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Associations of adolescent exposure to severe violence with substance use from adolescence into adulthood: Direct versus indirect exposures

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Abstract

Background: While previous research has documented the impact of violence on substance use, none has looked longitudinally across the lifespan to measure independent effects of direct and indirect violence exposure.

Objective: To examine independent associations between adolescent experiences of violence and subsequent substance use in adolescence and adulthood in the United States.

Method: Using the National Longitudinal Study of Adolescent to Adult Health (N=12,288), we examined being shot or stabbed (“experienced”), being threatened with a knife or gun (“threatened”), and seeing someone either shot or stabbed (“witnessed”) during adolescence (Wave I) as correlates of substance use in adolescence and adulthood (Wave IV) via logistic regression.

Results: Violence exposure was a significant correlate of drug use in adolescence and several associations remained significant in adulthood. Witnessing violence had the highest point estimates in the adjusted models in adolescence for each substance use outcome (e.g., Cocaine-

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DECLARATION OF INTEREST

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

Adjusted Odds Ratios [AOR]=2.59, 95% confidence interval [CI]=1.21, 5.54). However, the point estimates for threatened with violence or experienced violence were highest in three out of the four drug outcomes in adulthood (e.g., Threatened with violence: Binge drinking-AOR=1.41, 95% CI=1.08, 1.83).

Conclusion/Importance: Adolescent exposure to witnessing violence had stronger effects on substance use in adolescence, while experiencing and being threatened with violence in adolescence had stronger effects on substance use in adulthood. Violence prevention efforts targeted toward adolescents may lead to a reduction in substance use throughout the life-course, and clinicians and policy makers should be aware of the downstream effects of violence experienced in adolescence.

Statement of Integrity

The paper enclosed does not include any overlapping information in prior publications or submissions under review. This manuscript is currently not under review at any other journal, nor will it be submitted to any other journal while under consideration by *Substance Use and Misuse*.

Keywords

Gun Violence; Substance Use; Add Health; Life-course; Adolescence

Substance use among individuals over the age of 12 in the United States has been steadily rising in the past decade, and has increased by approximately 8% since 2002 (NIDA, 2015). This is a significant public health issue given that substance use has been linked to numerous negative health consequences (e.g., substance abuse disorders, smoking, liver damage, criminal justice involvement, educational failure) (Crisanti, Frueh, Gundaya, Salvail, & Triffleman, 2011; Dawson, Li, & Grant, 2008; King & Chassin, 2007; Kroutil, Vorburger, Aldworth, & Colliver, 2010; Wolff, Huening, Shi, & Frueh, 2014), as well as difficulties with interpersonal relationships and emotional distress (Newcomb, 1994). Substance use during adolescence is particularly detrimental as it is associated with impaired neurocognitive development and academic achievement, as well as increased risk of substance abuse later in adulthood (Hawkins, Catalano, & Miller, 1992; King & Chassin, 2007; Squeglia, Jacobus, & Tapert, 2009).

Exposure to violence represents an important correlate of substance use both in adolescence and adulthood (Berenson, Wiemann, & McCombs, 2001; Edalati & Krank, 2015; Kilpatrick et al., 2000, 2003; Schiff et al., 2014; Simantov, Schoen, & Klein, 2000; Turanovic & Pratt, 2015; Vermeiren, Schwab-Stone, Deboutte, Leckman, & Ruchkin, 2003; Zimmerman & Posick, 2015). For example, Schiff et al (2014) found in their longitudinal study that adolescent exposure to intimate partner violence (IPV) between their parents was associated with anxiety disorder, nicotine, alcohol, and cannabis use disorders in girls and boys. Turanovic and Pratt (2015) reported that adolescent exposure to violence and victimization was significantly associated with marijuana and hard drug use, among other adverse consequences, in adulthood.

Exposure to extreme violence during adolescence (e.g., being shot or stabbed or being threatened at knife or gunpoint, and witnessing murder) has been found to be strongly

associated with substance use (Berenson et al., 2001; Kilpatrick et al., 2000, 2003; Turanovic & Pratt, 2015; Vermeiren et al., 2003; Zimmerman & Posick, 2015). Posttraumatic stress disorder (PTSD) (Finkelstein & Yates, 2001; Fitzpatrick & Boldizar, 1993; Fowler, Tompsett, Braciszewski, Jacques-Tiura, & Baltes, 2009; Kennedy, Bybee, & Greeson, 2014; Kilpatrick et al., 2003), depression (Madruga et al., 2011), and trauma-related symptomatology (Dulmus & Wodarski, 2000), could be the mechanisms by which violence-related trauma leads to substance use in both adolescence and adulthood. However, the extant literature is limited in that most investigators have focused on effects during adolescence and have not examined for longitudinal effects later in the life course (Atwoli, Platt, Williams, Stein, & Koenen, 2015; Berenson et al., 2001; Kilpatrick et al., 2000; Martin, Clark, Lynch, Kupper, & Cilenti, 1999; Simantov et al., 2000). Thus, there remains a need to document the short- and long-term influence of childhood exposure to extreme violence (e.g., violence with a gun or knife). Because few studies have employed longitudinal data when assessing these relationships, the temporal order of exposure to violence and drug use has also not been well established.

