

Full length article

Influences of victimization and comorbid conditions on latency to illicit drug use among adolescents and young adults

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ARTICLE INFO

Keywords:

Relapse
Poly-Victimization
Illicit drug use
Substance use disorders
PTSD
Depression

ABSTRACT

Objective: Exposure to violent victimization is associated with higher rates of mental health and substance use disorders (SUD). Some youth who experience multiple victimizations and associated characteristics (i.e. poly-victims) are at heightened risk for long term problems. Thus, we conducted the first study to examine how heterogeneity in experiences of victimization vary in terms of latency to illicit drug use following treatment completion. We also examined if victimization profiles vary across gender and if comorbid conditions (e.g., posttraumatic stress disorder and major depressive disorder) differentially predict latency to illicit drug use across groups.

Methods: Adolescents and young adults ($N = 5956$; $M_{age} = 17.5$ years; 64.0% male) with SUDs in treatment for illicit drug use completed a battery of measures at baseline. At 3-, 6- and 12-month follow-ups, they reported on the number of days before they used any illicit drug following their last assessment.

Results: Continuous time survival mixture modeling revealed that, as hypothesized, females who experienced high rates of all victimization and related characteristics had a higher hazard for latency to first illicit drug use as compared to females in the low victimization group. This was not the case for males; rather, those who experienced high rates of sexual abuse were quickest to return to illicit drug use. Finally, comorbid conditions led to a higher hazard rate, but only for certain profiles across females.

Discussion: Findings emphasize the necessity for professionals to more fully integrate poly-victimization research and theory into their clinical practices and research.

1. Introduction

In the United States, 7.9% of adolescents (ages 12–17) and 23.2% of young adults (ages 18–29) report past-year illicit drug use (Substance Abuse and Mental Health Services Administration, 2017). Adolescents and young adults who seek treatment are at high risk of relapse, with average abstinence rates estimated at 38% at 6 months and 32% at 12 months post-treatment (Williams and Chang, 2006). An important correlate of young people's substance use disorder (SUD) treatment outcomes is exposure to violent victimization (e.g., physical, sexual, and emotional abuse; Davis et al., 2019a, 2019b). Indeed, in a national

sample, 87% of adolescents in residential SUD treatment and 60% of those in outpatient treatment had experienced victimization in the past year alone, and these adolescents had more severe substance use problems at both intake and follow-up (Shane et al., 2006). Research on the role of victimization in young people's SUD outcomes, however, has primarily focused on the effects of single-type victimization (Norman et al., 2012) even though multiple types of victimization are commonly experienced together (i.e., poly-victimization; Davis et al., 2017, 2019a, 2019b; Finkelhor et al., 2009). Furthermore, associated characteristics of these victimization experiences, including perpetration by a trusted adult, fear of being injured or for one's life, and negative reactions from

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<https://doi.org/10.1016/j.drugalcdep.2019.107721>

Received 16 June 2019; Received in revised form 30 October 2019; Accepted 1 November 2019

Available online 07 November 2019

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others during disclosure, have been shown to be important risk factors for substance use behavior and may differ by gender (Davis et al., 2019a, 2019b). Thus, it is important to measure victimization experiences and their outcomes in a more nuanced way.

Prior work notes that the effects of victimization on SUD outcomes may differ by gender, and may be more pronounced for females, although evidence is mixed. In a national sample of adolescents in SUD treatment, more severely-victimised girls evidenced a higher likelihood of relapse than less severely-victimised girls, but boys had a similar relapse risk independent of victimization history (Shane et al., 2006). Similarly, among adolescents, physical abuse was more strongly related to increased illicit drug use for females than for males (Moran et al., 2004). Finally, a study of adults presenting for cocaine dependence found that the types of victimization experienced and overall trauma severity were predictive of relapse for women, but not men (Hyman et al., 2008). However, other work has failed to find that the effects of various victimization types on mental health outcomes differ by gender (e.g., Rosen et al., 2002). Thus, while heterogeneity likely exists in terms of direct experiences of violent victimization between males and females, it may be important to explore gender-specific profiles of victimization experiences to determine variation in illicit drug use outcomes.

One mechanism by which patterns of victimization may exert gender-specific effects on illicit drug use outcomes is via comorbid conditions. Psychiatric conditions are a correlate of SUD outcomes, generally, given that individuals may use substances to provide relief from psychological symptoms, and psychological symptoms may trigger substance use cravings (Chilcoat and Breslau, 1998). In a review of the literature, a diagnosis of either posttraumatic stress disorder (PTSD) or major depressive disorder (MDD) was found to be a major factor associated with poorer outcomes for individuals with a comorbid substance use disorder, and there was some evidence that these effects were especially pronounced for males (Najt et al., 2011). Comorbid conditions appear to be a critical predictor of illicit drug use treatment outcomes (Grella et al., 2001), perhaps because treatment may not sufficiently address comorbid conditions, leaving youth with unresolved mental health symptoms following treatment discharge. However, to our knowledge, the gender-specific effect of comorbid conditions on the relationship between patterns of victimization and post-treatment relapse remains unexplored.

