UC San Diego
UC San Diego Previously Published Works

Title

Bidirectional Relationship of Posttraumatic Stress Disorder (PTSD) Symptom Severity and Alcohol Use Over the Course of Integrated Treatment

Permalink

https://escholarship.org/uc/item/8188h0kb

Journal

Psychology of Addictive Behaviors, 34(4)

ISSN

0893-164X

Authors

Tripp, Jessica C
Worley, Matthew J
Straus, Elizabeth
et al.

Publication Date

2020-06-01

DOI

10.1037/adb0000564

Peer reviewed

Bidirectional Relationship of PTSD Symptom Severity and Alcohol Use over the Course of Integrated Treatment

Jessica C. Tripp, Ph.D[1,2], **Matthew J. Worley, Ph.D.**[1,2], **Elizabeth Straus, Ph.D.**[1,2], **Abigail C. Angkaw, Ph.D.**[1,2], **Ryan S. Trim, Ph.D.**[1,2], **Sonya B. Norman, Ph.D.**[1,2,3,4]

[1]VA San Diego Healthcare System, 3350 Villa La Jolla Drive, San Diego, CA 92161

[2]University of California, San Diego, School of Medicine, 9500 Gilman Drive, La Jolla, CA 92037

[3]National Center for PTSD, 215 N. Main Street, White River Junction, VT 05009

[4]VA Center of Excellence for Stress and Mental Health, 3350 La Jolla Village Drive, MC116B, San Diego, CA 92161

Abstract

Posttraumatic stress disorder (PTSD) and alcohol use disorder commonly co-occur. Little is known about how symptoms of one affect subsequent week symptoms of the other during the course of integrated treatment for both disorders. The sample included 107 veterans who were randomized to receive either Concurrent Treatment of PTSD and Substance Use Disorder Using Prolonged Exposure (COPE; an exposure-based trauma focused treatment) or Seeking Safety (SS; a present-focused coping skills-based treatment) and completed measures of PTSD and alcohol use at every other session. Multilevel models estimated the prospective associations between PTSD and alcohol use during treatment. Results indicated that greater PTSD symptom severity was associated with greater future alcohol use ($b = 0.20$, $p = 0.024$), and greater alcohol use was associated with greater future PTSD symptom severity ($b = 0.13$, $p = 0.003$). The effect size for PTSD symptoms to future alcohol use was larger than the reciprocal relationship. When using lagged PTSD severity to predict future drinking, results revealed that clinically significant differences in PTSD severity levels were associated with comparably large differences in drinking. Treatment condition did not moderate the effect of PTSD symptom severity on alcohol use (or the reciprocal relationship). Findings lend support to the mutual maintenance model of addiction. Integrated treatments that treat both PTSD and alcohol use may be preferential to sequential model of care where individuals are expected to achieve abstinence or reduced use prior to receiving trauma-focused treatment.

Keywords

PTSD; alcohol use; integrated treatment; lagged treatment effects

Posttraumatic stress disorder (PTSD) commonly co-occurs with alcohol use disorder (AUD). There are several theoretical models that address how PTSD and alcohol use influence one

Correspondence concerning this article should be addressed to: Sonya B. Norman, Ph.D., University of California San Diego and VASDHS, 3350 La Jolla Village Drive, MC116B, San Diego, CA 92161, snorman@ucsd.edu, 858-642-3885.

another, including the self-medication model (i.e., alcohol is used to alleviate PTSD symptoms; Khantzian, 2003), susceptibility model (i.e., long-term alcohol use inhibits processing of trauma and worsens PTSD symptoms; Back, Brady, Sonne, & Verduin, 2006), and the mutual maintenance model (i.e., there is a reciprocal relationship between PTSD and alcohol use, in that alcohol is used in an attempt to alleviate PTSD symptoms, but ultimately maintains or worsens PTSD symptoms as it interferes with the emotional processing of the trauma; Kaysen et al., 2011; McFarlane et al., 2009). Although a large body of research has examined the association between both disorders, little is known about the bidirectional relationship between PTSD symptoms and alcohol use during the course of integrated treatment.