There also is evidence that witnessing violence (or “indirect” exposure) constitutes a traumatic event by increasing stress, anxiety, and PTSD symptomatology, and is associated with substance use independent of the experience of violence (Kilpatrick et al., 2000; Vermeiren, Schwab-Stone, Deboutte, Leckman, & Ruchkin, 2003). Among the more rigorous studies conducted, a longitudinal study among adolescents (mean age 12 years) living in Chicago, suggested comparable independent effects of witnessing violence and experience of violence on subsequent alcohol and marijuana use one year later (Zimmerman & Posick, 2015). Specifically, experience of violence and witnessing of violence in the absence of direct experience predicted a mean marijuana use rate of 0.39 and 0.37 respectively, versus a mean of 0.15 for those not exposed to violence. These findings importantly highlighted the strong deleterious effects of witnessing violence early in the life course on adolescent substance use risk.

Unfortunately, the field of research on the impact of indirect violence controlling for direct violence is relatively limited. There is a need to evaluate, using longitudinal data, whether adolescent violence exposure continues to impact substance use risk into the young adult and adult developmental periods, and to evaluate whether indirect violence predicts subsequent substance use in a nationally representative sample. Given evidence indicating that over 70% of adolescents aged 14 to 17 witness violence against another person (Finkelhor, Turner, Ormrod, Hamby, & Kracke, 2009), research examining the role of witnessing violence, as well as direct experience of violence, has considerable public health relevance.

The purpose of this study is to address current gaps in research by examining the relationships between direct versus indirect violence and substance use using Wave I (1994–1995; adolescence), Wave III (2001–2002, young adulthood), and Wave IV (2007–2008; adulthood) data of the National Longitudinal Study of Adolescent to Adult Health (Add Health). Specifically, we measured associations between three forms of violence in adolescence (i.e., experience of being shot and/or stabbed, being threatened at knifepoint or gunpoint, and witnessing a shooting or stabbing) and both adolescent and adulthood

substance use outcomes, adjusting for other violence factors in an effort to isolate the potential contributing effect of each form of violence. While drug use has been shown to lead to increased risk of violent behavior (Weiner, Sussman, Sun, & Dent, 2001), this paper examines violence as a predictor of subsequent substance use given that previous literature has also suggested that exposure to violence may lead to substance use (Vermeiren et al., 2003; Zimmerman & Posick, 2015).

This study expands the research literature by incorporating a life-course perspective using data that is not only longitudinal, as was done by Zimmerman and Posick (2015), but also from two different developmental time periods (i.e., adolescence and adulthood). Incorporating this timeframe allows for the demonstration of short- and long-term effects throughout the life span. In addition, this study employs a nationally-representative sample that allows for wider generalization of the findings than with previous studies, which are typically focused on urban areas (e.g., Chicago) (Zimmerman & Posick, 2015). The current study also examines associations with individual substances (e.g., cocaine, methamphetamines) rather than combining them into categories (e.g., “hard” drugs) as has been done previously (Menard, Covey, & Franzese, 2015). It was also possible to isolate the effect of particular forms of severe violence (i.e., witnessing versus experiencing violence with a gun or knife) by controlling for other forms of violence as was done previously in a cross-sectional sample (Kilpatrick et al., 2003).

METHODS

The National Longitudinal Study of Adolescent to Adult Health (Add Health) is a nationally-representative longitudinal study of US adolescents who were in 7–12th grade during the 1994–95 school year. This cohort has completed three subsequent in-home interviews to date, consisting of measures assessing social, economic, psychological, and physical well-being described in detail elsewhere (Resnick et al., 1997; Sieving et al., 2001). A total of 20,745 adolescents completed a baseline interview at Wave I (adolescence ages 11–21; 1994–1995). Of those Wave I respondents, 15,197 were re-interviewed at Wave III (emerging adulthood ages 18–26; 2001–2002), and 15,701 at Wave IV (adulthood ages 24–32; 2007–2008). We excluded Wave II from this analysis given its temporal proximity to Wave I. Our final sample included 12,288 respondents who participated in Waves I, III, and IV and had valid sample weights (Chen & Chantala, 2014). Study activities were approved by the Institutional Review Boards at the University of Florida and NYU School of Medicine.

Measures

Independent Variables—Wave I data provided measures of exposure to three forms of violence during the prior year: witnessing (saw someone shoot or stab another person), being threatened with (had a knife or gun pulled on them), and experiencing (were shot or stabbed). We dichotomized violence variables as ever experienced and never experienced (referent). For the purposes of this paper witnessing violence will be considered “indirect violence”, and being threatened with violence or experiencing violence will be considered “direct violence”.

Dependent Variables (Wave I)—Three dichotomous (yes vs. no (referent)) substance use indicators were derived from Wave I data: binge drinking (consuming 5 or more drinks in a row) in the past year, marijuana and cocaine use during the past month.

Dependent Variables (Wave IV)—Four dichotomous (yes vs. no (referent)) substance use indicators were derived from Wave IV data: binge drinking and marijuana use during the past month, and cocaine and methamphetamine use since Wave III.

Covariates—We coded race/ethnicity as: White (referent), Black, Hispanic, and other, and gender as female (referent) and male. Age was a continuous variable and was the respondent's age at Wave I, though we categorized age ranges for Table 1. Educational attainment was an ordinal variable captured at Wave IV and was coded as less than high school (referent), high school, and more than high school. We included poverty indicators, based on the ability to pay one's housing/utility bills (yes vs. no (referent)), for Wave I (parent report) and Wave III (respondent report).

