The Association Between Daily PTSD Symptom Severity and Substance Use in Clinical and Nonclinical PTSD Patients: A Systematic Review

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Abstract

Posttraumatic stress disorder (PTSD) frequently co-occurs with substance use disorders (SUDs), resulting in a more complex clinical course than either disorder individually. This paper reviews eleven momentary assessment studies to investigate how daily PTSD symptoms severity relates to substance use among clinical and nonclinical PTSD patients. The substances examined include alcohol, nonmedical prescription opioids, cannabis, heroin, and cigarettes. Overall, the synthesis of these studies indicates a relationship between daily PTSD symptoms and substance use in various aspects. Evidence suggests a concurrent relationship between them, that is stronger during specific assessment times. However, conclusive findings on the timing of these assessment times have been lacking. There is no definite evidence supporting a delayed relationship between PTSD symptoms and substance use, nor is there evidence linking specific PTSD symptom clusters more closely with substance use. Further research is needed to obtain conclusive findings, address current limitations, and expand our knowledge of the various perspectives of the relationship between PTSD symptom severity and substance use. Addressing these research gaps will facilitate a more comprehensive understanding, enabling the development of current and new interventions.

Keywords: PTSD symptoms, substance use, momentary assessment

The Association Between Daily PTSD Symptom Severity and Substance Use in Clinical and Nonclinical PTSD Patients: A Systematic Review

Posttraumatic stress disorder (PTSD) reflects a debilitating psychological condition that affects the lives of many individuals (Gaher et al., 2014). It has been associated with various problematic behaviours, including extensive use of drugs and alcohol (Mills et al., 2005; Mills et al., 2007; Tarrier & Sommerfield, 2003). The lifetime prevalence of posttraumatic stress disorder is estimated 3.9% across samples of 26 countries, rising to 5.6% among those with trauma exposure (Koenen et al., 2017).

Previous research has examined the significant substance use associated with PTSD, mainly focusing on the self-medication hypothesis (Khantzian, 1997). The self-medication hypothesis asserts that substance use arises from the desire to reduce the psychological and physiological distress related to PTSD symptoms (Badour et al., 2023; Black et al., 2018; Luciano et al., 2022). Alternatively, the mutual maintenance hypothesis suggests that PTSD symptoms could increase substance use, which in turn could increase or maintain PTSD symptoms (Possemato et al., 2015; Simpson et al., 2014). While existing literature supports the self-medication hypothesis, the mutual maintenance hypothesis requires more research (Hruska et al., 2017).

Given the extensive substance use that has been linked with PTSD, substance use disorders (SUDs) are commonly comorbid with PTSD (Stewart, 1996). The prevalence of any alcohol or drug use disorder in nonclinical and clinical PTSD patients is estimated to be 43.3% and 46.4% respectively (Pietrzak et al., 2011). Individuals with PTSD are 2 to 4 times more likely to meet the criteria for an SUD than individuals without PTSD (Kessler et al., 1995). For treatment-seeking PTSD patients, the likelihood of having an SUD rose to 14 times higher than for patients without PTSD (Chilcoat & Menard, 2003; Ford et al., 2007).

The clinical trajectory of the PTSD/SUD comorbidity is a more complex one than for both PTSD and SUD individually (McCauley et al., 2012). The comorbidity of PTSD and SUD is linked to poorer social functioning, increased chronic physical health problems, increased risk of violence, more legal problems, higher rates of suicide attempts, less improvement during treatment, and worse treatment adherence compared to PTSD or SUD separately (Gaher et al., 2014; McCauley et al., 2012). These factors indicate the critical importance of research focused on the PTSD/SUD comorbidity, alongside research on these disorders independently.

Previous research on the comorbidity of PTSD and SUD primarily used longitudinal retrospective methods, which found evidence for a within-person association between PTSD symptoms and substance use (Berenz et al., 2017; Kofoed et al., 1993; Stewart et al., 1996). However, these retrospective methods are vulnerable to bias and memory errors (Hruska et al., 2017; Shiffman et al., 2008) and have shown to measure higher levels of PTSD symptom than daily measurement methods (Campbell et al., 2017). To address the bias and errors of previous studies, researchers shifted to momentary assessment methods. Momentary assessment studies repeatedly measure their participants' daily experiences in real time and their natural environment (Shiffman et al., 2008; Sullivan et al., 2020).

This paper reviews the momentary assessment studies investigating the association between daily fluctuations in PTSD symptoms and substance use in clinical and nonclinical PTSD patients. Given the support for the self-medication hypothesis in previous research, this paper will focus on the changes of substance use resulting from daily fluctuations in PTSD symptom severity. The aim of this paper is providing knowledge to enhance interventions, identify research gaps, and guide future studies. Therefore, reviewing research on the association between daily PTSD symptoms and substance use holds significant importance.

By including substance use rather than only SUDs, this paper aims to allow for earlier intervention, given that mental health-related increases in substance use are recognized as risk factors for developing an SUD (McQue et al., 2014). Including both clinical and nonclinical PTSD patients in this review enhances its generalizability. Research has shown that individuals with subthreshold PTSD suffer from impairment and distress that is not significantly different from those with a current diagnosis of PTSD (Badour et al., 2023; Zlotnick et al., 2002), showing an indistinguishable difference between clinical and nonclinical PTSD patients.