1.1. The current study

The current study expands and replicates prior work that identified latent classes of victimization and associated characteristics (Davis et al., 2019a, 2019b) by using a sample of adolescents and young adults in treatment for illicit drug use disorder. We sought to understand prevalence of victimization profiles in this population in an exploratory manner (Aim 1). We also sought to extend our prior work by investigating how emergent victimization classes predict post-treatment latency to illicit drug use (defined as the time to first use of any illicit drug such as heroin, non-medical use of prescription drugs, methamphetamine, cocaine, and hallucinogens) (Aim 2). We hypothesized that both males and females in classes with high endorsement of all victimization types (i.e., poly-victimization) and theoretically-harmful trauma characteristics (e.g., closeness of the perpetrator, fear for life/injury, and negative reactions to disclosure of abuse; Davis et al., 2019a, 2019b), would have a shorter latency to illicit drug use upon leaving treatment (Hypothesis 1). We also examine the influence of comorbid psychiatric conditions (i.e. PTSD and MDD) on risk for relapse across profiles of victimization and associated characteristics (Aim 3). We hypothesized that higher PTSD and MDD symptoms would be associated with shorter time to first illicit drug use for both males and females endorsing high rates of all victimization types and harmful characteristics (Hypothesis 2).

2. Methods

2.1. Participants and procedures

Data were obtained from Chestnut Health Systems, a substance use and mental health treatment provider housed under the Global Appraisal of Individual Needs (GAIN) Coordinating Center in the United States. Data were collected by agency staff between September 2002 and December 2013. Participants were adolescents and young adults screened for SUD treatment. Individuals entering treatment came from a variety of referral sources, including parents, partners, spouses, the juvenile justice system, probation officers, and by self-referral. At treatment entry, each person completed the initial GAIN assessment (GAIN-I). After the initial assessment, participants were referred to receive treatment (with treatment type varying by site) and completed GAIN follow-up assessments at 3, 6, and 12 months. All participants were given the same GAIN follow-up assessments which were completed with the assistance of GAIN trained staff. To be included in this study, participants from the larger dataset ($N = 26,556$) had to be between ages of 12 and 29 at baseline ($n = 24,092$) and in treatment for illicit drug use ($n = 5,956$). Human subjects approval was received by the Institutional Review Board prior to all analyses.

On average, participants were 17.5 ($SD = 3.61$) years old, mostly male (64.0%; $n = 3,814$) and diverse with 39.0% identifying as white ($n = 2,320$), 31.9% Hispanic ($n = 1,898$), 10.4% African American ($n = 620$), 15.6% multi-race/ethnicity ($n = 931$), and 3.1% other ($n = 184$). Nearly 63% of participants were in treatment for amphetamines, 14.7% for heroin/opioids, 9.0% for cocaine, and 13.5% for other drugs such as non-medical use of prescription drugs. Many participants had not, themselves, initiated treatment (e.g., 19.4% were court-mandated to be in treatment). See Table 1 for more details.

2.2. Measures

The GAIN assessment tool (GAIN-I) is a comprehensive, structured interview with over 100 scales assessing background, substance use, physical health, risk behaviors, mental health, environment, legal records, and vocation (Dennis et al., 2004).

2.2.1. Control variables

Covariates included age (adolescent = 0, young adult = 1), race/ethnicity (white as reference category), criminal justice involvement, number of prior substance use disorder treatment episodes, the substance each participant was in treatment for ("other" as reference category), and number of days in past 90 spent in a controlled environment (e.g., hospital, jail, prison).

2.2.2. Illicit drug use

At follow-ups, participants were asked to indicate how many days since their last assessment had passed before they used any illicit drug. Participants responded with a value from 0 (i.e., they used that day) to 90 or more (i.e., they did not use in the follow-up period). The timeline follow back procedures for substance use used in this study have been validated and used in similar, large scale, nationally representative studies including Monitoring the Future, Treatment Episode Data Set, and the National Survey on Drug Use and Health. This event variable allowed us to model survival functions for every day in the year following treatment entry (365+ days).

2.2.3. Victimization and characteristics of trauma

Each participant was asked questions referring to their exposure to violent events. Specific to the current study, we extracted four dichotomous items that reflected endorsing a history of sexual abuse, emotional abuse, and physical abuse. Sexual abuse and emotional abuse were single items asking if anyone had ever "pressured or forced you to participate in sexual acts against your will, including your sexual partner, a

Table 1
Baseline characteristics.

	Total Sample (N = 5956) M (SD) or n (%)	Males (n = 3814) M (SD) or n (%)	Females (n = 2142) M (SD) or n (%)
<i>Demographics</i>			
Age, in years	17.5 (3.61)	17.23 (3.30)	17.87 (4.06)
Male n (%)	3814 (64.0%)	–	–
White n (%)	2320 (39.0%)	1308 (34.3%)	1012 (47.3%)
African American/Black n (%)	620 (10.4%)	492 (12.9%)	128 (6.0%)
Hispanic n (%)	1898 (31.9%)	1351 (35.4%)	547 (25.6%)
Multi-race/ethnicity n (%)	931 (15.6%)	554 (14.5%)	377 (17.6%)
Other n (%)	184 (3.1%)	108 (2.8%)	76 (3.6%)
Prior substance abuse treatment	2,731 (45.9%)	1711 (45.0%)	1020 (47.8%)
<i>Psychiatric Disorders</i>			
MDD Diagnosis n (%)	3845 (64.5%)	2227 (58.5%)	1618 (75.9%)
MDD symptoms	4.21 (3.69)	3.44 (3.43)	5.57 (3.75)
PTSD Diagnosis n (%)	1852 (31.1%)	907 (23.8%)	945 (44.2%)
PTSD symptoms	2.90 (3.90)	2.20 (3.47)	4.13 (4.30)
<i>Illicit Drug Use</i>			
Days of Use (past 90)	1.34 (3.04)	1.68 (3.24)	1.15 (2.91)
<i>Trauma and related characteristics</i>			
Physical abuse	3,185 (53.5%)	2198 (57.8%)	987 (46.4%)
Sexual abuse	794 (13.3%)	134 (16.9%)	660 (31.1%)
Emotional abuse	2019 (33.9%)	852 (22.4%)	1167 (54.8%)
Happened several times over a long period of time	2,228 (37.4%)	1209 (31.9%)	1019 (47.9%)
Trusted family member or friend	1811 (30.4%)	790 (20.8%)	1021 (48.0%)
Afraid for your life/injury	1,411 (23.7%)	803 (21.1%)	608 (28.6%)
People you told did not believe you	846 (14.2%)	389 (10.3%)	459 (21.5%)