Additional potential confounding risk factors were also included as covariates in the analysis. Parents were asked at Wave I if they were currently receiving public assistance (i.e., welfare and/or food stamps), and whether they had concerns related to drugs in their neighborhood. Experience of physical and sexual abuse by the beginning of 6th grade were each captured at Wave III, and experience of each form of abuse before the age of 18 was captured at Wave IV. Affirmative response at Wave III and Wave IV were combined to create the two variables included for analysis. Neglect by the beginning of 6th grade was also captured at Wave III by combining two items, one which assessed whether the respondent had been left alone when they should have been supervised, and the second which assessed whether the respondent's caregiver had ever failed to meet their basic needs (e.g., keeping them clean or providing food or clothing); affirmative answers for both were combined for analysis. Self-report of parental binge drinking was captured at Wave I, and respondent's report of parental incarceration during respondent's childhood was also captured at Wave IV. Finally, respondent report of peer substance use was captured at Wave I. Receiving public assistance, concerns about drugs in their neighborhood, childhood abuse/neglect, parental binge drinking, and parental incarceration were all dichotomous variables (yes vs. no (referent)).

Analysis—We conducted analyses with SAS version 9.4 ("SAS/STAT Software. SAS Institute, Inc.: Cary, NC," 2010) and accounted for stratification, clustering, and unequal selection probabilities, yielding nationally-representative estimates. We conducted bivariable analyses for the weighted prevalence of participants' sociodemographic characteristics and substance use by exposure to any of the three forms of violence. Multivariable logistic regression estimated partially adjusted and fully adjusted odds ratios, and 95% confidence intervals for associations between each form of violence exposure and substance use outcomes at waves I and IV. For Wave I outcomes, the partially adjusted models controlled for gender, age, race, poverty indicator in adolescence, receiving public assistance, concerns related to drugs in their neighborhood, parental binge drinking, parental incarceration, peer substance use, child abuse (sexual and physical), and neglect. Fully adjusted models included the variables in the partially adjusted models in addition to all three violence

variables. For Wave IV outcomes, the partially adjusted models included all variables in the partially adjusted models at Wave I, as well as the poverty indicator in emerging adulthood and educational attainment. Wave IV partially and fully adjusted models also controlled for substance use at Wave I, with the exception of methamphetamine use which was not collected at Wave I.

RESULTS

Sample Characteristics

The total sample was predominantly White (65.6%), and evenly divided by gender (50.6% male). The largest proportion of participants (42.8%) were between the ages of 11–15 at Wave I, and the mean age was 15.9 years at Wave I. Seventeen percent of caregivers (17.0%) reported having difficulty paying bills at Wave I, and 14.1% of respondents reported similar difficulty at Wave III. Seventy-four percent (74.0%) of the respondents had obtained more than a high school education by adulthood. When looking at additional potential confounders of the association between exposure to violence and substance use, peer substance use was the most prevalent (57.4%), followed by worrying about drugs in the neighborhood (39.0%), and receiving public assistance (15.7%).

Alcohol and marijuana were the most commonly used substances both Waves I and IV. Marijuana use during the past month increased from 14.0% at adolescence to 17.2% at adulthood, representing over a 3-percentage point increase. A similar proportion of respondents reported having engaged in binge drinking in the past month (17.2%) as used marijuana during the past month (16.2%) at adulthood.

Approximately 11% witnessed violence, 12% were threatened with violence, and 5% experienced violence in the year prior to the Wave I survey (data not shown in tables). The three violence exposures were also strongly correlated. Specifically, those who had witnessed a shooting or stabbing were much more likely to have been threatened at knife or gunpoint (47.9 versus 7.7%, $p<0.0001$) and/or to have been shot or stabbed (22.5% versus 3.0%, $p<0.0001$) (data not shown in tables). Likewise, those who had been threatened with violence were much more likely to have experienced violence (26.2% versus 2.2%, $p<0.0001$) than those who had not been threatened. However, given the large sample size, collinearity was not a concern for the proposed analysis.

Differences in Exposure to Any Form of Violence across Sociodemographic, and Substance Use Outcomes

The results from the bivariable analyses (Table 1) indicated that those who had been exposed to any of the three forms of violence were more likely to be Black (29.7% among exposed to violence vs. 19.1% among unexposed) and Hispanic (22.2% among exposed to violence vs. 13.9% among unexposed) than White (38.3% among exposed to violence vs. 57.6% among unexposed). Males constituted a larger percentage of those exposed to violence (65.2%) when compared to those not exposed to violence (47.1%). Younger youth between the ages of 11 – 15 represented a smaller percentage of those exposed to violence (36.0%) compared to those unexposed to violence (44.4%). Caregivers of those exposed to violence

also reported a significantly higher prevalence of difficulty paying bills (22.1%) compared to those unexposed to violence (15.7%) at Wave I. This was the case as well during emerging adulthood (Wave III) when 18.9% of respondents exposed to violence reported difficulty paying bills, compared to 13.1% among those not exposed to violence. There was also a statistically significant difference in education among those exposed to violence when compared to those unexposed: 76.6% of those unexposed to violence had obtained at least a high school degree, while only 64.2% of those exposed to violence reached the same level of education. With the exception of parental binge drinking, all potential confounders proved to be more prevalent among those exposed to violence. Lastly, having been exposed to violence was significantly associated with all substance use outcomes at both waves in the bivariable analysis.

