This is the peer reviewed version of the following article: Peirce, J. M., Brooner, R. K., Kolodner, K., Schacht, R. L., & Kidorf, M. S. (2013). Prospective effects of traumatic event re-exposure and post-traumatic stress disorder in syringe exchange participants. Addiction (Abingdon, England), 108(1), 146–153. https://doi.org/10.1111/j.1360-0443.2012.04003.x, which has been published in final form at https://doi.org/10.1111/j.1360-0443.2012.04003.x. This article may be used for non-commercial purposes in accordance with Wiley Terms and Conditions for Use of Self-Archived Versions. All other rights are reserved. Access to this work was provided by the University of Maryland, Baltimore County (UMBC) ScholarWorks@UMBC digital repository on the Maryland Shared Open Access (MD-SOAR) platform.

Please provide feedback

Please support the ScholarWorks@UMBC repository by emailing scholarworks-group@umbc.edu and telling us
what having access to this work means to you and why it's important to you. Thank you.

NIH Public Access
Author Manuscript
Addiction. Author manuscript; available in PMC 2014 January 01.

Published in final edited form as:
Addiction. 2013 January ; 108(1): 146–153. doi:10.1111/j.1360-0443.2012.04003.x.

Prospective effects of traumatic event re-exposure and PTSD in syringe exchange participants

Jessica M. Peirce, **Robert K. Brooner**, **Ken Kolodner**, **Rebecca L. Schacht**, and **Michael S. Kidorf**
Johns Hopkins University School of Medicine, Baltimore, MD, USA

Abstract

Aim—Determine the effect of traumatic event re-exposure and PTSD symptom severity on proximal drug use and drug abuse treatment-seeking in syringe exchange participants.

Design—Prospective longitudinal 16-month cohort study of new syringe exchange registrants enrolled in a parent study of methods to improve treatment engagement.

Setting—Data were collected in a research van next to mobile syringe exchange distribution sites in Baltimore, Maryland.

Participants—Male and female (*N* = 162) injecting drug users (IDUs) registered for syringe exchange.

Measurements—Traumatic event re-exposure was identified each month with the Traumatic Life Events Questionnaire. PTSD symptoms were measured with the Modified PTSD Symptom Scale-Revised, given every four months. Outcome measures collected monthly were days of drug use (heroin, cocaine) and drug abuse treatment-seeking behavior (interest, calls to obtain treatment, treatment participation).

Findings—Each traumatic event re-exposure was associated with about 1 more day of cocaine use after accounting for the previous month's cocaine use [same month adjusted B(*SE*) = 1.16 (0.34); one month later: .99 (0.34)], while PTSD symptoms had no effect. Traumatic event re-exposure increased interest in drug abuse treatment [same month adjusted odds ratios with 95% confidence intervals = 1.34 (1.11–1.63)] and calling to obtain treatment [same month 1.58 (1.24–2.01); one month later 1.34 (1.03–1.75)]. Each 10% increase in PTSD symptom severity was associated with persistent increased interest in treatment [same month 1.25 (1.10–1.42); one month later 1.16 (1.02–1.32); two months later 1.15 (1.02–1.30)] and calling to obtain treatment [same month 1.16 (1.02–1.32)]. Neither traumatic events nor PTSD symptoms were associated with participants receiving treatment.

Conclusions—Becoming exposed again to traumatic events among injecting drug users is associated with an increase in cocaine use up to one month later, but drug use is not related to post-traumatic stress disorder symptoms. Both traumatic event re-exposure and posttraumatic stress disorder symptoms predict drug abuse treatment-seeking behavior for up to two months.

Introduction

Traumatic event exposure and posttraumatic stress disorder (PTSD) are common in injecting drug users (IDUs). Nearly all IDUs report a lifetime history of traumatic events,[1] and recent data suggests that most are regularly re-exposed to traumatic events.[2] Perhaps more

Address: Mason F. Lord, 6th Floor East, 5200 Eastern Avenue, Baltimore, MD 21224, USA.
Conflict of interest declaration: None.

$watermark-text
$watermark-text
$watermark-text

$watermark-text

$watermark-text

$watermark-text

importantly, about 25% of IDUs exposed to traumatic events subsequently meet diagnostic criteria for PTSD.[3–4] Despite the high rates of traumatic events and PTSD in this population, comparatively little is known about their effects on the clinical outcomes of drug use and drug abuse treatment-seeking.

PTSD has been associated with more drug use during and following a drug abuse treatment episode, particularly when patients remain symptomatic for PTSD,[5–7] although the diagnosis has not consistently influenced response to drug abuse treatment,[8] and the relationship in out-of-treatment populations remains unexplored. While many epidemiological studies using general population samples have shown that large-scale traumatic events are followed by higher rates of drug use,[9–16] others have shown no relationship[17–20] or a negative relationship.[21–22] However, few of these studies employed prospective designs and results from community samples may not generalize well to chronic drug users who are repeatedly re-exposed to interpersonal traumatic events. The literature has nevertheless identified several factors that might place trauma-exposed individuals at risk for increased drug use, including severity of trauma-related psychiatric symptoms,[23–26] greater lifetime exposure to traumatic events,[27] greater ongoing stress,[28] and history of greater pre-trauma drug use,[18] all of which are characteristics of IDUs.

