

Gender-Moderated Pathways From Childhood Abuse and Neglect to Late-Adolescent Substance Use

Julia M. Kobulsky,¹ Susan Yoon,² Charlotte L. Bright,³ Guijin Lee,² and Boyoung Nam³

¹School of Social Work, College of Public Health, Temple University, Philadelphia, Pennsylvania, USA

²College of Social Work, The Ohio State University, Columbus, Ohio, USA

³School of Social Work, University of Maryland Baltimore, Maryland, USA

Substantial research has linked childhood maltreatment to the development of substance use in adolescence. However, gender differences in the mechanisms that connect child abuse and neglect to substance use remain unclear. In this study, we applied multiple-group structural equation modeling in a sample of 1,161 youths (boys, $n = 552$; girls, $n = 609$) from the Longitudinal Studies of Child Abuse and Neglect (LONGSCAN) to examine gender differences in the associations between childhood abuse and neglect exposure from ages 0–12 years and substance use severity at age 18 as mediated by early substance use at age 14 and psychological symptoms (anger, anxiety, and depression) at age 16. In both genders, neglect directly predicted substance use severity, $\beta = .25, p < .001$ for boys and $\beta = .17, p = .007$ for girls; and early substance use, $\beta = .03, p = .002$ for boys and $\beta = .06, p = .005$ for girls; and anger mediated this association, $\beta = .10, p < .001$ for boys and $\beta = .06, p = .005$ for girls. Anger mediated paths from abuse in boys, $\beta = .06, p = .018$. In girls, early substance use mediated the path from abuse to substance use severity, $\beta = .06, p = .008$, with the mediated effect and direct path from abuse to early substance use significantly moderated by gender. For substance use severity, $R^2 = .26$ for girls and $R^2 = .27$ for boys. These findings demonstrate the prominence of neglect in predicting substance use severity and gender differences in paths from abuse.

Substance use is one of the leading public health problems in the United States (National Center on Addiction and Substance Abuse [CASA], 2011). Negative consequences of substance use include accidental injury and death; social problems, such as lack of employment and strained interpersonal relationships; and physical and psychological health problems (CASA, 2011). A clear understanding of how substance use develops, including gender differences in its development, is needed to inform prevention and intervention efforts.

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Correspondence concerning this article should be addressed to Julia M. Kobulsky, School of Social Work, Temple University, 1301 W. Cecil B. Moore Avenue, Philadelphia, PA 19122-6091. Email: julia.kobulsky@temple.edu

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Child maltreatment is the abuse (acts of commission, including physical, emotional, and sexual abuse) and neglect (acts of omission, including failure to provide necessary care that meets a child's basic needs, such as food, household cleanliness, and supervision) of children under 18 years of age (Leeb, Paulozzi, Melanson, Simon, & Arias, 2008). Numerous studies have shown associations between child abuse and neglect and adolescent substance use, including substance abuse that begins at an earlier age and more severe substance use (Gabielli, Jackson, & Brown, 2016; Proctor et al., 2017; Tonmyr, Thornton, Draca, & Wekerle, 2010). Evidence suggests that substance use occurring in late childhood or early adolescence *early substance use* may be a mechanism linking childhood maltreatment and later-adolescent substance use (Lansford, Dodge, Pettit, & Bates, 2010). Maltreated youths initiate substance use at earlier ages (Proctor et al., 2017). Additionally, adolescents who initiate substance use earlier are more likely to engage in subsequent substance use, including the development of substance use disorder (Tucker, Ellickson, Orlando, Martino, & Klein, 2005). In one study, authors' finding showed that early substance use mediated the association between abuse and later substance use, but only in girls (Lansford et al., 2010).

Most existing studies examining the effects of maltreatment on substance use have either examined only a single type of maltreatment (e.g., Lansford et al., 2010) or examined maltreatment as an overarching construct (Gabielli et al., 2016). Given evidence of high co-occurrence in maltreatment types (Adams

et al., 2016), the first strategy is susceptible to overestimating the effects of single maltreatment types. However, examining maltreatment as a single construct potentially masks differences in the associations between various maltreatment types and adolescent substance use. In particular, child abuse (violence that occurs in discrete events) and child neglect (acts of omission that are typically nonviolent and not occurring in discrete events) have potentially meaningful differences in their relations to the definition of trauma (an event that threatens injury, death, or physical harm while causing shock, terror, or helplessness; American Psychiatric Association [APA], 2013) and may vary in their effects (Trickett & McBride-Chang, 1995). Empirical research that has examined multiple maltreatment types simultaneously and separately suggests unique pathways from abuse and neglect to substance use, warranting further investigation of the roles of abuse versus neglect (Yoon, Kobulsky, Yoon, & Kim, 2017).

Complex trauma and extreme stress, such as childhood abuse and neglect experiences, can lead to a host of psychological symptoms during adolescence (Cicchetti & Rogosch, 2002; van der Kolk, Roth, Pelcovitz, Sunday, & Spinazzola, 2005). According to the developmental traumatology model (De Bellis, 2002), trauma associated with maltreatment may lead to changes in the biological stress response system, causing psychological symptoms associated with behavioral and emotional dysregulation. Psychological symptoms of depression, anxiety, and anger caused by dysregulation of the biological stress response system may in turn lead to substance use during adolescence as adolescents attempt to “self-medicate” their psychological symptoms with alcohol and other drugs (De Bellis, 2002).

