% (47.5%, 56.0%)	21.1% (17.1%, 25.8%)	15.0% (11.8%, 18.8%)	42.4% (37.8%, 47.1%)
No	8.7% (8.3%, 9.1%)	10.0% (9.5%, 10.6%)	11.0% (10.5%, 11.5%)	9.8% (9.3%, 10.3%)	8.3% (7.9%, 8.7%)	12.2% (11.6%, 12.7%)	24.4% (23.6%, 25.1%)	7.5% (7.1%, 7.8%)	6.8% (6.4%, 7.1%)	22.6% (21.8%, 23.3%)
Past-year use disorder[c]										
Yes	29.9% (19.5%, 43.0%)	24.5% (16.2%, 35.3%)	29.2% (20.4%, 39.9%)	20.7% (13.1%, 31.1%)	24.4% (15.6%, 36.1%)	22.4% (15.1%, 31.9%)	54.8% (45.0%, 64.2%)	30.6% (20.6%, 42.9%)	16.6% (9.6%, 27.0%)	49.1% (35.3%, 63.0%)

Substance Variable	Adverse Childhood Experience Category									
	Emotional abuse	**Physical abuse**	**Sexual abuse**	**Emotional neglect**	**Physical neglect**	**Witnessing Domestic Violence**	**Household Substance Use**	**Incarcerated household member**	**Household mental illness**	**Parental divorce or separation**
	Prevalence, %[a] (95% CI)	**Prevalence, %[a] (95% CI)**	**Prevalence, %[a] (95% CI)**	**Prevalence, %[a] (95% CI)**	**Prevalence, %[a] (95% CI)**	**Prevalence, %[a] (95% CI)**	**Prevalence, %[a] (95% CI)**	**Prevalence, %[a] (95% CI)**	**Prevalence, %[a] (95% CI)**	**Prevalence, %[a] (95% CI)**
No	8.9% (8.5%, 9.4%)	10.2% (9.7%, 10.8%)	11.2% (10.7%, 11.7%)	9.9% (9.4%, 10.4%)	8.4% (8.0%, 8.8%)	12.3% (11.8%, 12.9%)	24.7% (24.0%, 25.5%)	7.6% (7.2%, 8.0%)	6.9% (6.6%, 7.2%)	22.8% (22.1%, 23.6%)
Cocaine										
Lifetime[b] use										
Yes	17.5% (15.9%, 19.2%)	18.4% (17.1%, 19.8%)	18.1% (16.4%, 19.9%)	15.8% (14.4%, 17.3%)	13.3% (12.0%, 14.8%)	18.7% (17.1%, 20.4%)	41.6% (39.5%, 43.7%)	13.0% (11.6%, 14.5%)	11.6% (10.3%, 13.1%)	34.3% (32.0%, 36.7%)