Method

Protocol and Registration

The study was designed and written following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines (Page et al., 2021). To ensure a transparent and reproducible research process, the review method, search strategy, screening procedure, and plans for data extraction were specified and documented in a protocol a priori, which is registered with OSF and accessible via https://osf.io/24auc.

Search Strategy and Information Sources

The literature was conducted in Web of Science searching Core Collection and MEDLINE databases, and PsychINFO through EBSCOhost. Moreover, the process of searching for the included articles revolved around three main components. The first component represents the stress concept, the second component consists of the mental health outcome, and the third component consists of studies that include a daily measures design.

In order to search for these components, various query strings were used and combined using the “AND” prompt. For the stress concept, the strings included the following search terms: stress*, or “life event*”, or “negative event*”, or hassles, or trauma*, or abuse,

or neglect, or "child* maltreatment", or "child* experiences", or violence, or disaster*. Meanwhile, for the mental health outcome, the following query strings were used: psychopathol*, or "mental disorder*", or anxiety*, or depress*, or "CIDI", or "DSM", or phobia*, or "ptsd", or "panic disorder*", or "GAD", or "MDD", or "MDE". Finally, for the daily measure design, the query strings that were used consisted of: diary, or daily, or "time series", or "time-series", or "experience sampling", or "ESM", or "ecological momentary assessment*", or "EMA", or "intensive longitudinal", or ambulatory, or "micro-longitudinal". These strings were searched in the abstract or title. Validation procedures were not used to conduct this literature search.

Eligibility Criteria

This review considered only empirical studies. Dissertations, reviews, comments, opinion articles, books, book chapters, and others of similar nature were excluded. Protocols were included at the first stage to facilitate automatic prioritization in ASReview, but excluded during data extraction. Case studies (i.e. studies with a single participant) were also excluded. To be included in this review, articles had to use ambulatory measurements that were collected at least once a day for at least several consecutive days (i.e. ≥ 2 days in a row). These measures could include but were not limited to self-reported subjective measures, subjective measures reported by others, or objective measures (through a smartwatch or a similar device). If variables were measured daily but they only reflected a treatment that was administered daily (e.g. medication administration), or if the daily measurements came in the form of Intensive Care Diaries (ICD) taken by nurses on the general state of participants, the study was excluded. Finally, if daily measures were not measured in human participants but solely focused on global statistical reports (e.g. crime reports), the study was also excluded. This review only included human participants. During the full-text screening, articles were excluded if they were: not in English, if not empirical, if the full text was not available, or if

the study had no daily measure. This way, articles wrongfully selected by included were taken out. If relevant information was missing from a certain study, the author of the article was contacted once, according to the protocol.

Data Collection Process

Before the data collection, a pilot extraction was conducted in ASReview using automatic prioritization. The pilot extraction phase consisted of 15 sources. Based on the pilot screening sheet, the information to be extracted was adjusted. A data extraction sheet was developed in Google Spreadsheets where the characteristics of the selected studies were extracted and recorded. In the primary data extraction phase, twelve extractors were involved. The extractors had a training phase, after which they worked independently. During the extraction phase, extractors had the opportunity to ask their project leader questions formed as comments in the datasheet or during the weekly meetings. The process of data extraction was supervised by the project leaders.

The following population characteristics from the included studies were extracted: country, sample size, age (mean or range), population type, population subtype, physical health (problem/diagnosis), and mental health (diagnosis). Furthermore, the following ambulatory variables were extracted: sampling frequency/day, type of report (self-report, objective measures, or both), stress, affect/emotions, cognition, physiology, behavior, coping, mental health concept and its measurement, and other variables measured daily. The extracted variables measured cross-sectionally were the exact same as the ambulatory variables, except for sampling frequency.

Studies selected from the database

Articles used in this review were selected once the previously mentioned database was completed. In the columns containing daily measures of behaviour a filter was used for variables with “use” or “consumption” in it. Simultaneously, a filter was put on daily

measures of mental health variables for all measures of PTSD. Next, the second filter was replaced by a filter on the column of general mental health diagnosis to filter all studies containing participants with a diagnosis of PTSD, next to the measurement of substance use and consumption. Articles were excluded when (a) the variable of interest was not analyzed, (b) when the study was done focusing on a treatment or intervention for either variable, or (c) when the definition of either variable differed from the ones used in this review. An additional reference search was conducted on Google Scholar and Smartcat, but no eligible articles were found. Further research was done through the reference list of included articles, but this also did not give more eligible articles.