Notes: PTSD = post-traumatic stress disorder; MDD = major depressive disorder.

family member, or a friend” and “abused you emotionally, that is, did or said things to make you feel very bad about yourself or your life?” Physical abuse was derived from two items that asked has anyone ever “attacked you with a gun, knife, stick, bottle, or other weapon” and “hurt you by striking or beating you to the point that you had bruises, cuts, or broken bones or otherwise physically abused you.” For physical abuse, participants could receive a code of “1” if either of the physical abuse items were endorsed.

We also extracted four additional dichotomous items addressing characteristics of trauma experiences. Each participant was asked about the chronicity of abuse (“did these previous things happen several times over a long period of time?”), closeness of the perpetrator (“did these things happen where one or more of the people involved was a family or close family friend, professional, or someone else you trusted”), fear for life/injury (“were you afraid for your life or that you might be seriously injured”) and negative reactions to disclosure of abuse (“people you told did not believe or help you”).

2.2.4. Comorbid conditions

To assess symptoms of PTSD, we used the count of past-year symptoms associated with traumatic events. Items were based on a series of item response theory and methodological analyses of the Civilian Mississippi Scale for PTSD (Norris and Perilla, 1996). Each participant responded “yes” or “no” to 12 items that asked “in the past year, have the following situations happened to you?” with example items including “when something reminded you of the past, you became very distressed and upset” and “your dreams at night were so real that you awoke in a cold sweat and forced yourself to stay awake.”

To assess symptoms of MDD, a count of DSM-IV symptoms for MDD was used. Specifically, each participant answered “yes” or “no” to 12 items reflecting DSM-IV criteria for MDD. The measure prompted participants as follows: “during the past 12 months, have you had significant trouble with...” Example items include “feeling lonely, sad, blue, depressed, or hopeless about the future,” and “feeling tired, having no energy, or feeling like you could not get things done.”

2.3. Analytic plan

We followed procedures described in Muthén and Masyn (2005) on

discrete and continuous time survival mixture analyses, and Asparouhov and Muthén (2014) on three step approaches in mixture modeling.

2.3.1. Class enumeration

We utilized multi-group latent class analysis (LCA) in Mplus version 8 (Muthén and Muthén, 2015) to assess heterogeneity in traumatic experiences and associated characteristics by gender. We used dichotomized childhood trauma and trauma characteristic items in our LCA to assess variation across both direct experiences and associated characteristics. We fit models ranging from one to six classes and examined fit statistics to determine if adding an additional class improved model fit. To assess model fit, we used decreases in the -2 log likelihood (-2LL), Akaike Information Criteria (AIC), Bayesian Information Criteria (BIC), and the sample size adjusted Bayesian Information Criteria (aBIC). Further, we utilized non-significant Vuong-Lo-Mendell-Rubin Likelihood Ratio Test (VLR), the Lo-Mendell-Rubin adjusted likelihood ratio test (LRT), and the bootstrapped likelihood ratio test (BLRT) to indicate that a $k - 1$ class solution is a better fit to the data.

2.3.2. Return to illicit drug use

We used Cox proportional hazards regression (Singer and Willett, 2003) to assess event occurrence. The follow-up period, defined in number of days from treatment entry (day 0) to ~1 year follow up (day 365+), was used as the survival time. The event variable was defined as the time to first use of illicit drugs. The amount of time to loss to follow up, death, or the end of the study period was treated as the censored time observation. The association between predictors and the outcome were quantified using hazard ratios and 95% confidence intervals.

2.3.3. Continuous time survival mixture analysis

To understand how emergent classes related to latency to illicit drug use, we used continuous time survival mixture modeling (Muthén and Masyn, 2005). To predict subsequent illicit drug use, a survival model was used as the outcome, and differences in the outcome intercept were estimated independently between classes. Variances of the latent survival indicator were fixed to zero (Muthén and Masyn, 2005) and the baseline hazard functions were held constant across classes (Larsen,

2004). The intercept (α_{it}) parameters varied across classes, giving different survival functions across emergent classes. We used a model building process such that Model 1 assessed general survival functions by class membership for latency to illicit drug use, Model 2 assessed effects of PTSD alone, and Model 3 assessed effects of MDD alone. In Model 4 we added symptoms of PTSD and MDD as predictors of the survival function by emergent classes, simultaneously. That is, we sought to understand whether symptoms of each mental health variable influenced the level and rate of change within a given class as well as subsequent use of illicit drugs within a given class, after controlling for class differences on the intercepts or thresholds of these outcomes. As a robustness check we ran the above model building process with PTSD and MDD diagnosis as predictors.

2.3.4. Missing data

We used full information maximum likelihood with robust standard errors in *Mplus*. This is a superior strategy to listwise deletion and equivalent to using multiple imputation techniques when data are assumed to be missing at random (Enders, 2011). In total, missing data ranged from 0% (baseline) to 40% (12-month follow up). Participants who had missing data due to lack of follow up were censored in the models.