The possibility that PTSD and traumatic event exposure could be associated with drug abuse treatment-seeking follows from the considerable evidence supporting a connection between PTSD and higher rates of medical and psychiatric treatment-seeking,[1,29–30] and between generalized psychiatric distress and drug abuse treatment-seeking.[31–33] Injecting drug users who report that the extreme negative consequences of their drug use have prompted their desire for treatment are popularly said to have hit “rock bottom,”[34–36] which can be associated with sustained remission.[37] To the degree that traumatic event re-exposures are perceived to be negative consequences of drug use, traumatic events are likely to increase IDUs’ treatment interest and enrollment.

The present study uses a prospective design to examine the effects of traumatic event re-exposure and PTSD symptoms on drug use and drug abuse treatment-seeking in a sample of injecting opioid-dependent men and women ($N = 162$) recently registered in a syringe exchange program. Participants in this 16-month study were assessed at intake and monthly for new traumatic event exposure, drug use, and drug abuse treatment interest and enrollment and for PTSD every four months. We hypothesized that PTSD symptoms and new traumatic event exposure would be associated with higher rates of concurrent and prospective drug use, and increased drug abuse treatment interest and enrollment.

Methods

Participants

The sample was drawn from new syringe exchange registrants in Baltimore, Maryland, USA who consented to a parent study comparing strategies to increase drug abuse treatment enrollment: 1) standard referral to drug abuse treatment; 2) referral with motivational enhancement and treatment readiness counseling (Motivated Referral Condition; MRC); and 3) motivational enhancement and treatment readiness counseling with incentives for attending counseling and enrolling in treatment (Motivated Referral Condition with Incentives; MRC+I).[38] The MRC+I participants were more likely to enter treatment and had lower rates of heroin use than the other conditions. Inclusion criteria for the parent study were: 1) newly registered at the syringe exchange program; 2) current opioid dependence; 3) under 60 years old; 4) not in drug abuse treatment; and 5) absence of major mental illness or severe cognitive impairment that interfered with understanding and completing study procedures.[38]

$watermark-text

$watermark-text

$watermark-text

The current study includes a subset of the parent study participants. Measures for the current study were administered from April 2004 through March 2007. Of 277 participants consented during this time period, 197 completed the parent study intake and were randomized to interventions. Participants were scheduled to attend one intake and 16 monthly follow-ups. Eighty-two percent ($N = 162$) of randomized participants attended at least one follow-up; this group comprises the current cohort study sample. All study visits occurred in a research vehicle parked near the syringe exchange vehicle at two distribution sites in Baltimore.

The study sample was largely male (69%; $n = 112$), with an average age of 42 years ($SEM = .62$). Most participants self-identified as Black (70%; $n = 114$), with the remainder identifying as White (26%; $n = 42$) or other category (primarily multiracial; 4%; $n = 6$). Most had a high school education (61%; $n = 98$), although few were employed (20%; $n = 33$). At intake, participants used heroin nearly every day [$M(SEM)$=27.83 (0.41) days in past month] and all reported injecting. Participants used cocaine often [16.11 (0.92) days in past month], with 85% of participants ($n = 137$) reporting that they inject cocaine. The study sample differed from the participants who attended intake only ($n = 35$) in two respects. The intake only group was more likely to endorse being White or an "other" category of race [51% Black, 34% White, 14% other; $\chi^2(2) = 8.05$; $p = 0.018$] and reported fewer days of cocaine use at intake [11.63(1.84); $t(194) = -2.08$; $p = 0.039$]. The current study sample did not differ from the larger parent study sample[38] on any demographic or drug use variable.

Measures

All participants completed intake assessments that included demographic information and a full Addiction Severity Index (ASI).[39] These were not repeated at follow-up.

Traumatic events and PTSD—The Traumatic Life Events Questionnaire (TLEQ)[40] was used to assess lifetime history of traumatic events at study intake, and new traumatic event exposures at each monthly follow-up. The TLEQ probes for exposure to 22 specific potential traumatic events and a 23rd "other" category, and includes questions to determine whether the event meets DSM-IV-TR Criterion A(2) for PTSD (i.e., a response of extreme fear, helplessness, or horror).[41] All events reported here met Criterion A(2). The TLEQ is considered a "gold standard" in traumatic event assessments,[42–43] and appears to detect traumatic events better than other measures in IDU populations.[44] The TLEQ was modified for follow-up administration by prefacing each event probe with "In the past 30 days…" When a participant missed a follow-up, data was collected for the missing month(s) using a timeline follow-back procedure[45] at the next attended follow-up. This procedure helped to minimize missing data. TLEQ data was collected for 83% of the follow-ups (2140 of 2592). For analysis, the TLEQ provided a dichotomous measure of traumatic event re-exposure in a given month (any exposure vs. none).

The Modified Posttraumatic Stress Scale-Revised (MPSS-R)[46] was used to assess current PTSD symptoms. It consists of 17 questions targeted to the 17 DSM-IV-TR symptoms, with scales to rate intensity (0–3) and frequency (0–4) of each symptom, which are summed for a total severity score. The MPSS-R has shown good reliability and validity in IDU populations.[47] The MPSS-R was administered at study intake, and was intended to be readministered at follow-up months 4, 8, and 12. However, a participant who missed a scheduled MPSS-R follow-up was administered the measure as written at the next attended follow-up, and symptoms were tied to that month. Of 334 MPSS-R administrations during the study, 77% were administered in the intended month, and an additional 14% within one month, with the remainder administered up to 7 months later than intended. The total severity score (range 0–119) was recoded into deciles (range 1–10) to facilitate the

$watermark-text

$watermark-text

$watermark-text

interpretation of results, so that the outcomes are expressed as a function of a 10% increase in PTSD symptom severity.