Studies suggest comorbid PTSD/AUD can be addressed most effectively with integrated treatments that address symptoms of both disorders (Roberts, Roberts, Jones, & Bisson, 2015). A limited number of studies have evaluated the relationship between PTSD and substance use disorder (SUD) symptoms within integrated treatments. Hien et al. (2010) examined a present-focused integrated therapy, Seeking Safety (SS), versus a health education treatment (both delivered in group) for women with comorbid PTSD/AUD. Results indicated that in both treatments, improvements in PTSD following baseline led to improvement in SUD during treatment and at follow-up, but not conversely. Another study found that individuals who continued using substances during either integrated exposure-based treatment, Concurrent Treatment of PTSD and Substance Use Disorders Using Prolonged Exposure (COPE; Back et al., 2015), or substance use disorder (SUD)-only treatment (Relapse Prevention Therapy) still benefited from exposure-based PTSD treatment. However, those who used substances daily during treatment experienced less PTSD symptom reduction from SUD-only treatment compared to those in COPE who remained abstinent (Hien et al., 2018). These studies suggest that PTSD is associated with future SUD symptoms and individuals who continue to use may still benefit from exposure-based treatment.

To date, less is known about the associations between PTSD symptoms and alcohol use week to week during the course of treatment, which would allow for a more nuanced understanding of how symptoms of each disorder relates to proximal symptoms of the other. Knowledge of whether the relationship is stronger in one direction than the other would inform theoretical understanding of the relationship between PTSD and AUD (e.g., self-medication versus susceptibility versus mutual maintenance), and could help guide clinicians as to when to emphasize specific therapeutic strategies during treatment.

There are two primary integrated psychotherapy models that have been used to treat comorbid PTSD/AUD: exposure therapy and coping skills therapy. COPE (Back et al., 2015) is exposure therapy for PTSD integrated with relapse prevention for SUD to treat both simultaneously. Seeking Safety (Najavits, 2002) is a present-focused therapy that emphasizes creating safety and learning coping skills as the most critical need for someone with PTSD/SUD. Although both treatments are effective in reducing PTSD and substance use, COPE has shown better PTSD symptom outcomes compared to AUD/SUD only treatment (Roberts et al., 2015), and compared to SS in this study's parent trial (Norman et al., 2019). We are not aware of studies that have examined the week-to-week PTSD

symptom-alcohol use relationship across two distinct integrated treatment approaches. Understanding whether these relationships vary by treatment would enhance understanding of the comorbidity and how each treatment works.

The aims of this study were to examine 1) week to week symptoms during treatment; 2) the relationship between PTSD symptom severity and subsequent week alcohol use and the reciprocal relationship (i.e., alcohol use and subsequent week PTSD symptom severity); and 3) whether COPE and SS showed a different association between PTSD symptom severity and subsequent week alcohol use and the reciprocal relationship. We hypothesized, based on previous literature (i.e. Hien et al., 2010), that 1) greater PTSD symptom severity would be associated with greater subsequent week alcohol use and that 2) greater alcohol use would not be associated with greater subsequent PTSD symptoms. As there is a dearth of literature on PTSD-alcohol use relationships during integrated treatment, our aim in examining differences between COPE and SS was exploratory. We controlled for treatment condition and examined all possible interactions with this variable.

Method

Participants

Participants were 107 veterans who were enrolled in a larger randomized controlled trial comparing COPE to SS (Norman et al., 2019). This sample included participants who received at least one therapy session and completed at least one in-treatment assessment of PTSD and alcohol use. Rates of retention in therapy were 85% at session 4, 63% at session 8, and 28% at session 12. Participants were self-referred or were referred by a mental health provider at a large urban VA hospital. Inclusion criteria included having experienced a past traumatic event and meeting DSM-5 criteria for current full or subthreshold (one symptom missing) current PTSD and AUD, with at least 20 days of alcohol use in the last 90 days. Exclusion criteria included moderate to severe cognitive impairment, acute suicidality, and unmanaged current psychosis or mania independent of substance use. The site's Institutional Review Board approved all study procedures.

This sample had a mean age of 41 years ($SD = 12.6$), was 89% male, and had a mean of 14.5 years of education ($SD = 1.9$). The sample was 32% Hispanic, and comprised of 64% White, 13% African-American, 11% more than one race, and 6% Asian, with the remaining 6% endorsing Pacific Islander, American Indian, or unknown.

Interventions

Both COPE and SS were delivered in 90-minute individual sessions, and participants were offered 12 sessions with the option of extending to 16 sessions if they had not met their treatment goals. Participants were encouraged to attend therapy once or twice weekly on consecutive weeks but were given up to six months to complete treatment.

COPE

COPE (Back et al., 2015) is an individual treatment that integrates Prolonged Exposure therapy for PTSD (Foa, Hembree, & Rothbaum, 2007) with cognitive-behavioral therapy

relapse prevention techniques for SUD (Carroll, 1998). COPE includes three key elements: in vivo (real life) exposure to trauma-associated stimuli for PTSD (sessions 3–16); imaginal exposure (repetitive oral discussion of the traumatic event; sessions 4–16); and relapse prevention. Approximately 15 minutes of each session was dedicated to relapse prevention, which occurred toward the end of the session following exposure. For those participants who completed 13 to 16 sessions, up to four SUD relapse prevention skills were repeated.