Synthesizing results

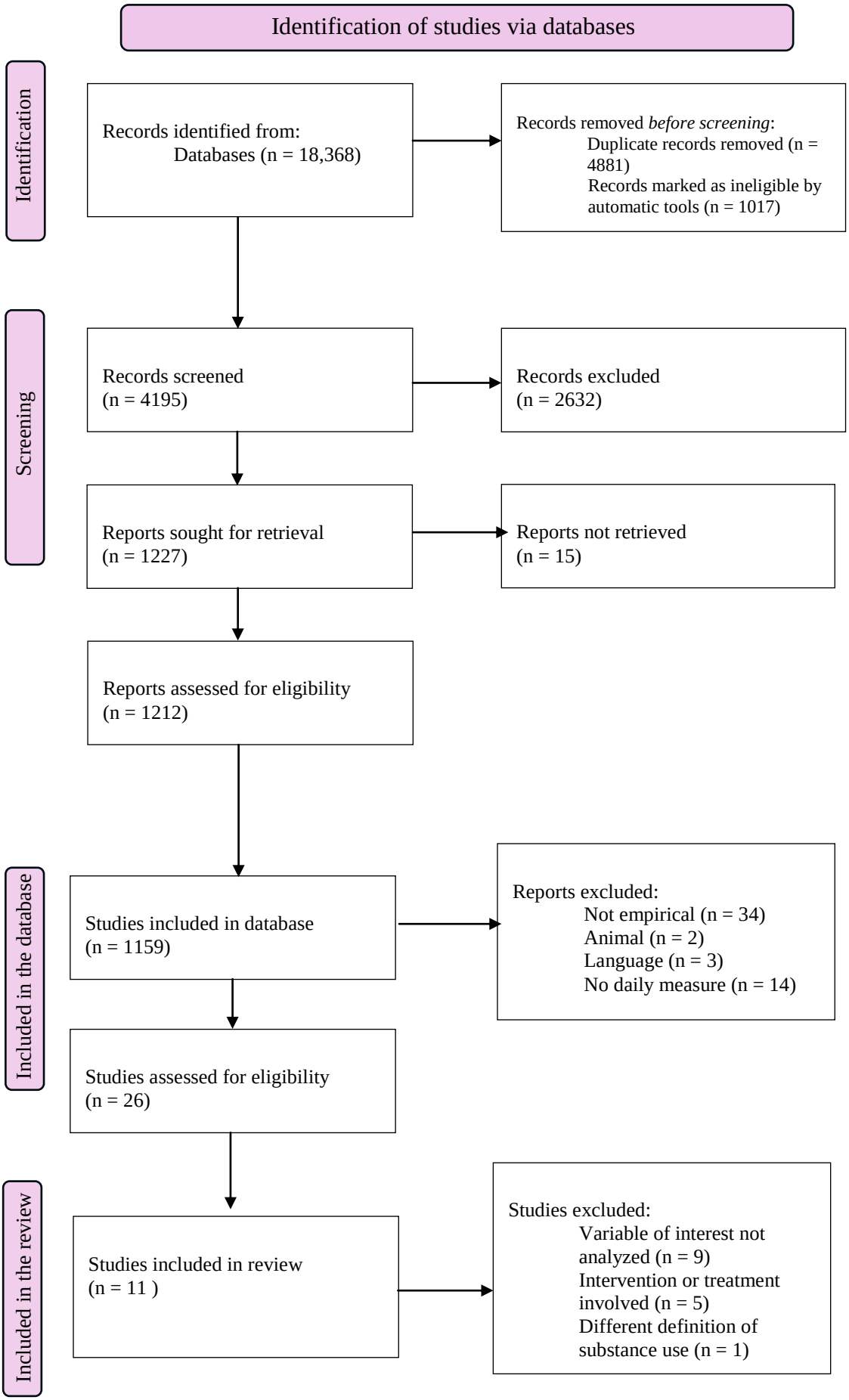
The following data were extracted from included studies: year of publication, sample size, age, population type and subtype, sampling frequency, length of study, type of substance measure, type of PTSD symptom measure, coefficients, effect sizes, and *p*-values. On reviewer extracted the data manually and put it into Table 1 and Table 2. The coefficients, effect sizes, and *p*-values were compared and analyzed narratively, leading to a conclusion.

Results

A total of 26 articles was identified from the database using the filters explained in the method section. After reading the text, (a) nine of them were excluded due to the variable of interest not being analyzed, (b) five were excluded due to their focus on interventions, and (c) one was excluded after using a definition of substance use differing from the one used in this review. An overview of this selection process is given in Figure 1. Finally, a total of eleven articles were included in the review to examine the effect of daily fluctuations in PTSD symptoms on substance use. An overview of the characteristics of the articles is shown in Table 1.