Associations between Violence during Adolescence and Substance Use in Adolescence

In models adjusting for sociodemographics and all forms of violence exposure (Table 2), witnessing violence and being threatened with violence were independently associated with binge drinking in the past year (witnessing violence AOR=1.94, 95% CI: 1.49, 2.52; threatened with violence AOR=1.61, 95% CI: 1.26, 2.06). While experienced violence was associated with over twice the odds of binge drinking in unadjusted and partially adjusted models, the estimate was reduced and no longer statistically significant at the 0.05 level when the other forms of violence were included. In fully adjusted models, witnessing violence was the strongest independent correlate of marijuana use (AOR=2.09, 95% CI: 1.62, 2.69), and threatened and experienced violence were associated with approximately 32% and 57% increase in the odds respectively. In addition, after adjustment for sociodemographics and the other forms of violence, witnessed violence remained a strong correlate (AOR=2.59, 95% CI: 1.21, 5.54) of cocaine use in adolescence; threatened with violence and experienced violence were no longer associated. In unadjusted models, each form of violence exposure was significantly associated with approximately three to three and a half times the odds of cocaine use.

Associations between Violence during Adolescence and Substance Use in Adulthood

Threatened with violence was the only form of violence that remained a significant correlate in fully adjusted models for binge drinking in adulthood (AOR=1.41, 95% CI: 1.08, 1.83) (Table 3). While each form of violence exposure was significantly associated with approximately a 45 percent to 93 percent increase in the odds of binge drinking in adulthood in the unadjusted models, being threatened with violence was the only significant correlate in the partially adjusted models (POR=1.41, 95% CI: 1.10, 1.81).

Similarly to binge drinking, being threatened with violence was the only form of violence that remained a significant correlate in fully adjusted models for marijuana use during the past month in adulthood (AOR=1.35, 95% CI: 1.04, 1.76). While each form of violence exposure was significantly associated with approximately a 61 percent to 97 percent increase in the odds of marijuana use in adulthood in the unadjusted models, being threatened with violence was the only significant correlate in the partially adjusted model (POR=1.37, 95% CI: 1.08, 1.74).

While none of the forms of violence were significantly associated with cocaine use in adulthood in the fully adjusted models, experiencing violence was significantly associated in the partially adjusted models (POR=1.58, 95% CI: 1.08, 2.32). Being threatened with and experiencing violence were both significantly associated with cocaine use in the unadjusted models, indicating a 46 percent and 62 percent increased odds respectively.

Lastly, while none of the fully adjusted models for methamphetamine use were statistically significant, witnessing violence was the strongest correlate in the fully adjusted models (AOR=1.44, 95% CI: 0.88, 2.36). All unadjusted models were significant with experience of violence being the strongest correlate (OR=2.01, 95% CI: 1.43, 2.82).

While the strengths of association weakened from adolescence to adulthood, significant associations remained even after controlling for substance use in adolescence. In contrast to the adolescent outcomes in which the highest point estimates tended to be for witnessing violence, the largest point estimates were for being threatened with violence in two out of the four substance use outcomes in adulthood (i.e., binge drinking and marijuana use). The largest point estimates for cocaine use since Wave III at adulthood were for experience of violence, but largest point estimates for methamphetamine use during the same time period were for having witnessed violence.

DISCUSSION

In this nationally representative sample, we observed that approximately one in ten youth living in the US during 1995–96 had witnessed a stabbing or shooting or had been threatened at knife or gun point, and that 5% were shot or stabbed during their adolescence. We also observed that, in multivariable models, witnessing violence had the largest point estimates for substance use during adolescence (relative to being threatened with and experiencing violence with a knife or a gun), but that more direct forms of violence had larger point estimates for three out of the four substance use outcomes in adulthood.

Thus, in a nationally representative sample this study corroborates the significance of both direct and indirect contact with serious violent events (e.g., gun violence) for substance use risk that has been documented in previous studies among populations recruited from high-risk neighborhoods (Lee, 2012). For example, Zimmerman et al. documented in a study of Chicago youth that direct and indirect exposure to violence had comparable effects in relation to several substance use outcomes, and other negative psychosocial outcomes (e.g., violent offending, property offending, and suicidal behavior) (Zimmerman & Posick, 2015). A recent study also found an over two-fold increased odds of drug use in female adults who consistently witnessed parental violence as an adolescent, or experienced general violent victimization (i.e., violence experienced outside the home) during adolescence (Menard, Covey, & Franzese, 2015). Thus, we confirm, in a nationally representative sample, that both direct and indirect violence are significantly associated with substance use and extend their work to document the long-term differential impact of exposure to direct and indirect forms of severe violence (i.e., involving knife or gun) during adolescence on the risk of use of particular substances in adulthood (i.e., not just looking at “hard drugs” combined).

Violence appeared to have the strongest influence on substance use in adolescence, but effects remained into the adulthood period. Perhaps surprisingly, we observed that point estimates were higher for the associations between indirect exposure (i.e., witnessing someone being stabbed or shot) and adolescent substance use when compared to direct experience of similar violence in multivariable models that controlled for all three forms of violence exposure. Our findings, therefore, underscore the deleterious effects of being exposed to violence, even when one is not physically harmed, and lend support to expansion of the posttraumatic stress disorder diagnosis to include indirect forms of violence (Long et al., 2008; Rosen & Frueh, 2007; Van Hooft, McFarlane, Baur, Abraham, & Barnes, 2009).