Seeking Safety (SS)

SS is a present-focused therapy that focuses on establishing safety (e.g., reducing risky behaviors, having healthy relationships) as the primary clinical need for individuals with comorbid PTSD/SUD (Najavits, 2002). Past trauma is discussed regarding how it is currently affecting the participant's life. Overarching themes of SS include interpersonal topics, cognitive topics, and behavioral topics.

Measures

PTSD Symptoms.—The 20-item PTSD Checklist for DSM-5 (PCL-5; Weathers, Litz, et al., 2013) assessed past month PTSD symptoms every other session. Each item on the PCL-5 corresponds to each of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013) PTSD symptoms. Scores range from 0 to 80. The PCL-5 has shown good temporal stability over the course of three months in a sample of veterans with combat exposure (Keane et al., 2014). Cronbach's alpha for this sample at session 1 was 0.79. Additionally, the Clinician Administered PTSD Scale for DSM-5 (Weathers, Blake, et al., 2013) was used to assess for PTSD symptoms at follow-up. The CAPS-5 has demonstrated strong psychometric properties in veteran samples, including good test-retest reliability and high internal consistency (Weathers et al., 2018).

Alcohol Use.—The Substance Use Inventory (SUI; Weiss, Hufford, & Najavits, 1995) measured the number of days alcohol was used and number of standard drinks consumed each day since the last therapy session (M_{days} at session 1 = 7.72; $SD = 3.90$). A variable was calculated based on the percentage of days participants drank multiplied by the average number of drinks consumed each day they drank (to index frequency by quantity of alcohol use). Measures that index frequency by quantity of alcohol use, as the SUI does, demonstrate remarkably similar means and standard deviations to more comprehensive measures of substance use such as the Timeline Followback (TLFB). For example, the Quick Drinking Screen, another quantity-frequency measure, showed strong intraclass correlations and non-significant differences with the TLFB on indexes such as drinks per week in the past year (Carter Sobell et al., 2003). To reduce the positive skew in this measure, log-transformed alcohol use was used in all analyses.

Data Analysis Plan

Statistical analyses used multilevel regression models to examine the study hypotheses, with random subject-level intercepts included to account for nested observations. All available observations were included via maximum-likelihood estimation, with missing data assumed missing-at-random. For the primary models, continuous measures were standardized to a mean of 0 and standard deviation of 1 to facilitate interpretation of results. For models of

PTSD outcomes, the initial model estimated session-level PCL-5 scores as a function of therapy condition, time, the condition by time interaction, and baseline PTSD severity scores as a subject-level covariate. A subsequent model added lagged (i.e., prior assessment) alcohol use as a time-varying covariate, with a final model estimating the alcohol use X therapy condition interaction. A similar sequence of models estimated alcohol use, with baseline percent days drinking (PDD) replacing CAPS scores as a subject-level baseline covariate, and lagged PCL-5 scores replacing lagged alcohol use as a time-varying covariate. Models of alcohol use were fit using the Poisson distribution, as preliminary analyses indicated non-normality in the alcohol use measure. All analyses were conducted in Stata 14.2.

Because we could not directly test differences between the estimated coefficients for lagged PCL-5 predicting alcohol use and lagged alcohol use predicting PTSD, we conducted additional analyses to compare the clinical/practical significance of model results. We computed the adjusted differences in outcome variables associated with clinically-significant differences in the lagged predictors, with values of M, $M + 1$ SD, and $M - 1$ SD for lagged PTSD severity, and 0, $0 + 1$ SD, and $0 + 2$ SD (log-transformed alcohol use, referred to as log alcohol use from here on out) log alcohol use for lagged drinking (which were back-converted to standard drinks for interpretation). These values were selected because they captured differences between participants that were both clinically significant and typical within the sample, with 0 used as the reference value for alcohol use instead of the mean because 0 comprised 43% of observations. Number of sessions attended at the time of each assessment was controlled in all models.