No	8.1% (7.7%, 8.5%)	9.4% (8.9%, 10.0%)	10.5% (10.1%, 11.0%)	9.3% (8.8%, 9.8%)	7.9% (7.5%, 8.3%)	11.7% (11.1%, 12.2%)	23.0% (22.2%, 23.7%)	7.1% (6.8%, 7.5%)	6.4% (6.0%, 6.8%)	21.6% (20.9%, 22.4%)
Past-year use										
Yes	19.8% (14.5%, 26.4%)	18.6% (14.7%, 23.2%)	17.4% (12.7%, 23.4%)	14.1% (10.5%, 18.6%)	14.2% (10.8%, 18.4%)	21.4% (16.6%, 27.1%)	50.3% (43.6%, 57.0%)	18.5% (14.8%, 22.9%)	14.9% (11.0%, 20.0%)	39.5% (34.0%, 45.3%)
No	8.9% (8.5%, 9.3%)	10.2% (9.7%, 10.8%)	11.2% (10.7%, 11.7%)	9.9% (9.4%, 10.4%)	8.4% (8.0%, 8.8%)	12.3% (11.7%, 12.8%)	24.5% (23.8%, 25.3%)	7.6% (7.2%, 8.0%)	6.8% (6.5%, 7.2%)	22.7% (21.9%, 23.5%)
Lifetime[b] use disorder[c]										
Yes	22.7% (19.2%, 26.5%)	26.0% (22.2%, 30.2%)	23.4% (19.9%, 27.2%)	19.8% (16.8%, 23.1%)	17.2% (14.2%, 20.6%)	26.8% (23.2%, 30.8%)	49.5% (45.8%, 53.2%)	17.1% (14.3%, 20.3%)	12.8% (10.1%, 16.1%)	40.1% (35.2%, 45.3%)
No	8.7% (8.3%, 9.1%)	9.9% (9.4%, 10.5%)	11.0% (10.5%, 11.5%)	9.7% (9.2%, 10.2%)	8.2% (7.8%, 8.6%)	12.0% (11.5%, 12.5%)	24.2% (23.5%, 25.0%)	7.5% (7.1%, 7.9%)	6.8% (6.4%, 7.1%)	22.5% (21.7%, 23.3%)
Past-year use disorder[c]										
Yes	21.0% (13.7%, 30.9%)	26.0% (19.3%, 33.9%)	18.3% (11.6%, 27.8%)	18.8% (11.9%, 28.4%)	19.8% (13.4%, 28.2%)	31.2% (21.6%, 42.6%)	52.6% (41.2%, 63.8%)	23.4% (16.0%, 33.0%)	15.6% (8.9%, 25.7%)	42.1% (30.9%, 54.1%)
No	9.0% (8.6%, 9.4%)	10.2% (9.7%, 10.8%)	11.2% (10.8%, 11.8%)	9.9% (9.5%, 10.4%)	8.4% (8.0%, 8.8%)	12.3% (11.8%, 12.9%)	24.7% (24.0%, 25.5%)	7.6% (7.3%, 8.0%)	6.9% (6.5%, 7.2%)	22.8% (22.1%, 23.6%)
Any Stimulant										