Authors of most past research on psychological mediators of the association between maltreatment and adolescent substance use have focused on internalizing and externalizing symptoms, with the majority of studies observing a significant mediating role for externalizing but not internalizing symptoms (Jones et al., 2013; Kobulsky, Holmes, Yoon, & Perzynski, 2016; Proctor et al., 2017). This finding generates new research questions needing investigation to move the field forward. First, significant findings regarding the mediating role of externalizing symptoms are tempered by conceptual overlap between externalizing symptoms and substance use (i.e., although other externalizing symptoms may precede substance use, substance use is an externalizing symptom; Asgeirsdottir, Sigfusdottir, Gudjonsson, & Sigurdsson, 2011; Hussong, Jones, Stein, Baucum, & Boeding, 2011). Anger is of particular interest in that it is closely related to externalizing symptoms and yet is conceptually distinct from substance use. Anger, if not regulated, may lead to problem behaviors, including substance use (Weiner et al., 2004). Furthermore, anger has been shown to mediate the association between childhood abuse and/or neglect and adolescent substance use (Asgeirsdottir et al., 2011; Faulkner, Goldstein, & Wekerle, 2014), which suggests that maltreated youths experience anger regulation difficulties, leading them to use substances to either to diminish or express anger.

Second, it is unclear how different types of internalizing symptoms, namely anxiety and depression, may differentially mediate the associations between abuse and neglect and adolescent substance use (Hussong et al., 2011) because prior studies have primarily examined internalizing symptoms by combining anxiety and depression. However, findings from a longitudinal community-based study showed that only major depression and not separation anxiety disorder or overanxious disorder at age 11 was associated with increased risk for substance use at age 14, underscoring the need for examining the mediating role of specific forms of internalizing symptoms (King, Iacono, & McGue, 2004). Results of studies examining internalizing symptoms as mediators of the link between maltreatment and adolescent substance use been mixed results, with some supporting internalizing symptoms as a significant mediator (Lewis et al., 2011) and others, more often, reporting no such evidence when externalizing problems are also considered (Jones et al., 2013; Kobulsky et al., 2016). Thus, examining depression and anxiety separately, along with anger, might clarify the mediating roles of psychological problems in the association between childhood maltreatment and later substance use.

Gender differences in the mechanisms connecting child abuse and neglect to substance use also remain unclear but are critical to effective prevention and intervention. Boys and girls may differ in their emotional-behavioral responses to child maltreatment, and thus a consideration of gender differences may elucidate psychological symptom paths. According to gender intensification theory, girls may be particularly susceptible to adverse reactions to stress because of their social awareness and attunement to relational harm (Zahn-Waxler, Shirtcliff, & Marceau, 2008). Similarly, feminist theories posit that cultural norms cultivate gender roles and expectations that encourage girls to use internalizing coping styles (e.g., depression and anxiety) in order to maintain their relationships and closeness (Chodorow, 1989). Earlier cognitive development may also make girls more vulnerable to anxiety and depression than boys while protecting girls from externalizing problems through improved inhibition control (Zahn-Waxler et al., 2008). Boys, on the other hand, may be more likely to use externalizing coping styles (e.g., anger) in response to trauma (Chodorow, 1989) or alternatively, to act out (e.g., express anger) in reaction to stress as a way to obtain, maintain, or restore power and control (Dobash & Dobash, 1979).

Research on gender differences in psychological symptoms as a mechanistic pathway from maltreatment to substance use remains sparse, with findings somewhat contrary to theory, suggesting stronger effects in girls through both externalizing and internalizing symptoms (Asgeirsdottir et al., 2011; Jones et al., 2013; Kobulsky, 2017; Lansford et al., 2010). An analysis based on the Longitudinal Studies of Child Abuse and Neglect (LONGSCAN) found that sexual abuse in childhood (age 2–12 years) was significantly associated with alcohol use at age 14 via externalizing symptoms in girls but not in boys (Jones et al., 2013). Asgeirsdottir and colleagues (2011) found stronger effects of sexual abuse on depression in girls. In another

analysis, externalizing symptoms mediated the association between physical abuse and early substance use in girls only, with significant moderation of the path between externalizing symptoms and early substance use (Kobulsky, 2017). Although these studies provide preliminary evidence of gender variations in mechanisms connecting maltreatment and substance use, further investigation is needed to advance a comprehensive understanding of possible gender differences in pathways from childhood maltreatment to substance use in adolescence through psychological symptoms.

In the current study, we advanced knowledge on the development of substance use in adolescence by examining gender differences in the association between exposure to abuse and neglect during childhood (i.e., ages 0–12 years) and substance use severity in late adolescence (18 years). We examined the mediating roles of early substance use at 14 years of age and psychological symptoms (anger, anxiety, and depression) at 16 years of age. Based on findings from past studies (Tonmyr et al., 2010), we hypothesized that childhood abuse and neglect would be directly associated with substance use severity at 18 years of age in both the male and female genders. We hypothesized that substance use at age 14 would significantly mediate the association between childhood abuse and neglect to substance use severity at age 18 in both genders. However, based on Lansford and colleagues' (2010) finding that early substance use mediated the association between abuse and later substance use in girls but not in boys, we expected stronger effects in girls. Finally, because past studies have found stronger effects of abuse on depression in girls (Asgeirsdottir et al., 2011) and between externalizing symptoms and substance use in girls (Jones et al., 2013; Kobulsky, 2017), we expected to find stronger significant indirect effects from childhood abuse and neglect to substance use via anger, depression, and anxiety in girls than in boys.