3. Results

3.1. Aim 1: gender-specific LCAs and prevalence rates of emergent victimization classes

Results from model fitting for the gender-specific LCAs are presented Table 2. The lowest BIC, aBIC, and AIC were found for the five-class solution, suggesting the five-class model fit the data best for both male and female participants. We selected names for each class that represented the defining type of violence experienced in that class, although there may have been high rates of other types of violence in the class. When classes were similar in terms of their defining type of violence, we additionally refer to associated trauma characteristics (e.g., chronicity) in class names to increase clarity.

3.1.1. Female LCA

Emergent classes for female participants ($n = 2,142$) can be found in Fig. 1. Over 26% ($n = 560$) of females were categorized into the *high all* class, reflecting high rates of all types of victimization and trauma characteristics. The *low all* class represented 36.9% ($n = 788$) of female participants entering treatment, reflecting participants with low levels of all types of victimization and trauma characteristics. Further, 9.1%

($n = 193$) of the sample was represented by females with high endorsement of sexual abuse and moderate endorsement of physical abuse, emotional abuse, and all potentially-harmful trauma characteristics (*“high sexual abuse class”*). Next, 19.3% ($n = 411$) were classified into the profile representing high endorsement of chronic emotional abuse and trusted perpetrators (*“high emotional abuse class”*). Finally, 8.5% ($n = 180$) were classified into the profile representing high rates of *physical abuse*, with moderate levels of emotional abuse, and low-moderate rates of chronic abuse, perpetration by a trusted person, and life threat (*“high physical abuse class”*).

3.1.2. Male LCA

Emergent classes for male participants ($n = 3,814$) are presented in Fig. 2. A class with high rates of physical/emotional abuse and moderate/high rates of harmful trauma characteristics represented 7.5% ($n = 286$) of male participants (*“high physical/emotional abuse class”*). Although they had high rates of physical and emotional abuse, they had very low endorsement of sexual abuse. Abuse tended to be chronic, perpetrated by a trusted person, and accompanied by life threat and disbelief. The majority of male participants were in the *low all* class (45.8%; $n = 1,744$), involving low rates of all experiences. Only 1.6% ($n = 103$) of male participants were represented by a class involving high sexual abuse, moderate other abuse, and moderate rates of trusted perpetrators (*“high sexual abuse class”*). Like the female model, male participants in the high sexual abuse class had moderate levels of physical and emotional abuse. Unlike the female model, which evidenced moderate levels of all potentially-harmful trauma characteristics, male participants in this class had high levels of closeness to the perpetrator, moderate levels of chronicity, and low levels of life threat and disbelief. The *high physical abuse class* represented 36.2% ($n = 1379$) of male participants and involved high levels of physical abuse, moderate levels of emotional abuse, and low levels of potentially-harmful trauma characteristics. Finally, the *chronic physical/emotional abuse class* represented 8.8% ($n = 325$) of male participants. Participants in this class endorsed moderate levels of physical and emotional abuse, high levels of chronicity, and high levels of trusted perpetrators.

3.2. Aim 2: variation in latency to illicit drug use across victimization classes

3.2.1. Females

In support of Hypothesis 1, females in the *high all* had a higher hazard for latency to first illicit drug use ($HR = 1.35, [1.06, 1.71]$) compared to the *low all* class (Table 3, Model 1). Visual inspection of the

Table 2
Fit statistics for latent class analysis.

No. of classes	-2LL	AIC	BIC	aBIC	Entropy	VLMRT	p	LRT	p	BLRT	p
Model: Males											
1	46950.148	46964.15	47010.98	46988.73							
2	37730.064	37760.06	37860.41	37812.74	0.913	9220.085	0	9089.335	0	9220.085	0
3	35977.55	36023.55	36177.41	36104.32	0.846	1752.514	0	1727.662	0	1752.514	0
4	35442.572	35504.57	35711.95	35613.44	0.807	534.978	0	527.391	0	534.978	0
5	35281.958	35359.96	35620.85	35496.92	0.836	160.614	0	158.336	0	160.614	0
6	20187.578	20281.58	20575.06	20425.72	0.859	26.832	0.06	26.431	0.07	26.832	0
Model: Females											
1	19151.308	19165.31	19204.97	19182.73							
2	14147.384	14177.38	14262.38	14214.72	0.971	5003.925	0	4923.643	0	5003.925	0
3	13670.804	13716.8	13847.13	13774.05	0.818	476.58	0	468.933	0	476.58	0
4	13490.366	13552.37	13728.02	13629.53	0.787	180.439	0	177.544	0	180.439	0
5	13388.418	13466.42	13687.4	13563.49	0.83	101.947	0	100.311	0	101.947	0
6	13362.122	13456.12	13722.43	13573.11	0.843	26.297	0.08	25.875	0.08	26.297	0

Note: -2LL = negative 2 log likelihood; AIC = Akaike Information Criteria; BIC = Bayesian Information Criteria; aBIC = sample size adjusted Bayesian Information Criteria; VLMRT = Vuong-Lo-Mendell-Rubini Likelihood Ratio Test; LMR = Lo-Mendell-Rubin test; BLRT = Bootstrapped log-likelihood ratio test. **Bold** indicates best fitting model.