Figure 1

PRISMA flow chart of studies selection



All studies are conducted in the United States using a wide variety of samples with mean ages between 20 and 50. The sample sizes lie between 33 and 279, with a great variety of participants. The participants include opioid users (Badour et al., 2023), veterans (Black et al., 2028; Gaher et al., 2024; Possemato et al., 2015), victims of intimate partner violence (Newberger et al., 2023; Sullivan et al., 2020), students (Kaysen et al., 2014), sexual minorities (Dworkin et al., 2017, pregnant patients (Sanjuan et al., 2017), and trauma exposed individuals (Hruska et al., 2017). Five of the included studies sampled only women (Dworkin et al., 2017; Kaysen et al., 2014; Newberger et al., 2023; Sanjuan et al., 2017; Sullivan et al., 2020) and one sampled only men (Black et al., 2018). The studies had an average sampling frequency of 3.09 times a day and lasted an average of 22.2 days. Half of the studies used a sample out of a clinical population, from which five samples had a PTSD diagnosis (Badour et al., 2023; Hruska et al., 2017; Kaysen et al., 2014; Possemato et al., 2015; Simpson et al., 2014;) and two had the diagnosis of an SUD (Sanjuan et al., 2017; Simpson et al., 2014). Seven of them examined alcohol consumption among individuals with PTSD symptoms (Black et al., 2018; Gaher et al., 2014; Hruska et al., 2017; Kaysen et al., 2014; Possemato et al., 2015; Simpson et al., 2014; Sullivan et al., 2020), three researched the use of drugs (Badour et al., 2023; Dworkin et al., 2017; Newberger et al., 2023), and one included both alcohol and drug use in their study (Sanjuan et al., 2017).

Association between daily PTSD symptoms and substance use

An overview of results in given in Table 2. Eight out of eleven articles found significant evidence for a link between daily PTSD symptom severity and substance use (Badour et al., 2023; Black et al., 2018; Dworkin et al., 2017; Gaher et al., 2014; Kaysen et al., 2014; Possemato et al., 2015; Simpson et al., 2014; Sullivan et al., 2020). Increased PTSD severity was associated with higher alcohol consumption (Black et al., 2018; Gaher et al., 2014; Kaysen et al., 2014; Possemato et al., 2015; Simpson et al., 2014; Sullivan et al., 2020).

Sullivan et al. (2020) found the link between daily PTSD symptoms and alcohol consumption to be stronger among individuals with lower average PTSD symptom levels, suggesting that those with higher symptoms may use alcohol more habitually. Two studies did not find a significant association between PTSD symptoms and alcohol consumption (Hruska et al., 2017; Sanjuan et al., 2019), although Hruska et al. (2017) found a significant link between daily PTSD symptoms and alcohol cravings.

Four articles examined the relationship between daily PTSD symptoms and the use of various drugs, including nonmedical prescription opioid (Badour et al., 2023), cannabis (Dworkin et al., 2017; Newberger et al., 2023; Sanjuan et al., 2019), heroin (Sanjuan et al., 2019), and cigarettes (Sanjuan et al., 2017). The results of these studies are inconclusive. A significant association was found between increased daily symptoms of PTSD and nonmedical prescription use (Badour et al., 2023). Cannabis use was significantly associated with peak PTSD symptoms (Sanjuan et al., 2019), and extended peaks over several days (Dworkin et al., 2017). Newberger et al. (2023) did not find a broad relationship between daily PTSD symptoms and cannabis use, except for few specific PTSD symptom clusters. Additionally, a peak in PTSD symptom severity was positively associated with cigarette use, but not significantly with heroin use (Sanjuan et al., 2017).

PTSD symptom clusters

Three of the eleven included articles explored the role of different PTSD clusters in their relationship with substance use (Kaysen et al., 2014; Newberger et al., 2023; Sullivan et al., 2020). In general, when a certain PTSD cluster level surpassed the average PTSD symptom severity of that assessment time, the consumption of alcohol increased (Sullivan et al., 2020). Similarly, when a certain PTSD cluster level across the whole day surpassed the average PTSD symptom severity of all clusters that day, an increase in alcohol consumption was shown (Sullivan et al., 2020). This indicates a positive association between a PTSD

symptom cluster and alcohol consumption; however, results did not establish a clear pattern about which PTSD cluster was implicated in the relationship (Sullivan et al., 2020).

Kaysen et al. (2014) noted that an increase in trauma-specific symptoms, such as intrusive and behavioural symptoms, correlated with stronger urges to drink and therefore a higher likelihood of alcohol consumption. They also identified a negative relationship between dysphoric PTSD symptoms and the quantity of alcohol consumed, meaning the alcohol consumption decreased after increased levels of dysphoric PTSD symptoms (Kaysen et al., 2014). In contrast, increased dysphoric and externalizing PTSD symptom clusters were associated with a heightened use of cannabis (Newberger et al., 2023), showing a positive relationship between these PTSD symptom clusters and cannabis use. This relationship was only shown when the increases in PTSD symptom clusters and cannabis use were reported on the same day (Newberger et al., 2023).

Time of assessment

Three out of eleven articles examined the relationship between PTSD symptom severity and alcohol consumption at different assessment times (Black et al., 2018; Hruska et al., 2017; Sullivan et al., 2020). They scheduled multiple assessment times throughout the day to examine patterns in the relationship on different assessment times. Two studies reported a positive correlation between PTSD severity and alcohol use at specific assessment times (Black et al., 2018; Sullivan et al., 2020), while Hruska et al. (2017) found no significant association regarding alcohol consumption. The study by Hruska et al. (2017) did find a positive relationship when PTSD symptom and alcohol cravings increases were recorded during the afternoon, but a negative relationship at night. Black et al. (2018) observed increases in alcohol consumption during nighttime and weekend assessment, linked to simultaneous increases in PTSD symptoms. Sullivan et al. (2020) found that on assessment times when PTSD symptom severity surpassed that day's average severity, the likelihood and

quantity of alcohol consumption increased. However, no clear patterns were found regarding specific assessment times, leaving the results of this study inconclusive.