Results

Models of within-treatment alcohol use revealed a positive association between PTSD severity and subsequent alcohol use. When controlling for condition, time, and baseline drinking, greater PTSD symptom severity predicted greater future alcohol use ($b = 0.20$, $p = 0.024$). Table 1 displays all model fit statistics and parameter estimates, and Figure 1 displays all paired observations of future alcohol use over lagged PTSD severity with the line of best fit. The time effect indicated a decline in alcohol use over time ($b = -0.04$, $p = 0.002$) that was not moderated by therapy condition, while the COPE condition had lower alcohol use throughout treatment compared to SS ($b = -0.48$, $p = 0.034$). Results did not reveal a moderating effect of therapy condition between PTSD severity and future alcohol use ($b = 0.28$, $p = 0.10$).

Models of within-treatment PTSD severity revealed a positive association between alcohol use and greater future PTSD severity. When controlling for condition, time, the condition by time interaction, and baseline PTSD symptom severity, greater lagged alcohol use predicted greater PTSD severity ($b = 0.13$, $p = 0.003$). Figure 1 displays all paired observations of PTSD severity over lagged alcohol use with the line of best fit. PTSD severity was also predicted by the condition by time interaction, with the COPE condition having greater decline in PTSD symptoms during treatment ($b = 0.05$, $p = 0.01$). Results did not reveal a moderating effect of therapy condition between alcohol use and future PTSD severity ($b = -0.01$, $p = 0.90$).

When using lagged PTSD severity to predict future drinking, we estimated the differences in drinking associated with PCL-5 scores of 25.6, 42.5, and 59.3. The difference between 25.6 and 42.5 PCL-5 was associated with 0.12 greater log alcohol use (equivalent to 1.13 on the raw quantity x frequency scale), while the difference from 25.6 to 59.3 PCL-5 was associated with 0.26 greater log alcohol use (equivalent to 1.29 on the raw quantity x frequency scale). These differences in log alcohol use translated to effect sizes of $d = 0.17$ and $d = 0.39$, respectively. Figure 2 displays log alcohol use from sessions 2–12 adjusted for lagged PTSD severity.

For adjusted predictions of PTSD severity from lagged alcohol use, we estimated the differences in PTSD severity associated with 0 drinks, 1.0 drinks, and 3.2 drinks. The difference from 0 to 1.0 drinks was associated with 1.75 greater PCL-5 ($d = 0.10$), while a difference from 0 to 3.2 drinks (+2 SD) was associated with 3.51 greater PCL-5 ($d = 0.20$). Figure 2 displays PCL-5 scores from sessions 2–12 adjusted for lagged drinking.

Discussion

In this study, we examined session by session data to understand the relationship between PTSD symptom severity and subsequent week alcohol use, and vice versa. As hypothesized, greater PTSD symptom severity was associated with greater subsequent week alcohol use. Contrary to our hypotheses, greater alcohol use was also significantly associated with greater future PTSD symptom severity. Given this finding, we conducted follow-up analyses which indicated that the effect size of PTSD symptom severity to future alcohol use relationship was larger than the converse relationship. We also found that treatment condition did not moderate the PTSD-alcohol use (and reciprocal) relationship, indicating that there were no differences between COPE and SS in these relationships.

These findings are consistent with other medication and psychotherapy treatment studies that have found that improvement in PTSD symptoms influences future improvement in alcohol/substance use (Back et al., 2006; Hien et al., 2010). Our findings are also consistent with studies examining the natural course of PTSD symptoms and alcohol use over time showing that greater PTSD severity is associated with future greater alcohol use and alcohol-related consequences (Langdon et al., 2016; Possemato et al., 2015; Read et al., 2012). Previous studies are inconsistent in demonstrating whether alcohol use impacts future PTSD symptoms, as several studies lend support to the susceptibility model (Back et al., 2006; Read, Wardell, & Colder, 2013), while others do not (Hien et al., 2010; Simpson, Stappenbeck, Luterek, Lehavot, & Kaysen, 2014). Our results do provide evidence of the mutual maintenance model given that alcohol use predicted subsequent PTSD symptom severity and PTSD symptom severity predicted subsequent alcohol use. As there was a larger effect for the association between PTSD symptom severity to future alcohol use compared to the alcohol use to future PTSD symptom severity relationship, this may provide stronger support of the self-medication hypothesis relative to the susceptibility model. However, given that the majority of our participants had been using heavily over the course of many years, they likely had physiological addiction and it is possible that other processes also contributed to their level of use.