Conversely in adulthood, the point estimates for direct forms of severe violence (i.e., being threatened at knifepoint or gunpoint, and being stabbed or shot) were larger than for indirect exposure of witnessing violence. These findings could suggest that experiencing these more direct forms of severe violence during adolescence have longer term effects, and would be consistent with the “dose-response” theory of trauma-psychopathology (McNally, 2003; L. C. Wilson, 2014). The dose-response model posits that PTSD symptoms worsen as the severity of the stressor increases. This would then suggest that symptoms of someone who experienced an actual gun shot or stabbing or being threatened with a gun or knife would be more severe when compared to someone who had just witnessed a shooting or stabbing. This higher PTSD symptomology could subsequently lead to greater levels of substance use as means of self-medicating, and stronger links with those more severe forms of violence.

The most robust relationships between violence and substance use appear to be with binge drinking and marijuana use, and these relationships remain robust into adulthood. This could be due to the fact that alcohol and marijuana are both substances that are more readily available and socially accepted in comparison to other “harder drugs”. Depressants, such as alcohol and marijuana, are also commonly used by those affected with PTSD (rather than stimulants such as cocaine), in order to cope with hyperarousal that is commonly associated with PTSD (Saladin, Brady, Dansky, & Kilpatrick, 1995; Stewart, Mitchell, Wright, & Loba, 2004). It is also evident, when comparing the three models (i.e., unadjusted, partially adjusted, and fully adjusted), that the other violence variables are significant confounders when looking at the associations between each individual form of violence and substance use outcomes at both waves. This is due to the high correlation between the three violence variables in this dataset. For example, as previously mentioned, those who had witnessed violence or been threatened with violence would be more likely to have experienced it.

The observed associations at both waves could be best explained as a coping response to the trauma experienced when exposed to various forms of violence, otherwise known as “Self-Medication” (Khantzian, 1997). The theory of self-medication posits that substance use occurs as an effort to manage distressing effects or symptoms associated with a trauma, and was also illustrated in the Zimmerman article that found higher levels of both suicidal ideation and substance use among those who experienced higher levels of violence exposure. The findings from the study also suggest that addressing the more common forms of severe violence (e.g., threat of or witnessing violence with a gun or a knife) that occur disproportionately in low resource communities could potentially impact substance use and abuse. These forms of violence are traumatic events that are often overlooked due to the lack

of physical signs of trauma as would be seen from more direct forms of physical violence (e.g., gunshot wounds). A trauma informed approach to addressing violence could also be an appropriate means of reducing substance use and abuse at a community level and necessitate a collaborative effort between policymakers, law enforcement, and clinical service providers.

Recent Add Health studies have sought to estimate the independent and joint influence of a range of traumatic events and substance use outcomes (Quinn et al., 2016; Scheidell et al., 2017). Noting these findings in the context of the current study focused on violence is relevant to understand the relative importance of violence compared with other traumatic events. In those studies, violence exposures were correlated with other forms of trauma, and cumulative exposure to multiple forms of childhood trauma greatly increased odds of marijuana and cocaine use (Scheidell et al., 2017), as well as prescription pain reliever misuse and injection drug use (Quinn et al., 2016). However, in models estimating the potential influence of one trauma, controlling for other traumas, each trauma was independently linked to substance use in adolescence and/or adulthood. Those studies also suggested that recent exposure to direct and indirect forms of extreme violence were, in general, more consistent independent correlates of adolescent marijuana and cocaine use. In addition, stronger associations between violence and these outcomes persisted into adulthood compared with most other traumas.

For example, Scheidell et al. (2017) found that, in adjusted models, childhood physical and sexual abuse indicators were linked to modest elevations in adolescent marijuana use (approximately 30% increase in the odds), while report of witnessing and/or being threatened with violence was associated with an approximate doubling of the odds of adolescent marijuana use. While they found physical abuse was not associated with adolescent cocaine use, sexual abuse and indirect violence had comparably strong associations, with both exposures independently associated with over twice the odds of the outcome. Violence exposures remained stronger predictors of adulthood cocaine use than physical and/or sexual abuse, with being threatened with violence and experience of violence associated with 50–90% the odds of adulthood cocaine use.

Efforts to reduce exposure to severe violence should target adolescents who may be at increased risk (e.g., Black or Hispanic, male, living in poverty, and parental incarceration), and those residing in neighborhoods with high levels of community violence. The common experience of violence in school settings, ranging from frequent and less well documented violent acts among youth (e.g., those involving guns and knives) (Diliberti, Jackson, & Kemp, 2017) to high-profile cases of mass shootings in schools (Barron, 2012; Burch & Mazzei, 2018), highlight the importance of addressing exposure to violence and subsequent trauma within these settings. Specifically, a recent report published by the US Department of Education showed that as many as 31% of US public high schools (and 16% of all public schools) reported serious violent incidents (i.e., sexual assault, physical attack or fight with a weapon, threat of physical attack with a weapon, and robbery) (Diliberti et al., 2017). School policies that improve gun control should be coupled with school-based programs that aim to reduce violence and address the traumas of direct and indirect experiences with violence. Schools have also been shown to be an effective environment to address issues related to violence (D. B. Wilson, Gottfredson, & Najaka, 2001).