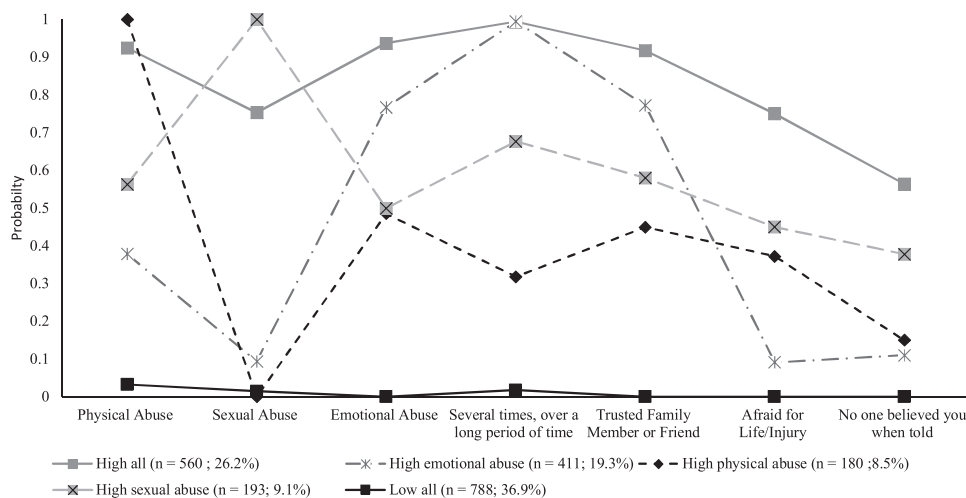


Fig. 1. Item probability plot for victimization and associated trauma characteristics for female youth.

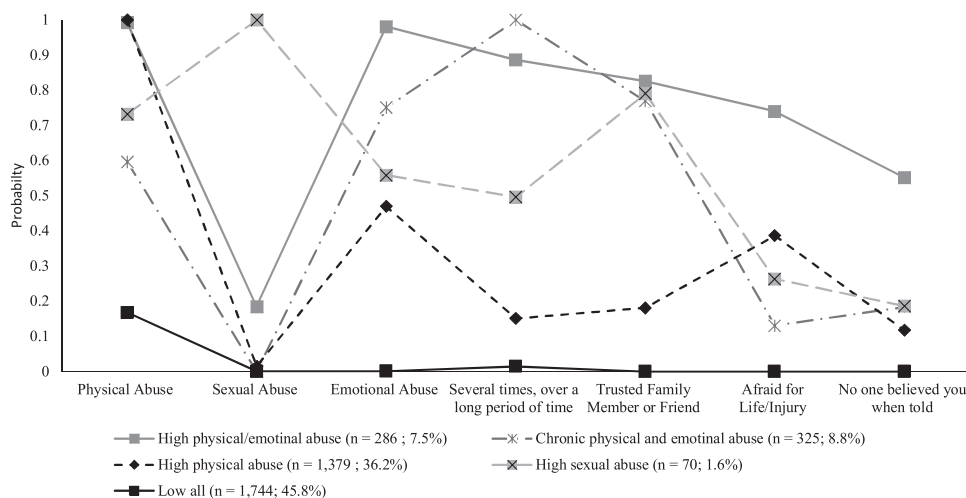


Fig. 2. Item probability plot for victimization and associated trauma characteristics for male youth.

survival graph indicated that the difference in hazard was notable between 100 and 200 days (Fig. 3). No other differences were found between other classes and the low-all class.

3.2.2. Males

We did not find support for Hypothesis 1 (Table 4, Model 1): males in the high physical/emotional abuse class did not differ in latency to first illicit drug use compared to the low all class (HR = 1.20, [0.86, 1.68]). However, males in the chronic physical and emotional abuse (HR = 1.43, [1.09, 1.87]), high sexual abuse (HR = 2.46, [1.57, 3.87]), and the high physical abuse classes (HR = 1.39, [1.16, 1.66]) had greater hazard for latency to first illicit drug use compared to male participants in the low all class. Visual inspection of the survival graph (Fig. 4) indicated that the differences in hazard appear to be especially notable between 100 and 200 days, and continued to be greater after 200 days for the high sexual abuse class.

3.3. Aim 3: moderation by PTSD and MDD

3.3.1. Females

We found partial support for Hypothesis 2 for females. In the final model (Model 4; Table 3), PTSD symptoms emerged as a contributor to greater hazard for latency to first illicit drug use for females in the high physical abuse class (11% increase; HR = 1.11, [1.03, 1.20]) only, and MDD symptoms emerged as predictors of greater latency to first illicit

drug use for females in the high all (11% increase; HR = 1.11, [1.03, 1.19]) and high emotional abuse classes (10% increase; HR = 1.10, [1.02, 1.18]).

3.3.2. Males

Contrary to Hypothesis 2, in the final Model (Model 4; Table 4), PTSD and MDD did not predict greater latency to illicit drug use for any emergent class.

4. Discussion

Adolescents and young adults in treatment for illicit drug use disorders are at especially high risk of relapse (Winters et al., 2014), and those who have experienced violent victimization are at even greater risk of poor outcomes (Davis et al., 2019a, 2019b). Our findings demonstrate that victimization, when modeled as a function of both types of violence experienced and associated trauma characteristics, is important for understanding young male and females' SUD treatment outcomes. The first aim of the current study was to identify victimization typologies among adolescents and young adults in treatment for illicit drug use disorders with a more nuanced lens than the typical focus on single victimization types. Several important findings emerged.

First, although some similar classes were identified for males and females, there were gender differences in class prevalence.

Table 3
Model for **Females**. Continuous time survival mixture model for return to illicit drug use by emergent victimization classes.