Concurrent and delayed effects

Seven articles have focused on the timing of a potential relationship between daily PTSD symptoms and substance use (Badour et al., 2023; Dworkin et al., 2017; Gaher et al., 2014; Possemato et al., 2015; Sanjuan et al., 2017; Simpson et al., 2014; Sullivan et al., 2020). Findings from these studies are mixed, although the majority reports concurrent effect (Badour et al., 2023; Gaher et al., 2014; Possemato et al., 2015; Simpson et al., 2014; Sullivan et al., 2020). Concurrent effect indicate that PTSD symptom severity correlates with substance use on the same day. Increases in the daily severity of PTSD symptoms, compared to the average across multiple days, have been associated with concurrent increases in alcohol consumption (Simpson et al., 2014; Sullivan et al., 2020), lasting up to three hours (Possemato et al., 2015). Results of Possemato et al. (2015) show a decrease in alcohol consumption three to six hours after reports of increased PTSD symptom severity. Gaher et al. (2014) linked increased PTSD symptom severity throughout the day with increased alcohol consumption that night (Gaher et al., 2014). Additionally, elevated PTSD symptom severity has been identified as temporary risk factor associated with increased use of cannabis and cigarettes on the same day (Sanjuan et al., 2017), as well as with nonmedical prescription opioid use and simultaneous use of at least one other substance (Badour et al., 2023).

Some articles examined a delayed relationship between PTSD symptom severity and substance use (Dworkin et al., 2017; Possemato et al., 2015; Simpson et al., 2014; Sullivan et al., 2020). A delayed relationship indicates that PTSD symptom severity is associated with substance use the next day. Increased PTSD symptom severity is correlated with increased alcohol consumption the next day, indicating a delayed positive relationship between them (Possemtato et al., 2015; Simpson et al., 2014). Prolonged periods of heightened PTSD

symptom severity were also associated with increased cannabis use in subsequent days (Dworkin et al., 2017). In contrast, Sullivan et al. (2020) found a delayed negative relationship, as increases in the PTSD symptom clusters of avoidance; arousal; and numbing were linked to a decrease in alcohol consumption the next day.

Table 1

Characteristics of the included studies

Authors (year)	Total N (% female)	Age (SD)	Population type (diagnosis)	Population subtype	Sampling	Length of study in	Measurement of substance	Measurement for PTSD symptoms at report time
Badour et al. (2023)	40 (60)	39.9 (11.6)	Clinical (PTSD)	Nonmedical prescription opioid users	1	28	Dosage of opioids/ nr. of standard drinks	Total score on the PCL-5 (modified version)
Sullivan et al. (2020)	279 (100)	37.2 (12.9)	General	Victims of intimate partner violence	4	30	Nr. of standard drinks	Cluster total scores on 5-point Likert scale per symptom
Black et al. (2018)	44 (0)	31.4 (5.7)	General	Male veterans	3	28	Nr. of standard drinks	Total score on the PCL-5 (modified version)
Kaysen et al. (2014)	174 (100)	20.0 (1.2)	General; clinical (PTSD)	Undergraduate students	2	30	Nr. of alcoholic drinks	Cluster total scores on the PCL-S (modified version)
Possemato et al. (2015)	143 (12)	30.1 (7.6)	Clinical (PTSD)	Veterans	4	28	Nr. of standard drinks	Total score on 3-point scale per symptom
Dworkin et al. (2017)	90 (100)	21.7 (2.1)	General	Sexual minority women	2	14	Cannabis use frequency	Total score on the PCL (modified version)

Table 1 (continued)

Gaher et al. (2014)	90 (34)	28.9 (5.6)	General	Veterans	8	14	Nr. of standard drinks	Total score on the PCL-5 (modified version)
Simpson et al. (2014)	86 (49)	44.7 (11.0)	Clinical (PTSD; AUD)	N/A	1	7	Nr. of standard drinks	Total score on the PCL-C
Hruska et al. (2017)	36 (25)	34.0 (10.8)	Clinical (PTSD)	Trauma exposed individuals	3	7	Nr. of alcoholic drinks	Total score on the SF-PCL
Sanjuan et al. (2017)	33 (100)	27.8 (4.8)	Clinical (SUD)	Pregnant patients in SUD treatment	3	28	Nr. of standard drinks since last report time/ drug use frequency	Total score on the PCL-5
Newberger et al. (2023)	145 (100)	40.7 (11.7)	General	Victims of intimate partner violence	3	30	Cannabis use frequency	Cluster total scores on the PCL-5 (modified version)

Note. mental health diagnosis is given based on the DSM-5, DSM-IV, DSM-IV-TR, SCID, CAPS. PTSD = posttraumatic stress disorder. AUD = alcohol use disorder, SUD = substance use disorder. NMPOU = nonmedical prescription opioid use. standard drinks = 12 oz beer, 8-9 oz malt liquor, 5 oz wine, 1.5 oz liquor. PCL = posttraumatic stress disorder checklist.