Limitations of the study included inconsistency of measurement of drug outcomes across waves, and it also not clear from the wording of the violence items where the violence took place (e.g., in the home or in the community). Specifically, the measures also do not specify whether the perpetrator of the violence was known or unknown to the witness or victim. As a result, we do not know whether this is interpersonal or familial violence (which could include child maltreatment) or whether this is community violence (i.e., peer violence or random acts of violence outside the home). This is in contrast to other studies which have been explicit in the way in which they have defined “community violence” (Lee, 2012; Vermeiren, Schwab-Stone, Deboutte, Leckman, & Ruchkin, 2003). This has implications for prevention or intervention, given that differential effects of these specific forms of violence cannot be identified and targeted with this data. For example, differential effects based on type of perpetrator (i.e., stranger or known person) have been reported suggesting that violence perpetrated by known individuals to the victim has been shown to lead to worse psychosocial outcomes (Price, Higa-McMillan, Kim, & Frueh, 2013).

There may have also been selection bias due to the school-based sampling methods, and attrition may have been concentrated among those with highest levels of violence exposure and/or substance use. Lastly, while violent crimes and associated exposures to violence remain at high levels (Finkelhor et al., 2009), they have declined since the mid-nineties nationally (Truman & Langton, 2014). As such, we are capturing long-term impacts of exposure to violence while it was still at higher levels in the mid 90’s relative to current levels, and the relationship between violence and substance use observed in our study may differ among youth today. Despite these limitations, there were several notable strengths. One such strength of the study included the prospective design for analyses of the influence of adolescent violence on adulthood substance use, the nationally-representative sample, and rich data on participant background characteristics to enable rigorous control for confounding including other exposures to violence.

In sum, this research highlights the extent to which less frequent and more severe forms of violence impact substance use. This study builds off of previous research (Lee, 2012), by using a nationally representative sample, and is not limited to high risk neighborhoods (e.g., high levels of poverty, unemployment, and serious crimes), or a specific urban area. The findings suggest that even witnessing violence, irrespective of where the violence takes place and who is perpetrating it, has a significant impact on substance use particularly in adolescence. Interventions designed to address early exposure to severe violence should target those populations previously mentioned, which are most at risk, and should attempt to address upstream causes of violence (e.g., poverty, employment opportunity, gun laws), as well as its downstream consequences (e.g., psychopathology related to traumatic exposure to violence).

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TABLE 1:

PARTICIPANT SOCIO-DEMOGRAPHIC CHARACTERISTICS, SUBSTANCE USE, AND ADOLESCENT EXPOSURES TO VIOLENCE IN THE US (N=12,288)

<u>Variable Name</u>	<u>Total* No., (Weighted %)</u>	<u>No Violence No., (Weighted %)</u>	<u>Violence** No., (Weighted %)</u>	<u>p (X² test)</u>
Demographic Covariates				
Race				
White	6597 (65.6)	5625 (57.6)	941 (38.3)	<.0001
Black	2609 (16.0)	1865 (19.1)	730 (29.7)	
Hispanic	1913 (11.9)	1354 (13.9)	544 (22.2)	
Other	1162 (6.5)	914 (9.4)	240 (9.8)	
Gender (Wave IV)				
Female	6684 (49.4)	5687 (52.9)	969 (34.8)	<.0001
Male	5604 (50.6)	4074 (47.1)	1488 (65.2)	
Age (Wave I)				
11–15	4548 (42.8)	3760 (44.4)	764 (36.0)	0.0004
16–17	4723 (32.8)	3650 (31.6)	1043 (37.4)	
18+	3012 (24.4)	2349 (24.0)	649 (26.6)	
Adolescent functional poverty indicator: Household had difficulty paying bills (Wave I)				
No	8570 (83.0)	6965 (84.3)	1560 (76.9)	<.0001
Yes	1849 (17.0)	1393 (15.7)	446 (22.1)	
Emerging Adult poverty indicator: Household had difficulty paying bills (Wave III)				
No	10464 (85.9)	8404 (86.9)	1994 (81.1)	<.0001
Yes	1720 (14.1)	1276 (13.1)	441 (18.9)	
Educational attainment (Wave IV)				
Less than HS	896 (8.5)	588 (7.1)	297 (14.0)	<.0001
HS graduate	1934 (17.5)	1435 (16.3)	478 (21.8)	
More than HS	9458 (74.0)	7738 (76.6)	1682 (64.2)	
Household Received Public Assistance (Wave I)				
No	8989 (84.2)	7314 (82.9)	1159 (73.2)	<.0001