Parameter	Hazard Ratio [95% CI] or Odds Ratio [95% CI]				
	High All	High Emotional Abuse	High Physical Abuse	High Sexual Abuse	Low all
Model 1: Overall					
<i>Latent Class Growth Factor</i>					
Intercept α_u (HR)	1.35 [1.06, 1.71]	1.23 [0.97, 1.57]	1.28 [0.89, 1.84]	1.25 [0.83, 1.87]	0 (Fixed)
Model 2: PTSD symptoms					
<i>Latent Class Growth Factor</i>					
Intercept α_u (HR)	1.60 [1.05, 2.42]	1.15 [0.81, 1.61]	0.98 [0.58, 1.66]	1.63 [0.93, 2.87]	0 (Fixed)
PTSD (HR)	1.00 [0.96, 1.04]	1.06 [1.01, 1.11]	1.11 [1.03, 1.19]	0.99 [0.93, 1.06]	1.09 [1.05, 1.14]
<i>Latent Class Regression</i>					
PTSD (OR)	2.38 [2.28, 2.49]	1.21 [1.16, 1.26]	1.21 [1.14, 1.28]	132 [1.24, 1.40]	REF
Model 3: MDD symptoms					
<i>Latent Class Growth Factor</i>					
Intercept α_u (HR)	1.07 [0.61, 1.86]	0.86 [0.51, 1.49]	1.36 [0.73, 2.67]	1.46 [0.72, 2.94]	0 (Fixed)
MDD (HR)	1.08 [1.01, 1.14]	1.11 [1.05, 1.18]	1.05 [0.95, 1.16]	1.03 [0.95, 1.13]	1.10 [1.06, 1.14]
<i>Latent Class Regression</i>					
MDD (OR)	1.49 [1.43, 1.57]	1.31 [1.24, 1.36]	1.21 [1.13, 1.29]	1.32 [1.23, 1.41]	REF
Model 4: PTSD & MDD symptoms					
<i>Latent Class Growth Factor</i>					
Intercept α_u (HR)	1.14 [0.65, 2.00]	0.83 [0.48, 1.42]	1.26 [0.65, 2.44]	1.48 [0.71, 3.07]	0 (Fixed)
PTSD (HR)	0.96 [0.92, 1.01]	1.03 [0.97, 1.08]	1.11 [1.03, 1.20]	0.96 [0.84, 1.09]	1.04 [0.99, 1.10]
MDD (HR)	1.11 [1.03, 1.19]	1.10 [1.02, 1.18]	0.98 [0.88, 1.09]	1.07 [0.92, 1.24]	1.07, 1.03, 1.12]
<i>Latent Class Regression</i>					
PTSD (OR)	8.98 [6.26, 12.7]	2.52 [1.80, 3.54]	2.09 [1.30, 3.37]	4.29 [2.62, 7.02]	REF
MDD (OR)	5.12 [3.05, 8.61]	4.19 [2.78, 6.33]	2.94 [1.70, 5.09]	3.31 [1.75, 6.25]	REF

Note: Thresholds and control variables (age, race/ethnicity, self-reported gender, criminal justice involvement, most severe drug needing treatment for, time spent in the community) are not shown for these models for ease of reading, however, were estimated in each model. PTSD = post-traumatic stress disorder; REF = reference class; OR = Odds Ratio; 95% CI = 95% confidence interval. Model 1: initial continuous time survival model by emergent trauma classes; Model 2: PTSD as a moderator of survival probability by emergent class; Model 3: MDD as a moderator of survival probability by emergent class; Model 4: both PTSD and MDD as moderators of survival probability by emergent class. **Highlights in bold indicates confidence interval does not include 1.**

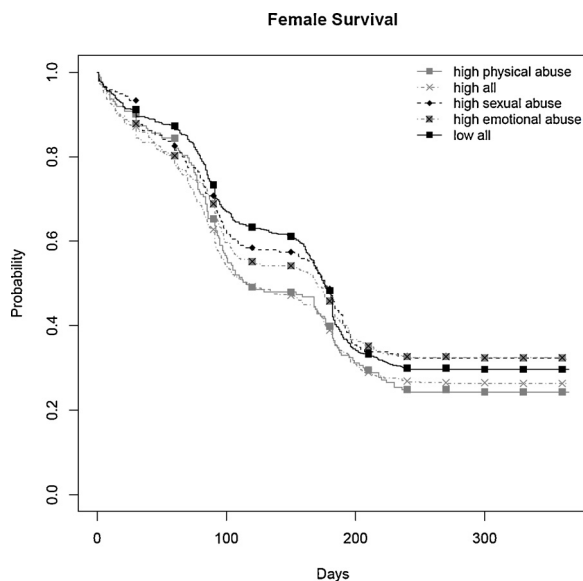


Fig. 3. Survival probability by emergent victimization classes for females.

Interestingly, the female model revealed a *high all* class, akin to prior work identifying individuals as experiencing poly-victimization. However, in the model for male participants, the majority of emergent classes involved physical abuse, with no class emerging as a pure poly-victimization class. It is important to note that rates of poly-victimization, especially among women, in the current sample were higher than studies assessing poly-victimization in community (Butcher et al., 2016) and other clinical samples (Davis et al., 2019a, 2019b), but are consistent with more recent estimates (Finkelhor et al., 2013) and evidence from high-risk samples (e.g., youth involved in the juvenile justice system; Charak et al., 2019; Davis et al., 2017, 2019a, 2019b; Ford et al., 2010). This suggests that it is vitally important for future

research with female populations to incorporate poly-victimization theory and measurement because it is a salient and yet understudied problem in this group. More females than males were classified into the class involving high sexual abuse (9.1% vs. 1.6%). More males than females were classified into the class defined by high levels of physical abuse specifically (36.2% vs. 8.5%) as well as the *low all* class (45.8% vs. 36.9%).