Drug use and drug abuse treatment-seeking outcomes—Participants were asked at each follow-up about cocaine and heroin use using the following format: In the past 30 days, how many days did you use (drug)? Participants were asked the following three questions to measure drug abuse treatment-seeking: 1) Are you interested in treatment at this time? (or "Are you interested in *further* treatment at this time?" if already receiving treatment); 2) In the past 30 days, have you called a treatment program for admission?; and 3) Did you participate in drug abuse treatment in the past 30 days? Data from missed follow-ups were collected at the next scheduled follow-up using the time-line followback procedure.

Statistical analyses

Design and analysis—The purpose of this cohort study was to determine the impact of traumatic event re-exposure and PTSD symptoms on proximal drug use and drug abuse treatment-seeking behaviors across short time frames up to 2 months, using data from intake and 16 monthly follow-ups. All data were analyzed using IBM SPSS Statistics 18.0 for Mac.

Mixed-effects models[48] (MIXED procedure) were used to analyze the relationship between traumatic event and PTSD variables and each drug use outcome in the same month, one month later, and two months later. Drug use outcomes were not normally distributed; the distribution was largely flat, with bimodal peaks at 0 and 30 days of use. As a result, a negative binomial distribution was specified in the analyses, with a first-order autoregressive covariance matrix structure. Unadjusted analyses are presented as B(*SE*) with p-values. Covariates used in subsequent analyses were chosen based on their known relationship to either dependent or independent variables, including parent study treatment condition, gender (i.e., women more likely to experience traumatic event re-exposure),[2] minority status (i.e., minorities less likely to enter drug abuse treatment)[49] and age (i.e., treatment-seeking increases with age).[50] Because ongoing drug use seemed likely to mediate the effect of traumatic event re-exposure and PTSD symptoms on drug use outcomes, adjusted models [adj B(*SE*)] also included the time-varying covariate of the previous month's days of drug use.

Generalized Estimating Equations[51] (GEE; GENLIN procedure) were used to determine associations between traumatic event and PTSD variables and each treatment-seeking outcome in the same month, one month later, and two months later. A binomial distribution with logit link was specified. Unadjusted analyses are reported as odds ratios (OR) with 95% confidence intervals (CI); subsequent analyses with covariates (treatment condition, gender, minority status, age) are reported as adjusted odds ratios (AOR).

We also wished to examine *a posteriori* whether treatment participation mediated or moderated the relationship between traumatic event exposure and PTSD symptoms and drug use and treatment-seeking outcomes. In accordance with established guidelines for mediational analyses,[52] partial or full mediation was considered if traumatic events or PTSD symptoms and drug use or treatment-seeking outcomes and treatment entry were all significantly associated. Moderation was considered if the main effects were significant and the interaction term of traumatic event or PTSD symptoms with treatment entry was associated with drug use or treatment-seeking outcomes. Significant interaction terms were explored with stratified analyses to compare the effect of traumatic event or PTSD symptoms on outcomes in participants who reported past-month treatment with those who denied past-month treatment at the follow-up.

$watermark-text

$watermark-text

$watermark-text

Missing data—All participants had intake data, although 2 were missing MPSS-R data and 1 was missing ASI data. Of 2592 possible follow-ups (162 participants × 16 follow-ups), 2140 had data on independent and dependent variables, with occasional missing data points. For traumatic event re-exposure analyses, 2137, 1977, and 1825 observations were available for the same month, one month later, and two months later, respectively. For PTSD symptom analyses, 333, 321, and 310 observations were available for the same month, one month later, and two months later, respectively. A GEE analysis determined that neither of the parent study active treatment conditions were more likely to attend follow-ups than the standard referral participants [MRC+I: AOR (95% CI) = 1.11 (0.48–2.57); MRC: 0.83 (0.37–1.83)] nor were any of the fixed covariates associated with follow-up attendance [male gender: 0.48 (0.22–1.07); minority status: 0.97 (0.46–2.03); age: 0.98 (0.94–1.01)].

Results

Traumatic events and PTSD symptoms

At entry into the study, 91% of participants had experienced at least one qualifying traumatic event in their lifetime, with the most common events being adult physical assault (75%) and unexpected death of a loved one (58%). Re-exposure during the 16-month study was very common, with 72% re-exposed at least once by the end of the study,[2] and an average of about 4 months in which re-exposure occurred [*M*(*SEM*) = 3.65 (0.33); range: 0–16]. Average PTSD severity measured by MPSS-R scores at intake represented some distress, but ranged widely [*M*(*SEM*) = 24.81 (2.18); range: 0–111]. The mean of all follow-up MPSS-R scores was slightly lower [18.54 (1.29); range 0–107]. The majority of follow-up MPSS-R scores fell in the first (25%) or second decile (33%), but all deciles were populated.