Table 2

Results of the included studies

Authors (year)	Association examined	Effect sizes	P-value
Badour et al. (2023)	The association between PTSD symptom severity and same day NMPOU use or co-use of NMPOU and at least one other substance	NMPOU: *OR* = 1.05, 95% CI [1.01,1.09] Co-use: *OR* = 0.06, 95% CI [1.02, 1.10]	- -

Table 2 (continued)

	The association between PTSD symptom severity and next day NMPOU use or co-use of NMPOU and at least one other substance	NMPOU: *OR* = 0.99, 95% CI [0.95, 1.02]	-
		Co-use: *OR* = 1.02, 95% CI [0.99, 1.05]	-
Sullivan et al. (2020)	The association between days where the severity of the PTSD symptom clusters surpassed the overall mean levels and alcohol consumption	Re-experiencing: *B* = 0.305, exp(b) = 1.356	$p < .001$
		Avoidance: *B* = 0.213, exp(b) = 1.238	$p = .001$
		Numbing: *B* = 0.3201, exp(b) = 1.223)	$p = .004$
		Arousal: *B* = 0.341, exp(b) = 1.407	$p < .001$
	The association between reporting times where the severity of the PTSD symptom clusters surpassed the overall severity levels of that day's PTSD symptoms and alcohol consumption	Re-experiencing: *B* = 0.183, exp(b) = 1.201	$p = .002$
		Avoidance: *B* = 0.184, exp(b) = 1.202	$p = .001$
		Numbing: *B* = 0.423, exp(b) = 1.526	$p < .001$

Table 2 (continued)

		Arousal: *B* = 0.305, exp(b) = 1.356	$p < .001$
	The association between increased levels of severity in the PTSD symptom clusters and alcohol consumption during the subsequent assessment time	Re-experiencing: *B* = -0.129, exp(b) = 0.879	$p = .174$
		Avoidance: *B* = -0.0170, exp(b) = 0.844	$p = .011$
		Numbing: *B* = -0.248, exp(b) = 0.780	$p = .006$
		Arousal**:** *B* = -0.198, exp(b) = 0.820	$p = .041$
Black et al. (2018)	The alcohol consumption at report times during the weekend and night, accounted for by increased PTSD symptom levels	Weekend: *B* = 0.79, *IRR* = 2.21, 95% CI [1.52, 3.20]	$p \leq .01$
		Night: *B* = 1.07, *IRR* = 2.93, 95% CI [1.64, 5.23**]**	$p \leq .01$
Kaysen et al. (2014)	The association between increased trauma-specific symptoms and drinking urges or drinking behaviour	Drinking urges: *B* = 0.17	$p < .05$
		Drinking behaviour: *B* = 0.42, *RR* = 1.04, 95% CI [0.83, 1.26]	$p < 0.05$

Table 2 (continued)

	The association between increased dysphoric symptoms and drinking urges or drinking behavior	Drinking urges: *B* = 0.003	*p* > .05
		Drinking behaviour: *B* = 0.12, *RR* = 0.82, 95% CI [0.71, 0.94]	*p* > .05
Possemato et al. (2015)	The association between increased PTSD symptoms and subsequent alcohol consumption within the same and next report time	Same report time: *B* = 0.04, *IRR* = 1.05, 95% CI [1.02, 1.07]	-
		Next report time: *B* = -0.10, *IRR* = 0.91, 95% CI [0.88, 0.94]	-
Dworkin et al. (2017)	The association between an increased average of PTSD symptom severity (across multiple days) and cannabis use	*OR* = 2.67, 95% CI [1.71, 4.41]	*p* < .001
	The association between daily PTSD symptom severity variations from one's own average and their cannabis use	*OR* = 0.97, 95% CI [0.78, 1.19]	*p* = .778
Gaher et al. (2014)	The association between increases in PTSD symptom severity during the day and subsequent alcohol consumption at night	*B* = 0.78, *SE* = 0.07	*p* < .001
Simpson et al. (2014)	The association between increased PTSD symptom severity and same-day or next-day alcohol consumption	Same day: *B* = 0.21, *IRR* = 1.23, 95% CI [1.14, 1.32]	*p* <.001
		Next day: *B* = 0.07, *IRR* = 1.07, 95% CI [0.98, 1.16]	*p* > .05

Table 2 (continued)