Method

Participants and Procedure

The study sample ($N = 1,161$) was drawn from the LONGSCAN. The LONGSCAN is a longitudinal, multisite study that investigates the causes and consequences of child abuse and neglect (Larrabee & Lewis, 2014). It consists of five regional cohort samples of children at high risk of maltreatment in the United States. Sample selection occurred between birth and 5 years of age and was based on prior Child Protective Services (CPS) involvement (Midwest, Southwest, and Northwest sites), involvement with a pediatric clinic serving low-income youths (East site), and identification as high risk at birth based on a state public health tracking system (South site; Larrabee & Lewis, 2014). Data reported in this paper were collected at seven time points (ages 4, 6, 8, 12, 14, 16, and 18 years) between July 1991 and January 2012. In the present study, we included a sample of 1,161 youths ($n = 552$ boys and $n = 609$ girls) who had any valid data on focal measures collected at 12,

14, 16, and/or 18 years. The study sample includes 85.7% of the original LONGSCAN sample of 1,354 participants. Youths who were lost to attrition were more likely to be White non-Hispanic than those in the study sample (34.7% vs. 24.7%), $\chi^2(1, N = 1,354) = 8.56, p = .003$. No differences were found based on gender or CPS determinations of individual maltreatment types (i.e., neglect, physical, sexual, and emotional abuse) during childhood. However, youths lost to follow-up were more likely to have any childhood abuse determination (i.e., physical, sexual, and emotional combined) than those in the study sample (58.0% vs. 47.8%), $\chi^2(1, N = 1,354) = 6.93, p = .008$. Secondary analysis of the LONGSCAN data provided through the National Data Archive on Child Abuse and Neglect was approved as nonhuman subjects research by the first author's Institutional Review Board.

Measures

Child abuse and neglect. Exposure to child physical, sexual, and emotional abuse and neglect (basic needs and supervisory) during childhood (i.e., ages 0–12 years) were measured using two sources: youth self-reports of victimization at age 12 and CPS records. Multiple informant approaches have been recommended as a more comprehensive way to measure maltreatment given low correspondence between self-report and CPS data (Everson et al., 2008).

Self-report measures. The first source of maltreatment information was LONGSCAN-developed self-report scales of physical abuse, emotional abuse, sexual abuse, and neglect collected at the 12-year interviews. These scales were developed to match legal statutes defining abuse and neglect, and all measures were administered via Audio-Computer Assisted Self Interview (ACASI; Knight, Smith, Martin, Lewis, & the LONGSCAN Investigators, 2010). Lifetime (i.e., between ages 0 and 12 years) histories of physical, sexual, and emotional abuse by parents or caregivers were assessed by the Self-Report of Physical Abuse and Assault, Self-Report of Sexual Abuse and Assault, and Self-Report of Psychological Abuse, respectively (Knight et al., 2010). The physical abuse measure contained 15 yes or no items (e.g., "Has any adult ever burned or scalded you on purpose?"), the sexual abuse measure contained 11 yes-or-no items (e.g., "Has anyone ever put some part of their body or anything else inside your private parts or bottom?"), and the emotional abuse scale contained 18 yes-or-no items (e.g., "Have any of your parents ever threatened to kill you?"). Dichotomous variables were created for each of the three abuse types, indicating any youth self-report of exposure (1 for any self-reported abuse and 0 for no self-reported abuse).

Basic needs and supervisory neglect were measured by 12 items on the About My Parents Scale (Knight et al., 2010). Respondents rated neglect occurring during elementary school on a 4-point scale ranging from 0 (*never*) to 3 (*a lot*). Because the scale includes scenarios that may not be considered high risk by CPS (e.g., "Sometimes" parents do not make sure you

bathe regularly”; Dubowitz et al., 2011), only youths who rated items in the upper half of the response scales, which indicated higher levels of neglect (i.e., 2 or 3 on the 4-point scale), for any item were coded as neglected (1 for any self-reported neglect and 0 for no neglect).

CPS measures. The second source of maltreatment information for the multiple informant measures was lifetime CPS records. Allegation and investigation narratives were reviewed and coded by trained LONGSCAN abstractors (Runyan, 2009), using the Modified Maltreatment Classification System (MMCS; Barnett, Manly & Cicchetti, 1993). For the purposes of this study, dichotomous measures of any determined physical abuse, sexual abuse, emotional abuse, and neglect (supervisory or basic needs) based on final investigation narratives for the 0–12-year time period were used. The use of abstracted and coded final investigation narratives is likely to be more sensitive and less biased than the use of substantiation alone but less susceptible to false positives than allegations (Everson et al., 2008).

Multiple informant maltreatment indicators. We observed both measurement sources to identify unique maltreatment cases. Consistent with past research (Everson et al., 2008), rates of maltreatment in which there was agreement between both sources (10.1% for physical abuse, 15.1% for emotional abuse, 5.0% for sexual abuse, and 17.2% for neglect) were markedly lower than rates identified by either source (42.8% for physical abuse, 54.0% for emotional abuse, 23.9% for sexual abuse, and 66.4% for neglect). Therefore, three multiple informant indicators of abuse (i.e., physical, sexual, and emotional) and one multiple informant indicator of any neglect from age between 0 and 12 years were created based on self-report and CPS determinations (1 for indication from CPS determination and/or self-report and 0 for no indication from either source). Childhood abuse exposure was modeled as a latent construct, using the three multiple informant abuse variables as indicators. Neglect was treated as an observed variable.