Effects on drug use

Traumatic event re-exposure was associated with an increase of one day or more of cocaine use in the same month and in the following month after adjustment for covariates including previous month's cocaine use (Table 1), which was not fully evident in the unadjusted mixed models [same month B(*SE*) = 0.26 (0.37); one month 1.02 (0.37); two months 0.37 (0.38)]. In contrast, traumatic events were unrelated to days of heroin use, and the unadjusted models had similar results [same month 0.15 (0.41); one month 0.70 (0.41); two months −0.29 (0.42)]. PTSD symptom severity was not associated with days of cocaine use in the adjusted models (Table 1) or in the unadjusted models [same month 0.29 (0.30); one month 0.48 (0.29); two months 0.38 (0.27)]. PTSD symptom severity was related to an increase of less than one day of heroin use in the unadjusted analyses [same month 0.79 (0.25); one month 0.82 (0.36); two months 0.11 (0.34)], which disappeared after adjustment for gender, age, race, and previous month's heroin use (Table 1).

Effects on treatment-seeking

As shown in Table 2, traumatic event re-exposure increased the odds of participants reporting an interest in drug abuse treatment in the same month by 34%, although the effect did not carry over to following months. The main effect of traumatic event re-exposure in unadjusted models was nearly identical to the adjusted results [OR (95% CI); same month 1.33 (1.11–1.60); one month 1.11 (0.92–1.33); two months 0.95 (0.78–1.15)]. Traumatic event re-exposure also increased the likelihood that participants reported calling about drug abuse treatment in the same and following month, but not two months after the traumatic event (Table 2). Again, the unadjusted model was nearly identical [same month 1.58 (1.24–2.02); one month 1.34 (1.04–1.74); two months 1.07 (0.82–1.38)]. Traumatic events were not associated with participants receiving drug abuse treatment in adjusted models within

$watermark-text

$watermark-text

$watermark-text

any time frame (Table 2). Unadjusted effects were very similar [same month 0.96 (0.81–1.15); one month 1.34 (1.04–1.74); two months 1.07 (0.82–1.38)].

Each 10% increase in PTSD symptom severity was associated with a consistent 15–**25**% increase in likelihood of participants reporting an interest in drug abuse treatment in the same month and in the following two months (Table 2). Unadjusted models of the relationship between PTSD symptom severity and interest in treatment were very similar [same month 1.24 (1.10–1.40); one month 1.17 (1.04–1.33); two months 1.15 (1.03–1.28)]. Each 10% increase in PTSD symptom severity also increased the chance that a participant called about treatment by **16**%, but only in the same month (Table 2). Unadjusted models were again similar [same month 1.16 (1.02–1.31); one month 1.14 (1.01–1.29); two months 1.11 (0.99–1.26)]. PTSD symptom severity was not associated with participants receiving drug abuse treatment in either adjusted models (Table 2) or unadjusted models [same month 0.95 (0.84–1.07); one month 0.96 (0.85–1.09); two months 0.98 (0.87–1.12)].

Mediating and moderating effects of treatment participation

Since neither traumatic event re-exposure nor PTSD symptoms were associated with treatment entry, the criteria to test for mediation were not met. Moderation criteria were met for 2 of 12 drug use outcomes only. Specifically, treatment participation interacted with traumatic event exposure on cocaine use in the same month and interacted with PTSD symptom severity on heroin use one month later. Stratified analyses revealed that traumatic event exposure was associated with a non-significant increase in cocaine use in participants who had been in treatment [adj B(*SE*) = 0.64 (0.45); $p = 0.155$], but was associated with almost two days more cocaine use in participants who had not been in treatment [1.68 (0.44); $p < 0.001$]. With a smaller number of observations, the association of PTSD symptoms with heroin use one month later was not significant in either set of participants, but the direction of change was different (treatment [−0.42 (0.37); $p = 0.265$] vs. no treatment [0.36 (0.28); $p = 0.206$]).

Discussion

In this prospective study of injecting drug users newly registered to a community syringe exchange program in Baltimore Maryland, new traumatic events, though not PTSD symptoms, were associated concurrently and prospectively with increases in cocaine use, even after accounting for ongoing drug use. Because this was the first study to prospectively measure drug use in chronic IDUs before and after a traumatic event, it was uniquely positioned to discover even subtle changes in drug use patterns. Although the absolute magnitude of 1 more day of cocaine use in a month attributable to traumatic event re-exposure may seem small, an average of 4 months of re-exposures during the course of the study corresponds to a cumulative increase of 4 more days of cocaine per month—a 25% increase in the already high base rate of cocaine use. The potential impact of this increase is severe, given that cocaine use (and drug injection more generally) is associated with up to 14 times greater risk of mortality when compared to age and gender-matched populations, with HIV/AIDS-related illnesses, overdose, and traumatic death as primary causes of death.[53–54] The absence of an effect on heroin use is likely related to restricted variability in heroin use, characterized by the flat distribution that peaked at 0 and 30 days of use. Data from the present study extends previous retrospective findings of increased alcohol and marijuana use after a disaster,[11, 15] and prospective reports showing that traumatic events are more likely to facilitate drug use in people with higher rates of pre-trauma drug use.[18] Although anecdotal and retrospective accounts have linked PTSD to drug use, the failure to find a prospective relationship between PTSD severity and drug use is consistent with several studies of drug users in treatment in which PTSD was not associated with amount or

$watermark-text

$watermark-text

$watermark-text

severity of drug use during or after treatment.[8, 55] The absence of a direct relationship between PTSD and drug use does not preclude a direct or indirect association with other outcomes important for IDUs, such as employment or social support networks,[8, 55–56] and future studies should evaluate these alternative mechanisms.