<u>Variable Name</u>	<u>Total</u> <u>No., (Weighted %)</u>	<u>No Violence</u> <u>No., (Weighted %)</u>	<u>Violence</u> <u>No., (Weighted %)</u>	<u>p (X² test)</u>
Yes	1580 (15.7)	1632 (17.1)	413 (26.8)	
Parent Worried about Drugs in the Neighborhood (Wave I)				
No	6360 (61.0)	5234 (84.5)	3163 (76.4)	<0.0001
Yes	4120 (39.0)	1097 (15.5)	936 (23.6)	
Childhood Physical Abuse (Wave III)				
No	10148 (87.8)	8209 (82.1)	1066 (73.3)	<0.0001
Yes	1477 (12.2)	1891 (17.9)	407 (26.7)	
Childhood Sexual Abuse (Wave IV)				
No	10836 (91.7)	8710 (81.6)	714 (74.1)	<0.0001
Yes	984 (8.2)	2076 (18.4)	264 (25.9)	
Childhood Neglect (Wave III)				
No	10375 (87.3)	8323 (81.6)	1158 (75.1)	<0.0001
Yes	1550 (12.7)	1999 (18.4)	384 (24.9)	
Parental Binge Drinking (Wave I)				
No	9355 (86.9)	7550 (82.0)	976 (78.3)	0.0131
Yes	1271 (13.1)	1757 (18.0)	293 (21.7)	
Parental Incarceration (Wave IV)				
No	10752 (89.6)	8659 (82.1)	919 (70.9)	<0.0001
Yes	1279 (10.4)	2035 (17.9)	357 (29.1)	
Friend Substance Use (Wave I)				
No	4889 (42.6)	4308 (89.4)	4992 (74.8)	<0.0001
Yes	6725 (57.4)	579 (10.6)	1727 (25.2)	
Drug Use Outcomes (Wave I)				
Binge past year***				
No	9109 (73.4)	7588 (77.1)	1458 (56.9)	<0.0001
Yes	3153 (26.6)	2155 (22.9)	992 (43.1)	
Marijuana use past month				
No	10435 (86.0)	8645 (88.9)	1781 (73.5)	<0.0001

<u>Variable Name</u>	<u>Total[*]</u> <u>No., (Weighted %)</u>	<u>No Violence</u> <u>No., (Weighted %)</u>	<u>Violence^{**}</u> <u>No., (Weighted %)</u>	<u>p (X² test)</u>
Yes	1680 (14.0)	1046 (11.1)	1126 (26.5)	
Cocaine use past month				
No	12018 (98.8)	9636 (99.1)	2363 (97.5)	<.0001
Yes	140 (1.2)	79 (0.9)	61 (2.5)	
Drug Use Outcomes (Wave IV)				
Binge past month^{***}				
No	10406 (83.8)	8392 (85.4)	1956 (77.3)	<.0001
Yes	1697 (16.2)	1232 (14.5)	454 (22.7)	
Marijuana use past month				
No	10323 (82.8)	8373 (84.8)	1891 (74.8)	<.0001
Yes	1951 (17.2)	1380 (15.2)	560 (25.2)	
Cocaine use since Wave III				
No	10873 (89.7)	8727 (90.5)	2095 (86.9)	0.0007
Yes	1242 (10.3)	914 (9.5)	316 (13.1)	
Meth use since Wave III				
No	11062 (90.6)	8911 (95.0)	2093 (92.0)	0.0004
Yes	605 (9.4)	428 (5.0)	173 (8.0)	

* Totals may not sum to 12,288 due to missing values on variables.

** Those who had been shot or stabbed, threatened at knife or gun point, or had witnessed a shooting or stabbing in the year prior to age 18 years were considered to exposed to violence.

*** Binge drinking was defined as having 5 or more drinks in a row.

TABLE 2:

ASSOCIATIONS BETWEEN VIOLENCE DURING ADOLESCENCE (WAVE I) AND SUBSTANCE USE OUTCOMES IN ADOLESCENCE (WAVE I)

	% with outcome	OR	POR ^a (95% CI)	AOR ^b (95% CI)
Binge Drinking (Past Year)				
Witnessed violence				
No	24.4	<i>Ref</i>	<i>Ref</i>	<i>Ref</i>
Yes	46.4	2.68 (2.24, 3.22) ***	2.46 (1.95, 3.11) ***	1.94 (1.49, 2.52) ***
Threatened with violence				
No	23.9	<i>Ref</i>	<i>Ref</i>	<i>Ref</i>
Yes	47.6	2.90 (2.46, 3.41) ***	2.16 (1.75, 2.67) ***	1.61 (1.26, 2.06) **
Experienced violence				
No	25.6	<i>Ref</i>	<i>Ref</i>	<i>Ref</i>
Yes	47.0	2.58 (2.03, 3.27) ***	2.16 (1.59, 2.92) ***	1.36 (0.97, 1.89)
Marijuana Use (Past Month)				
Witnessed violence				
No	12.0	<i>Ref</i>	<i>Ref</i>	<i>Ref</i>
Yes	30.3	3.18 (2.63, 3.83) ***	2.55 (2.07, 3.13) ***	2.09 (1.62, 2.69) ***
Threatened with violence				
No	12.0	<i>Ref</i>	<i>Ref</i>	<i>Ref</i>
Yes	28.4	2.90 (2.47, 3.41) ***	1.95 (1.53, 2.49) ***	1.32 (1.00, 1.75) *
Experienced violence				
No	13.1	<i>Ref</i>	<i>Ref</i>	<i>Ref</i>
Yes	30.8	2.96 (2.36, 3.71) ***	2.35 (1.65, 3.35) ***	1.57 (1.08, 2.29) *
Cocaine Use (Past Month)				
Witnessed violence				
No	0.9	<i>Ref</i>	<i>Ref</i>	<i>Ref</i>
Yes	3.3	3.62 (2.15, 6.08) ***	2.97 (1.49, 5.94) ***	2.59 (1.21, 5.54) *