Psychological symptoms. Anxiety, depression, and anger were measured by the Trauma Symptom Checklist for Children–Alternate Version (TSCC-A; Briere, 1996), which was administered to participants at age 16 years. The instrument included nine items related to anxiety (e.g., feeling afraid), nine items related to depression (e.g., feeling lonely, crying) and nine items related to anger (e.g., arguing too much, wanting to yell and break things) to which youths responded using a 4-point scale ranging from 0 (*never*) to 3 (*almost all the time*). Given the interest in gender differences, we selected raw scores (unstandardized by gender). The TSCC has demonstrated good convergent, discriminant, and construct validity (Briere, 1996), and internal consistency for this sample was good, with Cronbach’s alpha values of .82 for anxiety, .86 for depression, and .89 for anger.

Adolescent substance use. The National Institute of Mental Health Diagnostic Interview Schedule for Children–Youth (NIMH-DISC-Y; Shaffer et al., 1996) was administered through ACASI to capture adolescent self-reports of substance use. At ages 14 and 18 years, count variables indicating the number of substances used in the past year, including alcohol, cigarettes, marijuana, and hard drugs (i.e., stimulants, cocaine or crack, PCP or angel dust, heroin, hallucinogens, amyl nitrate, inhalants, unprescribed steroids, or other substances to get high) were created (potential range: 0–4). Given higher levels of substance use at 18 years of age, data at this age were additionally coded to indicate the maximum frequency of any substance used in the past year on a scale of 0 (*never*) to 5 (*almost every week*) as well as the diagnosis of abuse or dependence for any substance (i.e., alcohol, nicotine, marijuana, or hard drugs), with no substance use disorder coded as 0 and any substance use disorder coded as 1. Substance use severity at 18 years of age was modeled as a latent variable with number of substances used, maximum frequency of use, and the presence of substance use disorder as indicators. At 14 years of age, the observed indicator of number of substances used was included.

Control variables. Additional demographic control variables included gender (female coded as 1 and male coded 0) and race/ethnicity (White non-Hispanic coded as 1 and Black/Hispanic/Other coded as 0). In addition, two multiple informant measures indicating abuse (any type) and neglect during adolescence (ages 13–17 years) were included as controls to account for adolescence maltreatment exposure as a potential confound. For abuse, this was based on refined versions of the LONGSCAN self-report measures of physical, sexual, and emotional abuse administered at age 16 years (any exposure since the 12-year interview; Knight, Smith, Martin, Lewis, & the LONGSCAN Investigators, 2014) and determinations of physical, sexual, or emotional abuse based on CPS data for the time period between 13 and 17 years of age (1 for any abuse based on self-report or CPS determinations and 0 for no indication of abuse from either source). Neglect exposure during adolescence was based on youth self-reports of past-year neglect at 14 years of age on the About My Parents Scale (Knight et al., 2010) and past-year neglect at 16 years of age on a refined 20-item scale (Knight et al., 2014). Individuals who reported any past-year basic needs and supervisory neglect in the upper half of response scales at ages 14 or 16 years were considered neglected during adolescence. These data were then merged with CPS determinations of supervisory neglect or neglect of basic needs for the time period between 13 and 17 years of age (1 for neglect based on self-report or CPS determinations and 0 for no indication of neglect from either source).

Data Analysis

Descriptive analyses. We first examined frequencies, means, and standard deviations of study variables within the two gender groups using SPSS (Version 24). Chi-square and

Table 1
Descriptive Statistics of Study Variables

Variable ^a	Boys			Girls			Statistical Test
	%	<i>M</i>	<i>SD</i>	%	<i>M</i>	<i>SD</i>	
White non-Hispanic	25.2			24.3			$\chi^2(1, N = 1,161) = 0.12$
Black/Hispanic/Other	74.8			75.7			
Physical abuse (age 0–12)	47.3			38.8			$\chi^2(1, N = 1,161) = 8.61^{**}$
Sexual abuse (age 0–12)	20.1			27.3			$\chi^2(1, N = 1,161) = 8.15^{**}$
Emotional abuse (age 0–12)	53.1			54.8			$\chi^2(1, N = 1,161) = 0.36$
Neglect (age 0–12)	67.8			65.2			$\chi^2(1, N = 1,161) = 0.85$
Any abuse type (age 13–17)	32.4			39.9			$\chi^2(1, N = 1,161) = 6.99^{**}$
Neglect (age 13–17)	52.5			51.6			$\chi^2(1, N = 1,161) = 0.11$
Anxiety (age 16)		2.60	3.43		3.76	4.08	$t(836.33) = -4.51^{***}$
Depression (age 16)		2.38	3.17		3.80	3.90	$t(827.66) = -5.86^{***}$
Anger (age 16)		3.37	4.09		3.83	4.40	$t(853) = -1.58$
Past-year substance use							
Number used (age 14)		0.27	0.68		0.33	0.76	$t(829.44) = -1.19$
Frequency (age 18)		1.58	1.31		1.18	1.21	$t(815.49) = 4.69^{***}$
Dependence or abuse (age 18)	21.4			13.4			$\chi^2(1, N = 819) = 9.24^{**}$
Number used (age 18)		1.35	1.23		1.07	1.15	$t(829.13) = 3.59^{***}$

Note. $n = 552$ boys; $n = 609$ girls.

^aAbuse and neglect measures are based on Child Protective Services determinations and self-report.

** $p < .01$. *** $p < .001$.

t-test analyses were then conducted to assess group differences (Table 1). Correlation analysis identified no multicollinearity concerns per Allison's (1996) criterion that *r* should be below .80 (p. 64).