Hruska et al. (2017)	The association between PTSD symptom severity and alcohol consumption	*B* = 0.08, *IRR* = 1.08	*p* = .10
	The association between PTSD symptom severity and alcohol cravings during the afternoon and night report times	Afternoon: *B* = 0.35, *IRR* = 1.42, 95% CI [1.11, 1.82]	*p* < .05
		Night: *B* = -0.28, *IRR* = 0.75, 95% CI [0.58, 0.97]	*p* < .05
Sanjuan et al. (2017)	The association between the peak of PTSD symptom severity and the use of cannabis, cigarettes, heroin, and alcohol	Cannabis: *B* = 0.37, 95% CI [0.10, 0.57]	-
		Cigarettes: *B* = 0.08, 95% CI [0.02, 0.16]	-
		Heroin: *B* = 0.09, 95% CI [-0.22, 0.28]	-
		Alcohol: *B* = 0.02, 95% CI [-0.1, 0.06]	-
Newberger et al. (2023)	The association between reported PTSD symptom clusters and cannabis use during the same report time	Externalizing behaviour: *OR* = 1.37, 95% CI [1.15, 1.65]	*p* <0.001
		Dysphoric arousal: *OR* = 1.28, 95% CI [1.09, 1.49]	*p* = 0.002
		Re-experiencing: *OR* = 1.18, 95% CI [0.98, 1.42]	*p* = 0.074

Table 2 (continued)

	Avoidance: *OR* = 0.98, 95% CI [0.82, 1.19]	*p* = 0.977
	Negative affect: *OR* = 1.04, 95% CI [0.86, 1.25]	*p* = 0.654
	Anhedonia: *OR* = 1.07, 95% CI [0.91, 1.26]	*p* = 0.428
	Anxious arousal: *OR* = 1.09, 95% CI [0.90, 1.31]	*p* = 0.381
The association between increased levels of severity in the PTSD symptom clusters and alcohol consumption during the subsequent assessment time	Externalizing behaviour: *OR* = 0.97, 95% CI [0.80, 1.18]	*p* = 0.760
	Dysphoric arousal: *OR* = 1.07, 95% CI [0.75, 1.52]	*p* = 0.656
	Re-experiencing: *OR* = 0.90, 95% CI [0.73, 1.11]	*p* = 0.303
	Avoidance: *OR* = 0.89, 95% CI [0.74, 1.09]	*p* = 0.245
	Negative affect: *OR* = 1.15, 95% CI [0.92, 1.44]	*p* = 0.200
	Anhedonia: *OR* = 1.06, 95% CI [0.78, 1.44]	*p* = 0.694
	Anxious arousal: *OR* = 1.11, 95% CI [0.94, 1.30]	*p* = 0.212

Note. PTSD = posttraumatic stress disorder. NMPOU = nonmedical prescription opioid use. B = unstandardized coefficient. IRR = incidence rate ratio. OR = odds ratio. RR = rate ratio. CI = Bayesian credible interval or confidence interval. SE = standard error. Exp(b) = increase in the rate of drinking for a unit increase in the PTSD symptom severity.

Discussion

This review aimed to assemble evidence for the association between daily fluctuations of PTSD symptoms and substance use in clinical and nonclinical patients with PTSD. It included six articles focusing on alcohol consumption (Black et al., 2018; Hruska et al., 2017; Kaysen et al., 2014; Possemato et al., 2015; Simpson et al., 2014; Sullivan et al., 2020), three articles focusing on drug use (Badour et al., 2023; Dworkin et al., 2017; Newberger et al., 2023), and one including both alcohol and drug use (Sanjuan et al., 2017). This discrepancy in research on alcohol or drugs use may stem from differing prevalence rates. Among PTSD patients, up to 42% have reported using alcohol and 22% reported drug use (Pietrzak et al., 2011). Consequently, researcher tend to focus more on alcohol use then drug use when examining its association with daily PTSD symptoms.

In agreement with a large body of previous literature, the majority of included articles have found a positive relationship between daily PTSD symptoms and their substance use (Badour et al., 2023; Black et al., 2018; Dworkin et al., 2017; Gaher et al., 2014; Kaysen et al., 2014; Possemato et al., 2015; Simpson et al., 2014; Sullivan et al., 2020). Reviewing eleven momentary studies, this paper has tried to examine the relationship between daily PTSD symptoms and substance use by reviewing it from multiple perspectives.

Overall, increased PTSD symptom severity was associated with heightened alcohol consumption (Black et al., 2018; Gaher et al., 2014; Kaysen et al., 2014; Possemato et al., 2015; Simpson et al., 2014; Sullivan et al., 2020). This is in line with previous research, where an association was found between PTSD symptoms and alcohol use (Berenz et al.,

2017; Kofoed et al., 1993; Stewart et al., 1996). Furthermore, increased PTSD symptom severity was partially associated with drug use, including cannabis (Dworkin et al., 2017; Newberger et al., 2023; Sanjuan et al., 2023); nonmedical prescription opioids (Badour et al., 2023); and cigarettes (Sanjuan et al., 2019). Prior research supports this finding (Kofoed et al, 1993).