The fact that traumatic event re-exposure and PTSD symptoms in this study were related to increased desire for and efforts to obtain drug abuse treatment extends earlier work that found relationships between psychiatric distress, including PTSD, and treatment-seeking behaviors.[30, 33] The absence of a corresponding increase in treatment enrollment is concerning, but supported by findings that fewer than 50% of IDUs in the U.S. and around the world are receiving drug abuse treatment.[57–58] This discrepancy has been targeted successfully in several studies focusing on presumed barriers to treatment entry (e.g., transportation, finances, and treatment waiting lists).[59–61] Time is one element common to all these barriers, and the increased motivation for treatment in the present study was also time-limited, dropping to baseline levels within one to two months. Providing rapid access to treatment during this brief window of opportunity may reduce the discrepancy between treatment motivation and enrollment. Among the many benefits of drug abuse treatment is the additional finding that it may also moderate the increase in drug use related to new traumatic events or PTSD.

The study was limited by the use of a convenience sample that likely represents injecting drug users in inner-city Baltimore, but which may not generalize well to non-urban samples or samples from urban environments characterized by less community violence and poverty.[62] We also collected somewhat fewer PTSD measures over time than anticipated, although the rate of follow-up attendance is consistent with other studies observing chronic injecting drug users.[63–64] Fewer observations and scores in the non-clinical range may have limited our ability to find effects of PTSD symptoms alone and prevented us from modeling the combined effects of traumatic events and PTSD symptoms on drug use and treatment-seeking.

The primary strength of this study lies in the prospective evaluation of traumatic events and PTSD symptoms that fluctuate over time. This design allowed for repeated observations made independent of participant or interviewer assumptions about relationships; such unbiased data appears more useful to scientific inquiry than anecdotal or retrospective beliefs about these relationships.[65] Indeed, the relatively common belief that PTSD symptoms trigger drug use was not supported in this study, while new traumatic events do appear to worsen drug use. Although other recent studies also failed to find a direct relationship between PTSD and drug use, the high comorbidity of these two problems has yet to be explained. The relationship may be indirect, in which PTSD increases risk of new traumatic event exposures,[66] which lead to increased drug use as found in the present study. Future clinical and research attention should be focused on exploring potential indirect relationships between traumatic event re-exposure, PTSD, and drug use, with the ultimate goal of identifying targets for intervention.

Acknowledgments

This research was supported by NIH-NIDA grants K23DA015739 (Peirce) and R01DA021347 (Kidorf).

References

1. Mills KL, Lynskey M, Teesson M, Ross J, Darke S. Post-traumatic stress disorder among people with heroin dependence in the Australian treatment outcome study (ATOS): prevalence and correlates. Drug Alcohol Depend. 2005; 77:243–249. [PubMed: 15734224]

$watermark-text

$watermark-text

$watermark-text

2. Peirce JM, Kolodner K, Brooner RK, Kidorf MS. Traumatic event re-exposure in injecting drug users. J Urban Health. 2012; 89:117–28. [PubMed: 21989498]

3. Reynolds M, Mezey G, Chapman M, Wheeler M, Drummond C, Baldacchino A. Co-morbid post-traumatic stress disorder in a substance misusing clinical population. Drug Alcohol Depend. 2005; 77:251–258. [PubMed: 15734225]

4. Wasserman DA, Havassy BE, Boles SM. Traumatic events and post-traumatic stress disorder in cocaine users entering private treatment. Drug Alcohol Depend. 1997; 46:1–8. [PubMed: 9246548]

5. Brown PJ, Stout RL, Mueller T. Posttraumatic stress disorder and substance abuse relapse among women: A pilot study. Psychol Addict Behav. 1996; 10:124–128.

6. Hien DA, Nunes E, Levin FR, Fraser D. Posttraumatic stress disorder and short-term outcome in early methadone treatment. J Subst Abuse Treat. 2000; 19:31–37. [PubMed: 10867298]

7. Read JP, Brown PJ, Kahler CW. Substance use and posttraumatic stress disorders: symptom interplay and effects on outcome. Addict Behav. 2004; 29:1665–1672. [PubMed: 15451135]

8. Mills KL, Teesson M, Ross J, Darke S. The impact of post-traumatic stress disorder on treatment outcomes for heroin dependence. Addiction. 2007; 102:447–454. [PubMed: 17298653]

9. Adams RE, Boscarino JA, Galea S. Alcohol use, mental health status and psychological well-being 2 years after the World Trade Center attacks in New York City. Am J Drug Alcohol Abuse. 2006; 32:203–224. [PubMed: 16595324]

10. Biggs QM, Fullerton CS, Reeves JJ, Grieger TA, Reissman D, Ursano RJ. Acute stress disorder, depression, and tobacco use in disaster workers following 9/11. Am J Orthopsychiatry. 2010; 80:586–592. [PubMed: 20950299]

11. Boscarino JA, Adams RE, Galea S. Alcohol use in New York after the terrorist attacks: a study of the effects of psychological trauma on drinking behavior. Addict Behav. 2006; 31:606–621. [PubMed: 15982827]

12. Chemtob CM, Nomura Y, Josephson L, Adams RE, Sederer L. Substance use and functional impairment among adolescents directly exposed to the 2001 World Trade Center attacks. Disasters. 2009; 33:337–352. [PubMed: 19178553]

13. Rohrbach LA, Grana R, Vernberg E, Sussman S, Sun P. Impact of hurricane Rita on adolescent substance use. Psychiatry. 2009; 72:222–237. [PubMed: 19821646]