Structural equation modeling. We conducted multiple group structural equation modeling using Mplus (Version 8; Muthén & Muthén, 2017). Given the nonnormality of the data, weighted least squares mean and variance adjusted (WLSMV) estimation with theta parameterization was used, in accordance with recommendations by Millsap and Yun-Tein (2004). The following fit criteria were used to assess models: Tucker–Lewis Index (TLI) > 0.95, comparative fit index (CFI) > 0.95, and root mean square error of approximation (RMSEA) < 0.05 (Hu & Bentler, 1999). In addition, we compared nested models using a log likelihood ratio test with the DIFFTEST option in Mplus. Missing data were handled with full information maximum likelihood estimation (FIML; Raykov, 2005). Little's (1988) test results were nonsignificant, $\chi^2 = 34.45$ (28, $N = 1161$), $p = .186$, indicating that the assumption of missing at random (MAR) that is required for FIML was viable (Raykov, 2005).

Multiple group structural equation modeling occurred in two major steps: measurement invariance testing followed by analysis of the structural model. We conducted invariance testing of the measurement model (i.e., the latent factor for abuse, as indicated by multiple informant measures of physical abuse, sexual abuse, and emotional abuse, with the latent factor for substance use severity, as indicated by the number of substances

used, maximum frequency of use, and the presence of substance use disorder). All observed indicators for latent variables were specified as categorical, with underlying MPLUS programming reading dichotomous variables as categorical and variables with three or more categories as ordered categorical (Muthén & Muthén, 2017). After establishing baseline models in boys and girls separately, we examined a configural model simultaneously examining the measurement model across groups with no constraints to ensure that indicators were significantly and positively associated with latent variables. Next, weak measurement invariance was tested by comparing the configural model to a subsequent model constraining factor loadings between the two groups to be equal. To test strong measurement invariance, we compared the model with factor loadings constrained to be equal across the two groups to a subsequent model constraining thresholds to be equal between the two groups. Nested models were compared with the log likelihood ratio test (DIFFTEST option) by examining whether fit indices were within established thresholds and by the criterion that no change in TLI supports measurement invariance (Marsh et al., 2010).

We then conducted multiple-group analysis of the structural equation model to assess the direct associations between childhood abuse (between ages 0 and 12 years) and neglect (between ages 0 and 12 years) and substance use severity at 18 years of age as well as indirect associations mediated by substance use at age 14 years and depression, anxiety, and anger at 16 years of age. Sequential effects via substance use at age 14 and then depression, anxiety, and anger at age 16 were also examined. All

Table 2
Correlation Matrix for Study Variables

Variable	1	2	3	4	5	6	7	8	9	10
1. White non-Hispanic	–	.08	.12	.11	.03	.03	.06	.03	.17	.13
2. Abuse (age 0–12 years) ^a	.23	–	.16	.58	.20	.14	.20	.22	.09	.10
3. Neglect (age 0–12 years)	–.05	.01	–	.06	.19	.20	.19	.34	.22	.39
4. Any abuse type (age 13–17 years)	.14	.47	–.05	–	.05	.08	.11	.12	.05	.08
5. Neglect (age 13–17 years)	.08	.25	.10	.02	–	.06	.07	.10	.05	.08
6. Anxiety (age 16 years)	.10	.21	.23	.09	.07	–	.75	.56	.09	.19
7. Depression (age 16 years)	.17	.27	.21	.12	.09	.74	–	.63	.13	.20
8. Anger (age 16 years)	.03	.19	.33	.07	.08	.66	.70	–	.16	.39
9. Number of substances used (age 14 years)	.09	.27	.24	.12	.09	.25	.28	.24	–	.28
10. Substance use severity (age 18 years) ^a	.24	.22	.28	.10	.21	.22	.31	.31	.33	–

Note. $n = 552$ boys; $n = 609$ girls. Correlations for boys are displayed above the diagonal and correlations for girls are displayed in italics below the diagonal.

^aLatent variable.

endogenous variables were regressed on race/ethnicity. Substance use severity at 18 years of age was additionally regressed on abuse and neglect during adolescence. We also examined alternate models with direct paths and indirect paths only.

We tested gender differences in structural paths and indirect effects by labeling individual structural paths under the “Model” command in Mplus (e.g., b1 and g1 for corresponding paths in boys and girls). Next, these labels were used to create difference terms for individual paths as well as indirect effects under the “Model Constraint” command (e.g., difference for path 1: b1-g1 = d1). The Mplus output then provided estimates of these difference terms (i.e., moderated effects of each direct and indirect path, tested simultaneously by Wald tests).

Results

Descriptive Analyses

Descriptive statistics of the study sample are presented in Table 1. Based on the multiple informant measures, the incidence of childhood physical abuse was higher among boys than girls (47.3% vs. 38.8%, respectively), $p = .003$, and the incidence of childhood sexual abuse was higher among girls than boys (27.3% vs. 20.1%, respectively), $p = .004$. The majority (78.2%) of youths had any maltreatment exposure, and 58.6% of participants were exposed to two or more maltreatment types. Compared to boys, girls reported significantly higher levels of anxiety ($M = 3.76$ vs. 2.60, respectively), $p < .001$, and depression ($M = 3.80$ vs. 2.38, respectively), $p < .001$. All indicators of substance use severity at 18 years of age were significantly higher in boys, including substance use frequency ($M = 1.58$ for boys and $M = 1.18$ for girls), $p < .001$; number of substances used ($M = 1.35$ for boys and $M = 1.07$ for girls), $p < .001$; and substance abuse or dependency (21.4% for boys vs. 13.4% for girls), $p = .002$. Correlations are presented in Table 2.