Second, this study shows continued support for modeling victimization as a function of both direct experience and associated trauma characteristics. Individuals who were categorized as endorsing a majority of the victimization items had the highest probability of endorsing harmful characteristics, and individuals categorized into single victimization types (e.g., sexual abuse, emotional abuse) had differential endorsement of harmful characteristics. For example, males and females who primarily experienced emotional abuse were more likely to have a trusted perpetrator and were more likely to have experienced chronic abuse. Additionally, those who experienced primarily physical abuse were more likely to have feared for their life.

The second aim of this paper was to understand how emergent classes of victimization differentially predicted latency to illicit drug use after SUD treatment. Prior literature has supported the notion that a history of abuse (e.g., sexual, physical, or emotional) is common among individuals in SUD treatment (Farley et al., 2004) and is associated with pretreatment severity and post-treatment recovery (Branstetter et al., 2008), although it is unclear how various patterns of victimization experiences might relate to post-treatment outcomes. In partial support of our first hypothesis, females in the *high all* class had higher hazard to relapse compared to females in the *low all* class, but the same was not true for comparable classes in males. Our findings are in line with prior work that has found increased rates of relapse among individuals who report two or more traumatic events compared to individuals who report one or fewer (70% vs. 30%, respectively; Farley et al., 2004), and that victimization is a stronger predictor of SUD outcomes for females than males (Hyman et al., 2008; Moran et al., 2004; Shane et al., 2006). However, the current study extends this work to indicate that the

Table 4
Model for **Males**. Continuous time survival mixture model for return to illicit drug use by emergent victimization classes.

Parameter	High Physical/Emotional Abuse	Chronic Emotional and Physical Abuse	High Sexual Abuse	High Physical Abuse	Low all
Model 1: Overall					
<i>Latent Class Growth Factor</i>					
Intercept α_u (HR)	1.20 [0.86, 1.68]	1.43 [1.09, 1.87]	2.46 [1.57, 3.87]	1.39 [1.16, 1.66]	0 (fixed)
Model 2: PTSD symptoms					
<i>Latent Class Growth Factor</i>					
Intercept α_u (HR)	11.14 [0.50, 2.61]	1.33 [0.91, 1.96]	2.48 [1.21, 5.07]	1.27 [1.04, 1.56]	0 (Fixed)
PTSD (HR)	1.02 [0.93, 1.12]	1.03 [0.96, 1.10]	1.02 [0.89, 1.16]	1.04 [1.01, 1.07]	1.07 [0.99, 1.16]
<i>Latent Class Regression</i>					
PTSD (OR)	5.20 [4.64, 5.85]	4.06 [3.72, 4.41]	3.85 [3.38, 4.40]	3.71 [3.45, 3.98]	REF
Model 3: MDD symptoms					
<i>Latent Class Growth Factor</i>					
Intercept α_u (HR)	0.94 [0.38, 2.61]	1.69 [1.07, 2.67]	2.67 [0.95, 7.49]	1.30 [1.02, 1.67]	0 (Fixed)
MDD (HR)	1.06 [0.96, 1.18]	1.00 [0.94, 1.07]	1.02 [0.85, 1.23]	1.05 [1.01, 1.83]	1.08 [1.03, 1.13]
<i>Latent Class Regression</i>					
MDD (OR)	1.69 [1.58, 1.84]	1.49 [1.41, 1.57]	1.41 [1.25, 1.59]	1.30 [1.24, 1.37]	REF
Model 4: PTSD & MDD symptoms					
<i>Latent Class Growth Factor</i>					
Intercept α_u (HR)	0.94 [0.37, 2.37]	1.73 [1.10, 2.71]	2.72 [1.02, 7.24]	1.30 [1.02, 1.67]	0 (Fixed)
PTSD (HR)	0.98 [0.89, 1.09]	1.05 [0.96, 1.14]	1.02 [0.87, 1.17]	1.03 [0.99, 1.06]	1.03 [0.96, 1.11]
MDD (HR)	1.06 [0.94, 1.20]	0.95 [0.87, 1.04]	0.98 [0.80, 1.21]	1.03 [0.99, 1.07]	1.07 [1.02, 1.12]
<i>Latent Class Regression</i>					
PTSD (OR)	1.42 [1.31, 1.54]	1.25 [1.16, 1.34]	1.24 [1.11, 1.38]	1.23 [1.16, 1.31]	REF
MDD (OR)	1.41 [1.31, 1.52]	1.37 [1.29, 1.45]	1.33 [1.19, 1.48]	1.21 [1.15, 1.27]	REF

Note: Thresholds and control variables (age, race/ethnicity, self-reported gender, criminal justice involvement, most severe drug needing treatment for, time spent in the community) are not shown for these models for ease of reading, however, were estimated in each model. PTSD = post-traumatic stress disorder; REF = reference class; OR = Odds Ratio; 95% CI = 95% confidence interval. Model 1: initial continuous time survival model by emergent trauma classes; Model 2: PTSD as a moderator of survival probability by emergent class; Model 3: MDD as a moderator of survival probability by emergent class; Model 4: both PTSD and MDD as moderators of survival probability by emergent class. **Highlights in bold indicates confidence interval does not include 1.**