Treatment condition was not a moderator of the relationship between greater PTSD severity and greater future alcohol use, or the converse relationship, suggesting that the PTSD-alcohol use relationship is stronger than the relationship between specific treatments (specifically COPE or SS) and PTSD-alcohol use. There is some extant data suggesting that the PTSD to subsequent substance use relationship may be seen further downstream in integrated exposure therapies. In a meta-analysis of PTSD/SUD treatment studies, Roberts et al. (2015) found better PTSD outcomes for integrated exposure therapies such as COPE than SUD only treatment but no differences in substance use at post treatment. However, they found a small effect for exposure therapies improving SUDs compared to treatment as usual at five to seven months posttreatment, indicating that although improvements in SUD may not be seen at posttreatment, there is a "downstream" effect in which SUD shows better outcomes in exposure therapies over time. Future research is needed to examine mechanisms involved in both PTSD and SUD outcomes during integrated treatments in order to elucidate the relationship between treatment and SUD symptom improvement. The findings of this study and other recent studies (Back et al., 2006; Hien et al., 2010; Read et al., 2012) showing that PTSD symptoms are related to future substance use underscore the importance of treating PTSD concurrently with SUD rather than following SUD treatment.

There are several limitations to this study that should be noted. This sample consisted of veterans with a primary diagnosis of AUD, and therefore the results may not generalize to civilians or those with other SUDs. Alcohol use was based on self-report and was assessed for the past week, while the PCL-5 asked about symptoms in the past month. This limits the ability to draw any causal conclusions from our analyses. Additionally, we are unaware of a valid procedure to conduct a statistical significance test comparing parameters from separate multilevel models of two different response variables that utilized different statistical distributions. Our sample size was modest and results may have been impacted by attrition, which is common in psychotherapy trials for PTSD/SUD (Roberts et al., 2015).

Despite these limitations, this is the first study to our knowledge to examine the relationship between PTSD symptom severity and subsequent week alcohol use (and the reciprocal relationship) during integrated treatment for PTSD/AUD. The current study adds evidence that even when comparing two different active treatment models for PTSD/AUD, both PTSD and alcohol use were associated with one another over time, with a larger effect of greater PTSD being associated with greater future alcohol use. There is also evidence that greater alcohol use is associated with subsequent greater PTSD symptoms, indicating that alcohol use may serve to maintain PTSD symptoms and impede recovery from PTSD.

Acknowledgments

References

American Psychiatric Association. (2013). Diagnostic and Statistical Manual of Mental Disorders (5th ed.). Washington, DC.

Back SE, Brady KT, Sonne SC, & Verduin ML (2006). Symptom improvement in cooccurring PTSD and alcohol dependence. Journal of Nervous and Mental Disease, 194(9), 690–696. doi:10.1097/01.nmd.0000235794.12794.8a [PubMed: 16971821]

Back SE, Foa EB, Killeen TK, Mills KL, Teesson M, Dansky Cotton B, … Brady KT (2015). Concurrent treatment of PTSD and substance use disorders using prolonged exposure (COPE): Therapist guide. New York, NY: Oxford University Press.

Carroll KM (1998). A cognitive-behavioral approach: Treating cocaine addiction. Rockville: National Institute on Drug Abuse.

Carter Sobell L, Agrawal S, Sobell MB, Leo GI, Young LJ, Cunningham JA, & Simco ER (2003). Comparison of a quick drinking screen with the timeline followback for individuals with alcohol problems. Journal of Studies on Alcohol and Drugs, 64(6), 858–861. doi:10.15288/jsa.2003.64.858

Foa EB, Hembree EA, & Rothbaum BO (2007). Prolonged exposure therapy for PTSD: Emotional processing of traumatic experiences: Therapist guide: Oxford University Press, New York, NY.

Hien DA, Jiang H, Campbell AN, Hu MC, Miele GM, Cohen LR, … Nunes EV (2010). Do treatment improvements in PTSD severity affect substance use outcomes? A secondary analysis from a randomized clinical trial in NIDA's Clinical Trials Network. American Journal of Psychiatry, 167(1), 95–101. doi:10.1176/appi.ajp.2009.09091261 [PubMed: 19917596]

Hien DA, Smith KZ, Owens M, López-Castro T, Ruglass LM, & Papini S. (2018). Lagged effects of substance use on PTSD severity in a randomized controlled trial with modified prolonged exposure and relapse prevention. Journal of Consulting and Clinical Psychology, 86(10), 810–819. doi:10.1037/ccp0000345 [PubMed: 30265040]

Kaysen D, Atkins DC, Moore SA, Lindgren KP, Dillworth T, & Simpson T. (2011). Alcohol Use, Problems, and the Course of Posttraumatic Stress Disorder: A Prospective Study of Female Crime Victims. Journal of Dual Diagnosis, 7(4), 262–279. doi:10.1080/15504263.2011.620449 [PubMed: 23538605]

Keane TM, Rubin A, Lachowicz M, Brief D, Enggasser JL, Roy M, … Rosenbloom D. (2014). Temporal stability of DSM-5 posttraumatic stress disorder criteria in a problem-drinking sample. Psychological Assessment, 26(4), 1138–1145. doi:10.1037/a0037133 [PubMed: 24932642]

Khantzian EJ (2003). The self-medication hypothesis revisited: The dually diagnosed patient. Primary Psychiatry, 10(9), 47–48.