Structural Equation Model Analysis

Baseline measurement models supported identical patterns of freed and fixed parameters in girls and boys. All loadings in the configural model were positive and statistically significant, $p < .001$. Fit met established thresholds, $\chi^2(17, N = 1,161) = 15.38, p = .568, TLI = 1.00, CFI = 1.00, RMSEA = 0.00, 90\% CI [0.00, 0.03]$. Overall, fit indices remained strong in the model that constrained factor loadings to be equal across groups and no change in TLI was observed, establishing weak measurement invariance, $\Delta\chi^2(4, N = 1,161) = 11.15, p = .024, TLI = 1.00, CFI = 1.00, RMSEA = 0.01, 90\% CI [0.00, 0.04]$. Similarly, although log likelihood tests were significant when thresholds were constrained to be equal across groups, fit indices remained strong, suggesting strong measurement invariance, $\Delta\chi^2(9, N = 1,161) = 48.39, p < .001, TLI = 1.00, CFI = 1.00, RMSEA = 0.04, 90\% CI [0.02, 0.05]$. Multiple group analysis of structural paths proceeded given evidence of at least partial measurement invariance (Asparouhov & Muthen, 2014).

We conducted multiple group analysis of the full structural model examining moderation in paths from child abuse and neglect to substance abuse severity at 18 years of age with mediated effects via anxiety, depression, anger at age 16 and early substance use at age 14, constraining factor loadings and thresholds to be equal across groups. Model fit was within established thresholds, $\chi^2(113, N = 1,161) = 191.32, p < .001, TLI = 0.99, CFI = 0.99, RMSEA = 0.03, 90\% CI [0.02, 0.04]$. Assessment of the direct-only model resulted in notably poorer model fit, $\Delta\chi^2(38, N = 1,161) = 463.12, p < .001, TLI = 0.92, CFI = 0.94, RMSEA = 0.09, 90\% CI [0.09, 0.10]$, supporting the hypothesized model. No substantial differences in model fit of the indirect-only model were found, $\Delta\chi^2(4, N = 1,161) = 15.00, p = .004, TLI = 0.99, CFI = 0.99, RMSEA = 0.04, 90\% CI [0.03, 0.05]$. However, given substantive interest in significant direct paths identified, the hypothesized model was maintained. Parameter estimates are displayed in Figure 1. Indirect effects are summarized in Table 3.

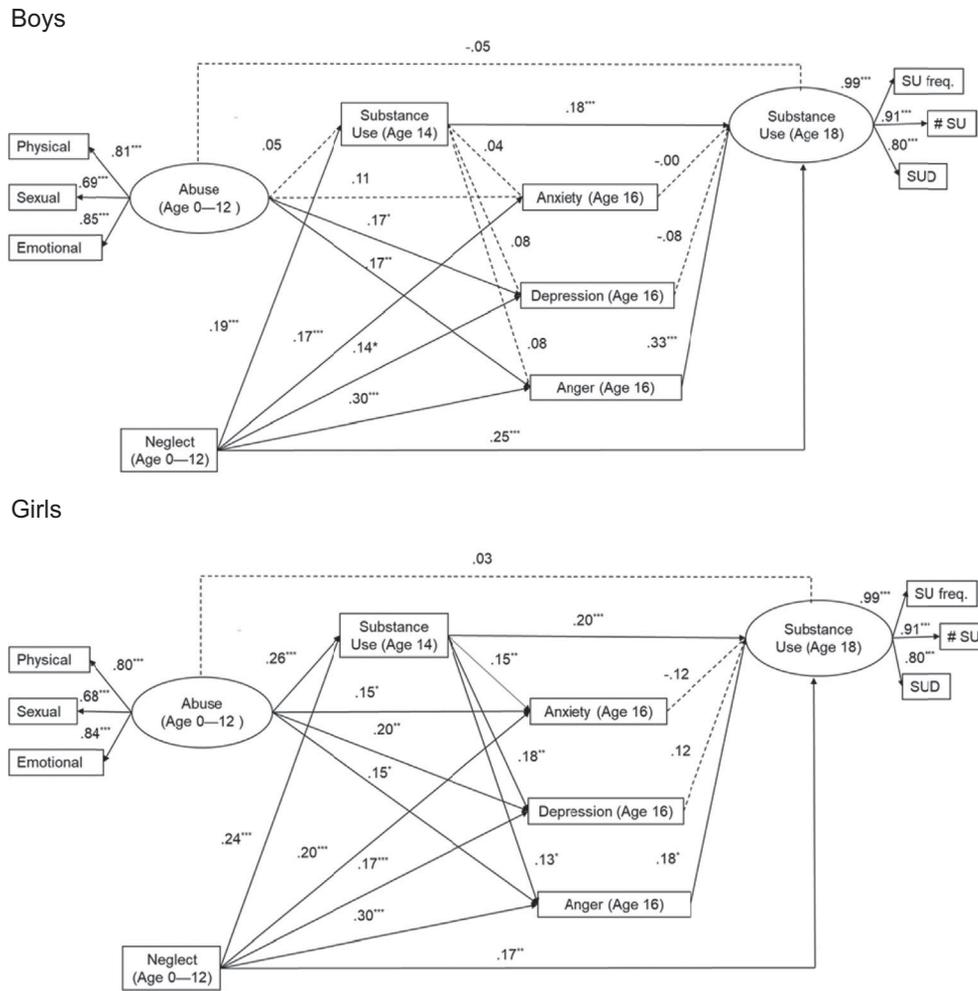


Figure 1. Standardized coefficient estimates for mediation model predicting substance use severity by gender ($n = 552$ boys, $n = 609$ girls). Significant paths are bold solid lines, nonsignificant paths are dashed. Control variables (not shown) include race, abuse (ages 13–17 years), and neglect (age 13–17 years). White race and neglect (ages 13–17 years) were positively related to substance use at age 18 in girls. White race was also positively associated with substance use at age 14 in boys and depression at age 16 in girls. R^2 for substance use (age 18) was .27 for boys and .26 for girls. SU freq. = substance use frequency; SUD = substance use disorder.