14. Schiff M, Zweig HH, Benbenishty R, Hasin DS. Exposure to terrorism and Israeli youths' cigarette, alcohol, and cannabis use. Am J Public Health. 2007; 97:1852–1858. [PubMed: 17761574]

15. Vlahov D, Galea S, Ahern J, Resnick H, Kilpatrick D. Sustained increased consumption of cigarettes, alcohol, and marijuana among Manhattan residents after september 11, 2001. Am J Public Health. 2004; 94:253–254. [PubMed: 14759935]

16. Wu P, Duarte CS, Mandell DJ, Fan B, Liu X, Fuller CJ, et al. Exposure to the World Trade Center attack and the use of cigarettes and alcohol among New York City public high-school students. Am J Public Health. 2006; 96:804–807. [PubMed: 16571705]

17. Cepeda A, Valdez A, Kaplan C, Hill LE. Patterns of substance use among hurricane Katrina evacuees in Houston, Texas. Disasters. 2010; 34:426–446. [PubMed: 19863564]

18. Hasin DS, Keyes KM, Hatzenbuehler ML, Aharonovich EA, Alderson D. Alcohol consumption and posttraumatic stress after exposure to terrorism: effects of proximity, loss, and psychiatric history. Am J Public Health. 2007; 97:2268–2275. [PubMed: 17971553]

19. North CS, Ringwalt CL, Downs D, Derzon J, Galvin D. Postdisaster course of alcohol use disorders in systematically studied survivors of 10 disasters. Arch Gen Psychiatry. 2011; 68:173–180. [PubMed: 20921113]

20. Perrine MW, Schroder KE, Forester R, McGonagle-Moulton P, Huessy F. The impact of the September 11, 2001, terrorist attacks on alcohol consumption and distress: reactions to a national trauma 300 miles from Ground Zero. J Stud Alcohol. 2004; 65:5–15. [PubMed: 15000498]

21. Lippert AM, Fendrich M, Johnson TP. Vicarious exposure to terrorist attacks and substance use: results from an urban household survey. J Urban Health. 2008; 85:411–427. [PubMed: 18363107]

22. Shimizu S, Aso K, Noda T, Ryukei S, Kochi Y, Yamamoto N. Natural disasters and alcohol consumption in a cultural context: the Great Hanshin Earthquake in Japan. Addiction. 2000; 95:529–536. [PubMed: 10829329]

$watermark-text

$watermark-text

$watermark-text

23. McFarlane AC, Browne D, Bryant RA, O'Donnell M, Silove D, Creamer M, et al. A longitudinal analysis of alcohol consumption and the risk of posttraumatic symptoms. J Affect Disord. 2009; 118:166–172. [PubMed: 19230982]
24. Schroeder JM, Polusny MA. Risk factors for adolescent alcohol use following a natural disaster. Prehosp Disaster Med. 2004; 19:122–127. [PubMed: 15453169]
25. Simons JS, Gaher RM, Jacobs GA, Meyer D, Johnson-Jimenez E. Associations between alcohol use and PTSD symptoms among American Red Cross disaster relief workers responding to the 9/11/2001 attacks. Am J Drug Alcohol Abuse. 2005; 31:285–304. [PubMed: 15912717]
26. Vlahov D, Galea S, Resnick H, Ahern J, Boscarino JA, Bucuvalas M, et al. Increased use of cigarettes, alcohol, and marijuana among Manhattan, New York, residents after the September 11th terrorist attacks. Am J Epidemiol. 2002; 155:988–996. [PubMed: 12034577]
27. Cerdá M, Tracy M, Galea S. A prospective population based study of changes in alcohol use and binge drinking after a mass traumatic event. Drug Alcohol Depend. 2011; 115:1–8. [PubMed: 20977977]
28. Richman JA, Wislar JS, Flaherty JA, Fendrich M, Rospenda KM. Effects on alcohol use and anxiety of the September 11, 2001, attacks and chronic work stressors: a longitudinal cohort study. Am J Public Health. 2004; 94:2010–2015. [PubMed: 15514245]
29. Elhai JD, Voorhees S, Ford JD, Min KS, Frueh BC. Sociodemographic, perceived and objective need indicators of mental health treatment use and treatment-seeking intentions among primary care medical patients. Psychiatry Res. 2009; 165:145–153. [PubMed: 19042031]
30. Schnurr PP, Friedman MJ, Sengupta A, Jankowski MK, Holmes T. PTSD and utilization of medical treatment services among male Vietnam veterans. J Nerv Ment Dis. 2000; 188:496–504. [PubMed: 10972568]
31. Cohen E, Feinn R, Arias A, Kranzler HR. Alcohol treatment utilization: findings from the National Epidemiologic Survey on Alcohol and Related Conditions. Drug Alcohol Depend. 2007; 86:214–221. [PubMed: 16919401]
32. Kidorf M, King VL, Peirce J, Burke C, Kolodner K, Brooner RK. Psychiatric distress, risk behavior, and treatment enrollment among syringe exchange participants. Addict Behav. 2010; 35:499–503. [PubMed: 20079972]
33. Marlowe DB, Merikle EP, Kirby KC, Festinger DS, McLellan AT. Multidimensional assessment of perceived treatment-entry pressures among substance abusers. Psychol Addict Behav. 2001; 15:97–108. [PubMed: 11419236]
34. Hajema KJ, Knibbe RA, Drop MJ. Social resources and alcohol-related losses as predictors of help seeking among male problem drinkers. J Stud Alcohol. 1999; 60:120–129. [PubMed: 10096317]
35. Power R, Hartnoll R, Chalmers C. The role of significant life events in discriminating help-seeking among illicit drug users. Int J Addict. 1992; 27:1019–1034. [PubMed: 1399164]
36. Varney SM, Rohsenow DJ, Dey AN, Myers MG, Zwick WR, Monti PM. Factors associated with help seeking and perceived dependence among cocaine users. Am J Drug Alcohol Abuse. 1995; 21:81–91. [PubMed: 7762546]
37. Matzger H, Kaskutas LA, Weisner C. Reasons for drinking less and their relationship to sustained remission from problem drinking. Addiction. 2005; 100:1637–1646. [PubMed: 16277625]
38. Kidorf M, King VL, Neufeld K, Peirce J, Kolodner K, Brooner RK. Improving substance abuse treatment enrollment in community syringe exchangers. Addiction. 2009; 104:786–795. [PubMed: 19413790]
39. McLellan AT, Kushner H, Metzger D, Peters R, Smith I, Grissom G, et al. The Fifth Edition of the Addiction Severity Index. J Subst Abuse Treat. 1992; 9:199–213. [PubMed: 1334156]
40. Kubany ES, Haynes SN, Leisen MB, Owens JA, Kaplan AS, Watson SB, et al. Development and preliminary validation of a brief broad-spectrum measure of trauma exposure: the Traumatic Life Events Questionnaire. Psychol Assess. 2000; 12:210–224. [PubMed: 10887767]
41. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4. Washington, DC: Author; 2000. text revision
42. Gray MJ, Litz BT, Hsu JL, Lombardo TW. Psychometric properties of the life events checklist. Assessment. 2004; 11:330–341. [PubMed: 15486169]