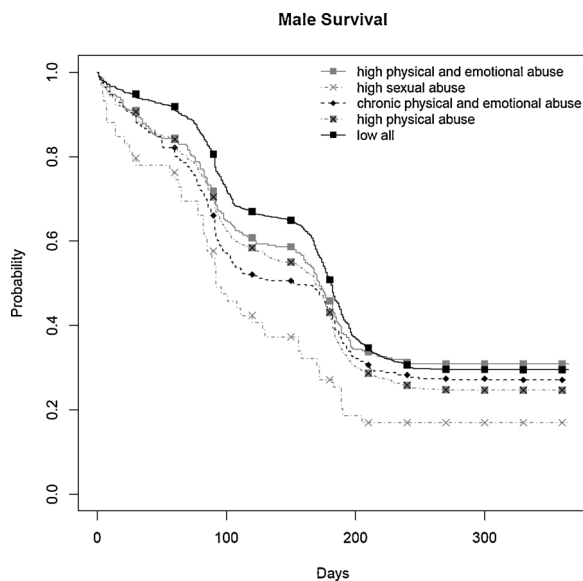


Fig. 4. Survival probability by emergent victimization classes for males.

relationship between poly-victimization, specifically, and SUD outcomes may be especially pronounced for women. Contrary to our hypothesis, we found that men in the *high sexual abuse* class had the highest hazard for return to illicit drug use compared to men in the low-all victimization profiles. This is consistent with past work that identified that sexual abuse may be especially harmful to SUD outcomes. For example, an early study found that nearly 90% of relapse-prone female patients in treatment for SUDs had a history of sexual abuse (Wadsworth et al., 1995), and a second study found that sexual abuse was a stronger predictor of outcomes following alcohol treatment than physical abuse (Greenfield et al., 2002). However, these findings extend this work by suggesting this association may be especially pronounced

among males. Although we were unable to statistically test the precise timing of increased risk for return to use, it was notable from visual inspection of the survival graphs that the differences in hazard appeared to be especially prominent between 100 and 200 days post-discharge, and continually over time for males in the sexual abuse class. This preliminary finding should be confirmed in future work, but suggests that interventions could be strategically timed to prevent relapse among at-risk individuals.

The third aim of this study was to extend past research on SUD treatment outcomes for individuals who endorse comorbid conditions (Norman et al., 2007) by considering heterogeneity in experiences of trauma. Contrary to our hypotheses, comorbid mental health conditions were associated with greater latency to illicit drug use for females, but not males, in certain victimization classes. Specifically, PTSD symptoms predicted faster latency to illicit drug use for females in the *high physical abuse* class, and MDD symptoms predicted faster relapse for females in the *high all* and *high emotional abuse* classes. These findings were surprising in light of evidence that the effects of co-occurring disorders on SUD outcomes are especially pronounced for males (Najt et al., 2011). Prior research has found that women with more mental health problems are less likely to complete SUD treatment (Green et al., 2002); yet, in several literature reviews and meta-analyses (see Greenfield et al., 2007 for review), gender does not appear to be a specific predictor of treatment outcomes (e.g., relapse). This study clarifies these discrepant findings by suggesting that comorbid conditions may be especially relevant for females with certain victimization experiences, rather than females generally.

These results have two major implications. First, in order to identify patients at heightened risk for relapse, it is important that clinicians and allied health care professionals screen to address patients' range of victimization experiences including the presence of poly-victimization and associated harmful trauma characteristics. This may be especially important for women entering treatment who have experienced poly-victimization, women with comorbid conditions, and men with a history of sexual abuse. Second, it is clear that victimization experiences

are abundant and individuals (especially females) with comorbid conditions may have more complex clinical needs. Individuals who enter treatment with histories of chronic victimization and comorbid conditions may benefit from a care model that re-evaluates treatment needs at more frequent intervals. That is, clinicians may consider initial brief interventions to increase treatment engagement and, subsequently, include more trauma-focused therapy.

5. Limitations and conclusion

The current study is not without limitations. First, the results of this study may not be generalizable to all adolescents and young adults in SUD treatment because this subsample was focused on illicit drug use disorders. Second, because all data are self-reported, actual latency to illicit drug use may be biased. Third, the sexual abuse item does not include forms of abuse that did not occur against the conscious will of the child, and the emotional abuse item relies on subjective perceptions of events that constitute “abuse.” Finally, while this study uses a prospective design, no causal inferences can be made.

In conclusion, this study found that while victimization profiles were similar by gender, females experiencing poly-victimization and high rates of trauma-related characteristics and males experiencing sexual abuse had the quickest return to illicit drug use following treatment. We found that latency to illicit drug use was amplified by comorbid conditions for certain classes of females, but not males. A call for clinicians and researchers to more fully integrate poly-victimization assessment and theory as well as integrated care for adolescents and young adults entering SUD treatment with comorbid conditions is needed.

6. Contributors

JD conceived the study, carried out initial analyses, drafted the manuscript. NC, edited and drafted introduction and discussion; ED helped conceive the study idea, drafted manuscript, edited final version; JP helped conduct statistical analyses and draft results section; TD edited and drafted manuscript; GD helped conceive the idea edited and drafted manuscript; JH helped conceive the idea edited and drafted manuscript; CR edited final version of manuscript. All authors have read and approved the final version of this manuscript

Role of funding source

Manuscript preparation for this article was supported by National Institute of Alcohol Abuse and Alcoholism (NIAAA) Grant K99AA026317 (PI: Dworkin). The views expressed in this article are those of the authors and do not necessarily reflect the positions or policies of the University of Washington or the NIAAA.

Declaration of Competing Interest

No conflict declared.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.drugalcdep.2019.107721>.

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