* $p < .05$. ** $p < .01$. *** $p < .001$.

In boys, there was a positive direct association between neglect, $\beta = .25, p < .001$, but not abuse and substance use severity. Similarly, childhood neglect, $\beta = .19, p < .001$, but not abuse was associated with significantly higher early substance use. Early substance use, $\beta = .18, p < .001$, was associated with a higher level of substance use severity. Childhood neglect was additionally associated with higher levels of anxiety, $\beta = .17, p < .001$; anger, $\beta = .30, p < .001$; and depression, $\beta = .14, p = .016$. Childhood abuse was associated with significantly higher levels of depression, $\beta = .17, p = .017$, and anger, $\beta = .17, p = .005$. Anger positively predicted substance use severity, $\beta = .33, p < .001$. The indirect effect from childhood neglect to substance use severity via early substance use was significant in boys, $\beta = .03, p = .002$. The indirect effects via anger to substance use severity from childhood neglect, $\beta = .10, p < .001$, and childhood abuse, $\beta = .06, p = .018$,

were also significant. The R^2 value for substance use severity was .27.

Similar to boys, neglect, $\beta = .17, p = .007$, but not abuse was positively associated with substance use severity in girls. In girls, both childhood abuse, $\beta = .26, p < .001$, and childhood neglect, $\beta = .24, p < .001$, were associated with early substance use. Early substance use was associated with a higher level of substance use severity, $\beta = .20, p < .001$. Both childhood abuse and neglect also significantly predicted anxiety (abuse: $\beta = .15, p = .018$; neglect: $\beta = .20, p < .001$), depression (abuse: $\beta = .20, p = .001$; neglect: $\beta = .17, p < .001$), and anger (abuse: $\beta = .15, p = .014$; neglect: $\beta = .30, p < .001$). Early substance use predicted anxiety, $\beta = .15, p = .009$; depression, $\beta = .18, p = .002$; and anger, $\beta = .13, p = .038$. Anger predicted substance use severity in girls, $\beta = .18, p = .026$. For girls, there were significant indirect effects through early substance use from

Table 3
Standardized Indirect Effects for Model Predicting Substance Use Severity

Indirect Effects	Boys		Girls	
	β	95% CI	β	95% CI
Child abuse (age 0–12 Years)				
Anxiety (age 16 years) path	0.00	[−0.02, 0.02]	−0.02	[−0.05, 0.01]
Depression (age 16 years) path	−0.01	[−0.04, 0.02]	0.02	[−0.01, 0.06]
Anger (age 16 years) path	0.06*	[0.01, 0.10]	0.03	[−0.00, 0.06]
Substance use (age 14 years) path	0.01	[−0.01, 0.03]	0.05**	[0.02, 0.09]
Child neglect (age 0–12 years)				
Anxiety (age 16 years) path	−0.00	[−0.03, 0.03]	−0.02	[−0.06, 0.01]
Depression (age 16 years) path	−0.01	[−0.04, 0.02]	0.02	[−0.01, 0.05]
Anger (age 16 years) path	0.10***	[0.05, 0.15]	0.05*	[0.00, 0.10]
Substance use (age 14 years) path	0.03**	[0.01, 0.06]	0.05**	[0.02, 0.08]

Note. $n = 552$ boys; $n = 609$ girls.

* $p < .05$. ** $p < .01$. *** $p < .001$.

both child abuse, $\beta = .06$, $p = .008$, and neglect, $\beta = .06$, $p = .005$. In addition, anger mediated the path between neglect and substance use severity, $\beta = .05$, $p = .041$. The R^2 value for substance use severity was .26.

The path between childhood abuse and early substance use was significantly moderated by gender, difference = -0.17 , $p = .007$, with a significant path in girls, $\beta = .26$, $p < .001$, but not in boys, $\beta = .05$, $p = .401$. We also found gender moderation in the indirect effects involving this path. That is, gender moderated the indirect path from childhood abuse to substance use severity through early substance use, difference = -0.05 , $p = .043$, which was significant in girls, $\beta = .06$, $p = .008$, but not boys, $\beta = .01$, $p = .395$. We did not identify any other gender moderated direct or indirect effects.

Discussion

Findings from this study suggest that the development of substance use in adolescence that stems from childhood abuse is a gender-specific phenomenon. Childhood abuse indirectly predicted substance use severity through early substance use in girls only, with significant gender moderation. Findings also suggest the importance of neglect in predicting substance use for both genders. As hypothesized, neglect prior to the age of 13 years directly predicted substance use severity, and early substance use significantly mediated this association in both genders. Anger was the sole psychological symptom that predicted substance use severity, with significant indirect effects stemming from neglect in both genders. Abuse also affected substance use severity in boys via anger. However, contrary to our hypotheses, indirect effects through anger were not stronger in girls. Further, childhood abuse that occurred prior to 13 years of age was not directly associated with substance use severity in either gender.