$watermark-text
$watermark-text
$watermark-text

43. Weathers FW, Keane TM. The Criterion A problem revisited: controversies and challenges in defining and measuring psychological trauma. J Trauma Stress. 2007; 20:107–121. [PubMed: 17427913]
44. Peirce JM, Burke CK, Stoller KB, Neufeld KJ, Brooner RK. Assessing traumatic event exposure: Comparing the Traumatic Life Events Questionnaire to the Structured Clinical Interview for DSM-IV. Psychol Assess. 2009; 21:210–218. [PubMed: 19485675]
45. Sobell, LC.; Sobell, MB. Timeline follow-back: A technique for assessing self-reported alcohol consumption. In: Litten, RZ.; Allen, JP., editors. Measuring alcohol consumption: Psychosocial and biochemical methods. Totowa, NJ: The Humana Press, Inc; 1992. p. 41-72.
46. Falsetti SA, Resnick HS, Resick PA, Kilpatrick DG. The Modified PTSD Symptom Scale: A brief self-report measure of posttraumatic stress disorder. Behav Therapist. 1993; 16:161–162.
47. Coffey SF, Dansky BS, Falsetti SA, Saladin ME, Brady KT. Screening for PTSD in a substance abuse sample: Psychometric properties of a modified version of the PTSD Symptom Scale Self-Report. J Trauma Stress. 1998; 11:393–399. [PubMed: 9565924]
48. McCulloch, CE.; Searle, SR. Generalized, linear, and mixed models. New York: Wiley; 2001.
49. Wells K, Klap R, Koike A, Sherbourne C. Ethnic disparities in unmet need for alcoholism, drug abuse, and mental health care. Am J Psychiatry. 2001; 158:2027–2032. [PubMed: 11729020]
50. Kessler RC, Aguilar-Gaxiola S, Berglund PA, Caraveo-Anduaga JJ, DeWit DJ, Greenfield SF, et al. Patterns and predictors of treatment seeking after onset of a substance use disorder. Arch Gen Psychiatry. 2001; 58:1065–1071. [PubMed: 11695954]
51. Liang KY, Zeger SL. Longitudinal data analysis using generalized linear models. Biometrika. 1986; 73:13–22.
52. Baron RM, Kenny DA. The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. J Pers Soc Psychol. 1986; 51:1173–1182. [PubMed: 3806354]
53. Degenhardt L, Bucello C, Mathers B, Briegleb C, Ali H, Hickman M, et al. Mortality among regular or dependent users of heroin and other opioids: a systematic review and meta-analysis of cohort studies. Addiction. 2011; 106:32–51. [PubMed: 21054613]
54. Degenhardt L, Singleton J, Calabria B, McLaren J, Kerr T, Mehta S, et al. Mortality among cocaine users: a systematic review of cohort studies. Drug Alcohol Depend. 2011; 113:88–95. [PubMed: 20828942]
55. Ouimette PC, Ahrens C, Moos RH, Finney JW. During treatment changes in substance abuse patients with posttraumatic stress disorder. The influence of specific interventions and program environments. J Subst Abuse Treat. 1998; 15:555–564. [PubMed: 9845869]
56. Ouimette PC, Finney JW, Moos RH. Two-year posttreatment functioning and coping of substance abuse patients with posttraumatic stress disorder. Psychol Addict Behav. 1999; 13:105–114.
57. Mathers BM, Degenhardt L, Ali H, Wiessing L, Hickman M, Mattick RP, et al. 2009 Reference Group to the UN on HIV and Injecting Drug Use. HIV prevention, treatment, and care services for people who inject drugs: a systematic review of global, regional, and national coverage. Lancet. 2010; 375:1014–1028. [PubMed: 20189638]
58. Substance Abuse and Mental Health Services Administration, Office of Applied Studies. The NSDUH report: demographic and geographic variations in injection drug use. Rockville, MD: Author; Jul 19. 2007
59. Kidorf M, King VL, Neufeld K, Peirce J, Kolodner K, Brooner RK. Improving substance abuse treatment enrollment in community syringe exchangers. Addiction. 2009; 104:786–795. [PubMed: 19413790]
60. Schwartz RP, Highfield DA, Jaffe JH, Brady JV, Butler CB, Rouse CO, et al. A randomized controlled trial of interim methadone maintenance. Arch Gen Psychiatry. 2006; 63:102–109. [PubMed: 16389204]
61. Strathdee SA, Ricketts EP, Huettner S, Cornelius L, Bishai D, Havens JR, et al. Facilitating entry into drug treatment among injection drug users referred from a needle exchange program: Results from a community-based behavioral intervention trial. Drug Alcohol Depend. 2006; 83:225–232. [PubMed: 16364566]