Langdon KJ, Fox AB, King LA, King DW, Eisen S, & Vogt D. (2016). Examination of the dynamic interplay between posttraumatic stress symptoms and alcohol misuse among combat-exposed Operation Enduring Freedom (OEF)/Operation Iraqi Freedom (OIF) Veterans. Journal of Affective Disorders, 196, 234–242. doi:10.1016/j.jad.2016.02.048 [PubMed: 26938966]

McFarlane AC, Browne D, Bryant RA, O'Donnell M, Silove D, Creamer M, & Horsley K. (2009). A longitudinal analysis of alcohol consumption and the risk of posttraumatic symptoms. Journal of Affective Disorders, 118(1–3), 166–172. doi:10.1016/j.jad.2009.01.017 [PubMed: 19230982]

Najavits LM (2002). Seeking safety: A treatment manual for PTSD and substance abuse. New York, NY: Guilford Press.

Norman SB, Trim R, Haller M, Davis BC, Myers US, Colvonen PJ, … Mayes T. (2019). Efficacy of integrated exposure therapy vs integrated coping skills therapy for comorbid posttraumatic stress disorder and alcohol use disorder: A randomized clinical trial. JAMA Psychiatry. doi:10.1001/jamapsychiatry.2019.0638

Possemato K, Maisto SA, Wade M, Barrie K, McKenzie S, Lantinga LJ, & Ouimette P. (2015). Ecological momentary assessment of PTSD symptoms and alcohol use in combat veterans. Psychology of Addictive Behaviors, 29(4), 894–905. doi:10.1037/adb0000129 [PubMed: 26727007]

Read JP, Colder CR, Merrill JE, Ouimette P, White J, & Swartout A. (2012). Trauma and posttraumatic stress symptoms predict alcohol and other drug consequence trajectories in the first year of

college. Journal of Consulting and Clinical Psychology, 80(3), 426–439. doi:10.1037/a0028210 [PubMed: 22545739]

Read JP, Wardell JD, & Colder CR (2013). Reciprocal associations between PTSD symptoms and alcohol involvement in college: A three-year trait-state-error analysis. Journal of Abnormal Psychology, 122(4), 984–997. doi:10.1037/a0034918 [PubMed: 24364601]

Roberts NP, Roberts PA, Jones N, & Bisson JI (2015). Psychological interventions for post-traumatic stress disorder and comorbid substance use disorder: A systematic review and meta-analysis. Clinical Psychology Review, 38, 25–38. doi:10.1016/j.cpr.2015.02.007 [PubMed: 25792193]

Simpson TL, Stappenbeck CA, Luterek JA, Lehavot K, & Kaysen DL (2014). Drinking motives moderate daily relationships between PTSD symptoms and alcohol use. Journal of Abnormal Psychology, 123(1), 237–247. doi:10.1037/a0035193 [PubMed: 24661174]

Weathers FW, Blake DD, Schnurr PP, Kaloupek DG, Marx BP, & Keane TM (2013). The Clinician-Administered PTSD Scale for DSM-5 (CAPS-5). Interview available from the National Center for PTSD at www.ptsd.va.gov.

Weathers FW, Bovin MJ, Lee DJ, Sloan DM, Schnurr PP, Kaloupek DG, … Marx BP (2018). The Clinician-Administered PTSD Scale for DSM-5 (CAPS-5): Development and initial psychometric evaluation in military veterans. Psychological Assessment, 30(3), 383–395. doi:10.1037/pas0000486 [PubMed: 28493729]

Weathers FW, Litz BT, Keane TM, Palmieri PA, Marx BP, & Schnurr PP (2013). The PTSD Checklist for DSM-5 (PCL-5). Retrieved from https://www.ptsd.va.gov/professional/assessment/adult-sr/ptsd-checklist.asp

Weiss RD, Hufford C, & Najavits LM (1995). Weekly Substance Use Inventory. Unpublished measure. Harvard University Medical School Boston, MA.