The gender-moderated indirect path from abuse through early substance use for girls is consistent with Lansford and colleagues' (2010) finding that physical abuse affects later substance use in girls through early initiation of substance use. The gender-moderated path between abuse and early substance use is also consistent with Kobulsky's (2017) finding of gender-moderated links between physical abuse and early substance use. The findings suggest sensitivity in early adolescent girls to the effects of childhood abuse, with "self-medication" in early adolescence cascading into more severe substance use by late adolescence. This apparent sensitivity to the traumatic effects of abuse may be associated with girls' attunement to relational harm or pubertal development (Zahn-Waxler et al., 2008).

Contrary to expectations and finding from past research of pathways to earlier adolescent substance use (Jones et al., 2013; Kobulsky, 2017), we did not find stronger indirect effects from abuse and neglect through anger in girls. Rather, there were significant indirect effects via anger on late adolescent substance use severity from childhood neglect in both genders and from abuse in boys. Anger is an understandable emotional response to maltreatment, and the links between anger and substance use severity suggest difficulties in anger regulation with pathological consequences among youth exposed to maltreatment. Findings of anger mediation are consistent with research observing the association between maltreatment and substance use to be mediated by anger (Asgeirsdottir et al., 2011) but suggest that these effects are primarily rooted in neglect, particularly in girls.

It is noteworthy that neglect affected substance use severity directly and indirectly via early substance use in both boys and girls. However, we found no direct effects and only gender-specific indirect effects from abuse to substance use. Neglected youths may be vulnerable to substance use because of trauma or other pathways, such as the lack of sufficient parental supervision. Findings support the notion that both child abuse and

neglect are detrimental to adolescent development but may have different specific effects (Trickett & McBride-Chang, 1995; Yoon et al., 2017). Further, findings indicate gender differences in the paths from abuse to substance use.

The current study also contributes to the literature by examining indirect effects through anxiety and depression, two specific internalizing symptoms. Consistent with past research examining overall internalizing symptoms (Kobulsky et al., 2016; Proctor et al., 2017) but contrary to one past study suggesting differential effects through anxiety and depression (King et al., 2004), we did not identify any indirect effects through anxiety and depression. However, early substance use contributed to girls' anxiety and depression as well as their anger. Thus girls' substance use severity at 18 years of age seemed to stem from earlier established substance use born from abuse or anger rooted in childhood neglect rather than an internalized way of coping with the effects of trauma. Future research should consider how feedback loops between substance use and psychological symptoms may unfold over the life course, mutually reinforcing one another, particularly in girls.

This study addressed a significant public health issue using a large, longitudinal data set of high-risk youths, thereby allowing for temporal ordering validity. By including multiple informant measures, the study improved on earlier research that relied on less-complete indicators of maltreatment. Finally, this study separated child abuse and neglect, allowing for a consideration of distinct paths from each form of maltreatment to substance use severity in late adolescence.

Although maltreatment measures had the advantage of being based on multiple informants and considering multiple types of maltreatment, they were limited in that they were indicated by dichotomous variables. Measures were only indicative of presence or absence of maltreatment rather than the level, severity, chronicity, frequency, or co-occurrence of maltreatment. Past studies have shown that overall maltreatment levels and co-occurrence patterns are salient predictors of outcome (Adams et al., 2016), and the extension of such models to the outcomes examined in this analysis are important areas for future research. There may also have been differences among abuse types not identified by this analysis. For example, emotional abuse may have a different effect on behavioral outcomes as compared with physical and/or sexual abuse (Spinazzola et al., 2014). Finally, other forms of victimization, such as community violence exposure, bullying, and sibling violence, may confound these associations as may other psychological symptoms, such as posttraumatic stress.

Differences based on substance use types may have been masked in this study and are a suggested area for future research. Although substance use was measured at 14 and 18 years of age, the measure differed at these two time points; therefore, we are unable to assess changes in substance use severity between ages 14 and 18 years. Substance use is a complex, polygenic phenomenon. Unmeasured factors, including neighborhood features, and genetics may also contribute to the development of substance use. Future research should consider

other mechanisms that may link maltreatment and substance use, particularly in regards to neglect.

Because our sample consisted of high-risk youth who were largely of low socioeconomic status, findings may not be generalizable to lower-risk populations. On the other hand, the samples were identified as high risk for various reasons, and the sample was drawn from multiple regions, improving generalizability of our findings over much previous research. Finally, it is of note that gender, the theoretical moderating variable in our study, is intertwined with sex. The self-report measure used to determine group status in our study did not clearly measure either biological sex or gender expression.

Our results indicate that child maltreatment and substance use should be viewed through a gender-specific lens. Girls may be particularly vulnerable to early substance use in response to abuse, which may then affect substance use severity in late adolescence, implying the need for early trauma-informed prevention and intervention. In both genders, the role of anger in substance use severity is relevant, suggesting the need for anger regulation and coping skills. The importance of intervening to curb child neglect is a key implication of research findings given direct and indirect associations between neglect and substance use severity in both genders. A multifaceted intervention to prevent child neglect using targeted programs, such as Family Connections (DePanfilis & Dubowitz, 2005), is therefore warranted. Our results suggest that substance use may be a reaction to traumatic events, requiring trauma-informed approaches to service provision. In addition, regardless of gender, substance use by early adolescence is a critical risk factor for later substance use severity. Universal screening for and improvement in accessibility to substance use treatment for young teens could prevent worsening patterns of use among youths (Winters, Leitten, Wagner, & O'Leary Tevyaw, 2007).

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