62. U.S. Department of Justice – Federal Bureau of Investigation. [Accessed: 2011-12-08] Table 6. Crime in the United States by Metropolitan Statistical Area. Crime in the United States, 2010. 2010. URL:http://www.fbi.gov/about-us/cjis/ucr/crime-in-the-u.s/2010/crime-in-the-u.s.-2010/tables/table-6Archived by WebCite® at http://www.webcitation.org/64kFemgJf)

63. Hagan H, McGough JP, Thiede H, Hopkins S, Duchin J, Alexander ER. Reduced injection frequency and increased entry and retention in drug treatment associated with needle-exchange participation in Seattle drug injectors. J Subst Abuse Treat. 2000; 19:247–252. [PubMed: 11027894]

64. Hakansson A, Isendahl P, Wallin C, Berglund M. Efficacy of mobile telephone contact for follow-up in injecting heroin users. Am J Drug Alcohol Abuse. 2011; 37:89–92. [PubMed: 21189096]

65. Dewart T, Frank B, Schmeidler J. The impact of 9/11 on patients in New York City's substance abuse treatment programs. Am J Drug Alcohol Abuse. 2006; 32:665–672. [PubMed: 17127555]

66. Acierno R, Resnick H, Kilpatrick DG, Saunders B, Best CL. Risk factors for rape, physical assault, and posttraumatic stress disorder in women: examination of differential multivariate relationships. J Anxiety Disord. 1999; 13:541–563. [PubMed: 10688523]

$watermark-text

$watermark-text

$watermark-text

$watermark-text

$watermark-text

$watermark-text

Table 1

Effects of traumatic event re-exposure and PTSD symptoms on days of drug use monthly over a 16-month follow-up, presented as adjusted B(*SE*) with p-value (*N* = 162).

	Same month	One month later	Two months later
	Cocaine use (days)		
Traumatic event re-exposure (yes/no)	1.16 (0.34)	0.99 (0.34)	0.39 (0.34)
	$p = 0.001$	$p = 0.004$	$p = 0.256$
PTSD symptoms (deciles)	−0.02 (0.17)	−0.03 (0.21)	0.06 (0.21)
	$p = 0.895$	$p = 0.876$	$p = 0.772$
	Heroin use (days)		
Traumatic event re-exposure (yes/no)	0.44 (0.39)	−0.33 (0.40)	−0.34 (0.40)
	$p = 0.266$	$p = 0.403$	$p = 0.391$
PTSD symptoms (deciles)	0.22 (0.21)	0.12 (0.22)	−0.32 (0.24)
	$p = 0.299$	$p = 0.590$	$p = 0.172$

Note. Models were adjusted for study treatment condition, gender, age, race, and previous month's drug use.

$watermark-text

$watermark-text

$watermark-text

Table 2

Effects of traumatic event re-exposure and PTSD symptoms on treatment-seeking over a 16-month follow-up ($N = 162$).

	Same month	One month later	Two months later
	Interested in drug abuse treatment (yes/no)		
Traumatic event re-exposure (yes/no)	1.34 (1.11 – 1.63) **	1.10 (0.91 – 1.34)	0.94 (0.76 – 1.15)
PTSD symptoms (deciles)	1.25 (1.10 – 1.42) **	1.16 (1.02 – 1.32) *	1.15 (1.02 – 1.30) *
	Called about drug abuse treatment (yes/no)		
Traumatic event re-exposure (yes/no)	1.58 (1.24 – 2.01) **	1.34 (1.03 – 1.75) *	1.06 (0.81 – 1.38)
PTSD symptoms (deciles)	1.16 (1.02 – 1.32) *	1.12 (0.99 – 1.27)	1.08 (0.95 – 1.23)
	Received drug abuse treatment (yes/no)		
Traumatic event re-exposure (yes/no)	0.96 (0.79 – 1.16)	0.99 (0.81 – 1.21)	1.00 (0.84 – 1.19)
PTSD symptoms (deciles)	0.95 (0.83 – 1.09)	0.97 (0.85 – 1.12)	0.98 (0.85 – 1.12)

* $p < .05$

** $p < .01$

Note. Models presented as adjusted odds ratios (AOR) with 95% confidence intervals (CI) and were adjusted for study treatment condition, gender, age, and race.