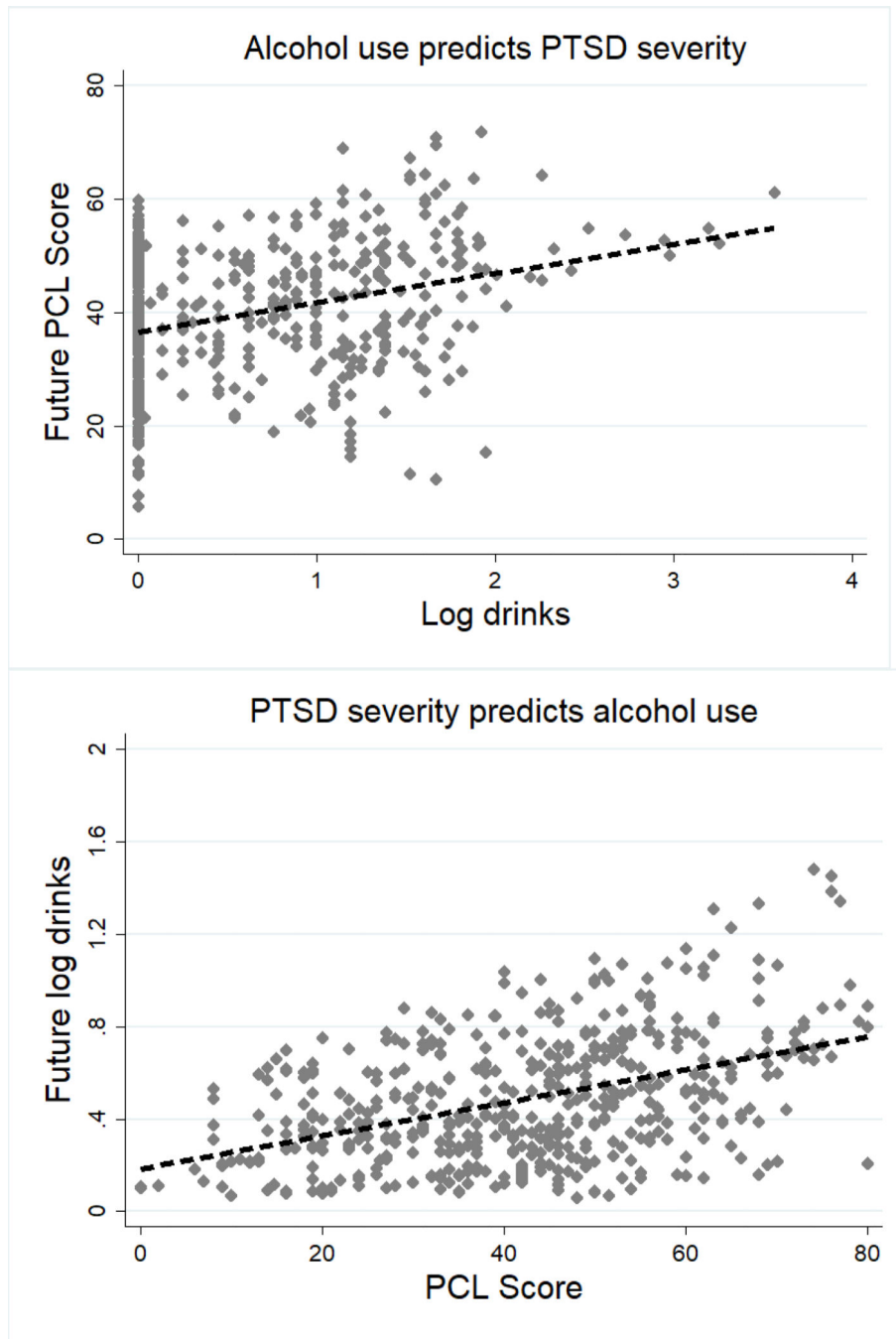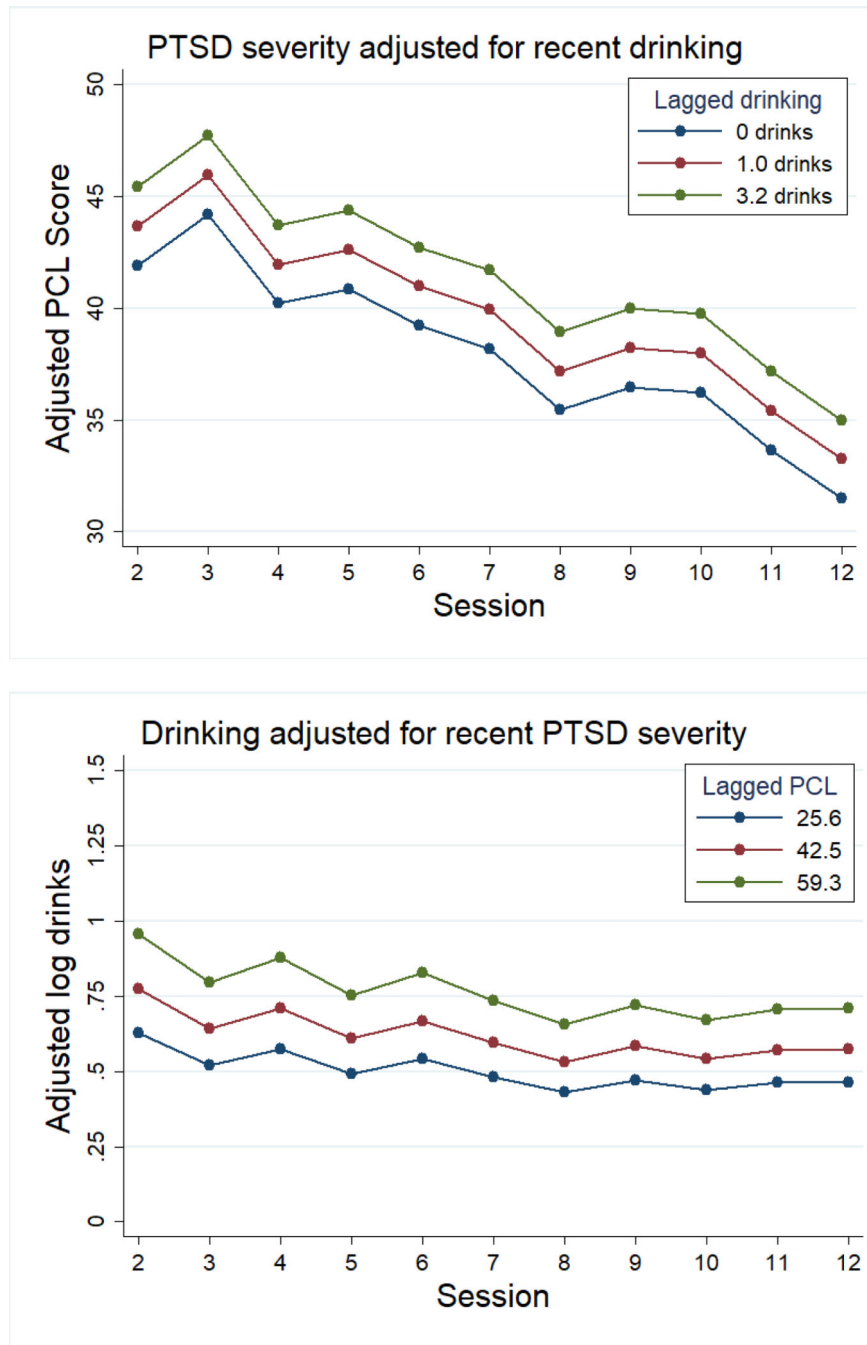**Figure 1.**