Substance Variable	Adverse Childhood Experience Category									
	Emotional abuse	Physical abuse	Sexual abuse	Emotional neglect	Physical neglect	Witnessing Domestic Violence	Household Substance Use	Incarcerated household member	Household mental illness	Parental divorce or separation
	Prevalence, %[a] (95% CI)	Prevalence, %[a] (95% CI)	Prevalence, %[a] (95% CI)	Prevalence, %[a] (95% CI)	Prevalence, %[a] (95% CI)	Prevalence, %[a] (95% CI)	Prevalence, %[a] (95% CI)	Prevalence, %[a] (95% CI)	Prevalence, %[a] (95% CI)	Prevalence, %[a] (95% CI)
Lifetime[b] use										
Yes	17.1% (15.8%, 18.5%)	18.1% (16.9%, 19.4%)	18.3% (16.8%, 20.0%)	15.2% (13.%, 16.5%)	13.1% (11.9%, 14.4%)	18.2% (17.0%, 19.5%)	40.6% (38.9%, 42.3%)	12.6% (11.3%, 14.0%)	11.2% (10.1%, 12.3%)	33.8% (31.9%, 35.8%)
No	7.8% (7.4%, 8.2%)	9.10% (8.6%, 9.7%)	10.2% (9.7%, 10.7%)	9.1% (8.6%, 9.6%)	7.7% (7.3%, 8.2%)	11.5% (10.9%, 12.0%)	22.4% (21.7%, 23.2%)	6.9% (6.6%, 7.3%)	6.3% (5.9%, 6.6%)	21.2% (20.5%, 22.0%)
Past-year use										
Yes	19.3% (14.9%, 24.5%)	17.9% (14.9%, 21.2%)	17.6% (14.4%, 21.5%)	13.6% (11.0%, 16.6%)	13.0% (10.2%, 16.4%)	19.1% (15.7%, 23.0%)	43.8% (39.2%, 48.4%)	16.5% (13.8%, 19.6%)	13.1% (10.3%, 16.6%)	39.1% (34.5%, 43.9%)
No	8.8% (8.3%, 9.2%)	10.1% (9.6%, 10.7%)	11.1% (10.6%, 11.6%)	9.8% (9.3%, 10.3%)	8.3% (7.9%, 8.7%)	12.2% (11.7%, 12.8%)	24.4% (23.6%, 25.1%)	7.5% (7.1%, 7.9%)	6.8% (6.4%, 7.1%)	22.6% (21.8%, 23.3%)
Lifetime[b] use disorder[c]										
Yes	22.6% (19.8%, 25.7%)	25.0% (21.8%, 28.5%)	25.2% (22.1%, 28.6%)	18.0% (15.6%, 20.8%)	16.6% (14.1%, 19.5%)	25.0% (22.2%, 27.9%)	49.2% (46.2%, 52.3%)	18.6% (16.0%, 21.5%)	13.5% (11.2%, 16.3%)	41.3% (37.7%, 45.1%)
No	8.5% (8.1%, 8.9%)	9.8% (9.2%, 10.3%)	10.8% (10.3%, 11.3%)	9.6% (9.1%, 10.2%)	8.2% (7.8%, 8.6%)	11.9% (11.4%, 12.4%)	24.0% (23.2%, 24.7%)	7.3% (6.9%, 7.7%)	6.7% (6.3%, 7.0%)	22.3% (21.5%, 23.0%)
Past-year use disorder[c]										
Yes	25.8% (18.5%, 34.8%)	25.7% (19.5%, 33.1%)	22.5% (16.6%, 29.7%)	19.5% (14.2%, 26.2%)	21.8% (15.5%, 29.7%)	26.0% (19.7%, 33.4%)	52.4% (45.2%, 59.5%)	24.5% (18.0%, 32.4%)	15.0% (9.5%, 22.7%)	45.2% (35.7%, 55.2%)
No	8.9% (8.5%, 9.3%)	10.2% (9.7%, 10.8%)	11.2% (10.7%, 11.7%)	9.9% (9.4%, 10.4%)	8.4% (8.0%, 8.8%)	12.3% (11.7%, 12.8%)	24.7% (23.9%, 25.4%)	7.6% (7.2%, 8.0%)	6.9% (6.5%, 7.2%)	22.8% (22.0%, 23.5%)