	% with outcome	OR	POR ^a (95% CI)	AOR ^b (95% CI)
Threatened with violence				
No	1.0	<i>Ref</i>	<i>Ref</i>	<i>Ref</i>
Yes	2.7	2.86 (1.79, 4.57) ***	1.95 (1.09, 3.48) *	1.23 (0.67, 2.26)
Experienced violence				
No	1.1	<i>Ref</i>	<i>Ref</i>	<i>Ref</i>
Yes	3.6	3.55 (1.89, 6.65) ***	1.99 (0.92, 4.30)	1.23 (0.58, 2.60)

* p 0.05,
** p 0.01,
*** p 0.001

^aModels include gender, age, race, and poverty indicator in adolescence, friend substance use, parent concern about drugs in neighborhood, parental incarceration, parental binge drinking, physical abuse, sexual abuse, neglect, and receipt of public assistance.

^bModels include three forms of violence, as well as gender, age, race, and poverty indicator in adolescence, friend substance use, parent concern about drugs in neighborhood, parental incarceration, parental binge drinking, physical abuse, sexual abuse, neglect, and receipt of public assistance.

TABLE 3:

ASSOCIATIONS BETWEEN VIOLENCE DURING ADOLESCENCE (WAVE I) AND SUBSTANCE USE OUTCOMES IN ADULTHOOD (WAVE IV)

	% with outcome	OR (95% CI)	POR ^a (95% CI)	AOR ^b (95% CI)
Binge Drinking (Past Month)				
Witnessed violence				
No	15.5	<i>Ref</i>	<i>Ref</i>	<i>Ref</i>
Yes	21.1	1.45 (1.21, 1.74) ***	1.22 (0.94, 1.58)	1.08 (0.81, 1.43)
Threatened with violence				
No	14.9	<i>Ref</i>	<i>Ref</i>	<i>Ref</i>
Yes	25.2	1.93 (1.62, 2.30) ***	1.41 (1.10, 1.81) **	1.41 (1.08, 1.83) *
Experienced violence				
No	15.7	<i>Ref</i>	<i>Ref</i>	<i>Ref</i>
Yes	23.9	1.69 (1.30, 2.19) ***	1.09 (0.79, 1.51)	0.91 (0.64, 1.28)
Marijuana Use (Past Month)				
Witnessed violence				
No	16.3	<i>Ref</i>	<i>Ref</i>	<i>Ref</i>
Yes	24.0	1.61 (1.35, 1.92) ***	1.29 (0.93, 1.54)	1.07 (0.81, 1.41)
Threatened with violence				
No	15.8	<i>Ref</i>	<i>Ref</i>	<i>Ref</i>
Yes	27.0	1.97 (1.67, 2.32) ***	1.37 (1.08, 1.74) **	1.35 (1.04, 1.76) *
Experienced violence				
No	16.7	<i>Ref</i>	<i>Ref</i>	<i>Ref</i>
Yes	26.3	1.79 (1.39, 2.30) ***	1.15 (0.80, 1.66)	0.97 (0.66, 1.44)
Cocaine Use (Since Wave III)				
Witnessed violence				
No	11.8	<i>Ref</i>	<i>Ref</i>	<i>Ref</i>
Yes	13.5	1.16 (0.90, 1.49)	1.31 (0.98, 1.78)	1.11 (0.77, 1.60)
Threatened with violence				

	% with outcome	OR (95% CI)	POR ^a (95% CI)	AOR ^b (95% CI)
No	11.5	<i>Ref</i>	<i>Ref</i>	<i>Ref</i>
Yes	15.8	1.46 (1.17, 1.82) ***	1.37 (0.99, 1.90)	1.22 (0.83, 1.79)
Experienced violence				
No	11.7	<i>Ref</i>	<i>Ref</i>	<i>Ref</i>
Yes	17.6	1.62 (1.20, 2.18) **	1.58 (1.08, 2.32) *	1.39 (0.88, 2.20)
Methamphetamine Use (Since Wave III)				
Witnessed violence				
No	5.3	<i>Ref</i>	<i>Ref</i>	<i>Ref</i>
Yes	7.4	1.42 (0.99, 2.02) *	1.59 (1.02, 2.44) *	1.44 (0.88, 2.36)
Threatened with violence				
No	5.2	<i>Ref</i>	<i>Ref</i>	<i>Ref</i>
Yes	8.1	1.60 (1.16, 2.23) **	1.39 (0.99, 1.96)	1.20 (0.81, 1.76)
Experienced violence				
No	5.3	<i>Ref</i>	<i>Ref</i>	<i>Ref</i>
Yes	10.1	2.01 (1.43, 2.82) ***	1.34 (0.85, 2.11)	1.08 (0.63, 1.85)

* p 0.05,

** p 0.01,

*** p 0.001

^aModels include gender, age, race, educational attainment, poverty indicator in adolescence and adulthood, friend substance use, parent concern about drugs in neighborhood, parental incarceration, parental binge drinking, physical abuse, sexual abuse, neglect, and receipt of public assistance as well as Wave I substance use (except Meth).

^bModels include three forms of violence, Wave I substance use (except Meth), as well as gender, age, race, poverty indicator in adolescence and adulthood, friend substance use, parent concern about drugs in neighborhood, parental incarceration, parental binge drinking, physical abuse, sexual abuse, neglect, and receipt of public assistance