Figure 2.

Table 1

Results of multilevel regression models predicting PTSD symptoms from lagged alcohol use and multilevel Poisson models predicting alcohol use from lagged PTSD symptoms

	PTSD Symptoms			Alcohol use		
	Covariate model	Lagged predictor model	Condition interaction model	Covariate model	Lagged predictor model	Condition interaction model
	b (SE)	*b (SE)*	*b (SE)*	*IRR (SE)*	*IRR (SE)*	*IRR (SE)*
Session	−0.05 (0.02) **	−0.04 (0.02) *	−0.04 (0.02) *	0.96 (0.02) *	0.98 (0.02)	0.98 (0.02)
Condition	0.41 (0.16 **	0.45 (0.15 **	0.45 (0.15) **	0.62 (0.14) *	0.61 (0.02) *	0.63 (0.13) *
Session X condition	−0.07 (0.03) **	−0.08 (0.03) **	−0.08 (0.03) **	–	–	–
Baseline level	0.67 (0.07) ***	0.65 (0.07) ***	0.65 (0.07) ***	1.78 (0.22) ***	1.74 (0.21) ***	1.73 (0.20) ***
Lagged PCL-5	–	–	–	–	1.22 (0.11) *	1.08 (0.12)
Lagged alcohol use	–	0.13 (0.05) **	0.14 (0.06) *	–	–	–
Condition interaction	–	–	−0.01 (0.09)	–	–	1.32 (0.22)
Log-likelihood	−459.16	−455.05	−455.04	−443.27	−440.78	−439.24

Note.

***
$p<.001$

**
$p<.01$

*
$p<.05$