[a] The percentages are weighted estimates.

[b] Lifetime use indicates a respondent reporting ever use of substance.

[c] Use disorder is assessed based on self-reported questions that correspond to DSM-V diagnosis criteria.

Source: National Epidemiological Survey on Alcohol and Related Conditions, United States, 2012–2013 (n = 36, 309).

Table 4

Association between adverse childhood experiences score and amphetamine-type stimulant, cocaine, or any stimulant use and use disorder[a]

Substance Variable	Series 1				Series 2			
	Adverse Childhood Experience Score				Adverse Childhood Experience Score			
	0	1	2–3	>=4	0	1	2–3	>=4
	AOR[b] (95% CD	AOR[b] (95% CD	AOR[b] (95% CD	AOR[b] (95% CD	AOR[c] (95% CD	AOR[c] (95% CD	AOR[c] (95% CI)	AOR[c] (95% CI)
Amphetamine-Type Stimulant								
Lifetime[d] use	1.00 (referent)	1.14 (1.00, 1.31)	1.50 (1.32, 1.71)	2.10 (1.75, 2.53)	1.00 (referent)	1.08 (0.94, 1.24)	1.32 (1.16, 1.51)	1.70 (1.39, 2.07)
Past-year use	1.00 (referent)	1.03 (0.73, 1.45)	1.16 (0.84, 1.59)	1.59 (1.15, 2.18)	1.00 (referent)	0.97 (0.68, 1.38)	0.99 (0.72, 1.36)	1.25 (0.89, 1.75)
Lifetime[d] use disorder[e]	1.00 (referent)	1.43 (1.07, 1.92)	2.01 (1.50, 2.70)	2.74 (2.07, 3.64)	1.00 (referent)	1.38 (1.04, 1.83)	1.78 (1.33, 2.39)	2.18 (1.65, 2.88)
Past-year use disorder[e]	1.00 (referent)	1.30 (0.59, 2.87)	2.33 (1.19, 4.56)	3.25 (1.78, 5.95)	1.00 (referent)	1.23 (0.55, 2.79)	2.06 (1.05, 4.05)	2.52 (1.36, 4.70)
Cocaine								
Lifetime[d] use	1.00 (referent)	1.26 (1.07, 1.50)	1.40 (1.22, 1.60)	1.93 (1.64, 2.26)	1.00 (referent)	1.22 (1.03, 1.45)	1.25 (1.08, 1.45)	1.57 (1.34, 1.85)
Past-year use	1.00 (referent)	0.95 (0.67, 1.36)	1.35 (0.92, 1.98)	1.90 (1.24, 2.90)	1.00 (referent)	0.87 (0.59, 1.26)	1.11 (0.73, 1.67)	1.35 (0.89, 2.05)
Lifetime[d] use disorder[e]	1.00 (referent)	1.08 (0.81, 1.44)	1.62 (1.30, 2.01)	2.52 (1.96, 3.24)	1.00 (referent)	1.02 (0.76, 1.38)	1.40 (1.11, 1.77)	1.98 (1.53, 2.57)
Past-year use disorder[e]	1.00 (referent)	0.76 (0.38, 1.54)	1.07 (0.52, 2.18)	2.39 (1.18, 4.86)	1.00 (referent)	0.70 (0.34, 1.44)	0.83 (0.39, 1.74)	1.70 (0.85, 3.37)
Any Stimulant[f]								
Lifetime[d] use	1.00 (referent)	1.25 (1.09, 1.44)	1.45 (1.29, 1.63)	1.99 (1.70, 2.32)	1.00 (referent)	1.21 (1.05, 1.39)	1.31 (1.16, 1.48)	1.66 (1.41, 1.95)
Past-year use	1.00 (referent)	0.98 (0.75, 1.29)	1.25 (0.96, 1.64)	1.72 (1.30, 2.27)	1.00 (referent)	0.91 (0.68, 1.22)	1.07 (0.80, 1.42)	1.32 (0.98, 1.77)
Lifetime[d] use disorder[e]	1.00 (referent)	1.20 (0.95, 1.53)	1.79 (1.50, 2.12)	2.55 (2.10, 3.09)	1.00 (referent)	1.15 (0.91, 1.47)	1.60 (1.32, 1.91)	2.08 (1.68, 2.56)
Past-year use disorder[e]	1.00 (referent)	0.95 (0.55, 1.66)	1.57 (0.98, 2.49)	2.48 (1.55, 3.98)	1.00 (referent)	0.89 (0.50, 1.59)	1.32 (0.82, 2.13)	1.87 (1.15, 3.02)

Note: The adjusted odds ratios (AORs) are weighted estimates; Bold text indicates statistical significance at a significance level of 5%Source: National Epidemiological Survey on Alcohol and Related Conditions, United States, 2012–2013 (n = 36, 309).

[a]Adverse childhood experience (ACE) score is calculated based on the number of exposures to 10 ACE categories.

[b]Models were adjusted for sex, age, race/ethnicity, education, marital status, region, employment status, lifetime cannabis use, lifetime tobacco use, and past-year binge drinking.

[c]Models were adjusted for sex, age, race/ethnicity, education, marital status, region, employment status, lifetime cannabis use, lifetime tobacco use, past-year binge drinking, lifetime prescription opioid misuse, lifetime heroin use.

[d] Lifetime use indicates a respondent reporting ever use of substance.

[e] Use disorder is assessed based on self-reported questions that correspond to DSM-V diagnosis criteria.

[f] Amphetamine-type stimulants and/or cocaine.