Research done on the relationship between daily PTSD symptom cluster severity and substance use found mixed results. Increased trauma-specific symptoms correlated with higher alcohol consumption (Kaysen et al., 2014), aligning with prior studies (Walton et al., 2017; Kaysen et al., 2007). However, elevated dysphoric symptoms were associated to decreased alcohol consumption (Kaysen et al., 2014), contradicting earlier findings that linked PTSD symptoms negatively affecting cognition and mood with alcohol use (Walton et al., 2017). Additionally, increased dysphoric PTSD symptoms were linked to higher cannabis use (Newberger et al., 2023), differing from previous research that connected dysphoric symptoms primarily with stimulant use (Livingston et al., 2022). Furthermore, reported increases in externalizing PTSD symptoms were associated with higher cannabis use (Newberger et al., 2023), which lacks support from earlier studies. Results from prior research also showed an association between PTSD clusters of avoidance or hyperarousal and substance use (Debell et al., 2014; Livingston et al., 2022; Somohano et al., 2019), that is not found in the studies included in this review.

Studies have found evidence that increased PTSD symptom severity increased the consumption of alcohol (Sullivan et al., 2020), mainly during the weekend (Black et al., 2018). Prior research supports this, as results showed an increase in alcohol consumption during the weekends related to PTSD symptoms (Rappaport et al., 2021). Elevated PTSD symptoms were associated with with both an increase (Black et al., 2018) and a decrease (Hruska et al., 2017) in nighttime alcohol consumption. The inconsistent findings in these

studies and the lack of support from previous research highlight the need for further investigation.

Studies focusing on the timing of the relationship between daily PTSD symptoms and substance use found inconsistent results. Elevated daily PTSD symptom severity have been associated with concurrent increases in alcohol consumption (Gaher et al., 2014; Possemato et al., 2015; Simpson et al., 2014; Sullivan et al., 2020). These results resemble results from previous research, where a concurrent relationship between PTSD symptoms and alcohol use was found (Simons et al., 2018). Similarly, increased PTSD symptom severity has been linked to concurrent elevated use of cannabis and cigarettes (Sanjuan et al., 2017), together with nonmedical prescription opioids (Badour et al., 2023). These findings align with findings from prior research that found evidence for a concurrent relationship between PTSD symptoms and the use of various drugs (Kevorkian et al., 2015).

Other studies examining the timing of the relationship between PTSD symptoms and substance use found evidence for a positive relationship (Dworkin et al., 2017; Possemato et al., 2015; Simpson et al., 2014). This is in accordance with prior research, as PTSD symptoms were found to be associated with delayed substance use (Simons et al., 2018; Ouimette et al., 2010). However, Sullivan et al. (2020) found a negative relationship, where increased levels of PTSD symptom clusters of avoidance, arousal, and numbing were associated with decreased alcohol consumption. This contradicts earlier findings, which showed a positive relationship between PTSD clusters of avoidance, arousal, and numbing and alcohol consumption (Livingston et al., 2022; Somohano et al., 2019; Walton et al., 2017).

Limitations of the review

This review faces multiple limitations. The included articles were published between 2014 and 2023, with some using the DSM-IV-TR (Gaher et al., 2014; Hruska et al., 2017; Kaysen et al., 2014; Possemato et al., 2015; Simpson et al., 2014) and others using the DSM-

V (Badour et al., 2023; Black et al., 2018; Dworkin et al., 2017; Newberger et al., 2023; Sanjuan et al., 2017; Sullivan et al., 2020) for the criteria of PTSD. Since these criteria differ significantly (American Psychiatric Association [APA], 2013), this variation limits the comparison between the articles to some extent. Furthermore, the effect sizes in the studies were reported using different statistical measures across the articles, which limits the ability to compare the effect sizes directly.

Another limitation is that this review was completed as part of a bachelor thesis, which relied on access to articles available through the university library. This dependency restricted access to resources not covered by the university library, including websites, online libraries, and other institutions. Some articles were also inaccessible due to being written in different languages.

Furthermore, the primary extraction phase involved 12 trained extractors. Even though they were guided throughout the process, this has led to inconsistencies in the data sheet. Employing multiple extractors introduced variability in extracted variables, which limited the interpretability of results and the conclusions drawn from them.

Additionally, this paper was written by one individual. Even though the initial process of article selection and coding was done in a group, the final selection of articles and the review of them was done by one undergraduate student. This means that this review could have been influenced by a slight bias, with no one to rectify it.

Limitations of the studies

The studies used in this review also have some limitations. Firstly, all samples used in the studies are from the United States, potentially restricting the generalizability to populations in other continents. The use of relatively small sample sizes further limits the generalizability of the study results, as does the relatively short timeframes the studies were conducted. Moreover, participants were recruited from treatment facilities, schools, or other

public places. This potentially excludes patients with more severe substance use or PTSD symptoms, as they may be unable to attend these facilities. Additionally, the availability of substances and exposure to them varies significantly across these samples. For instance, undergraduate participants might be significantly influenced by institutional activities, whereas victims of intimate partner violence might face limitations on their belongings imposed by their spouse. This could have intervened with the analyzed association throughout the studies.

Lastly, all studies are conducted using self-reports as measurements. This method is susceptible to social desirability bias, which entails that people tend to portray themselves as behaving in a socially desirable way and avoid causing negative associations towards themselves in social settings (Tan et al., 2022). This could lead them to report more socially desirable measurements than true ones, threatening the internal validity of the studies. Additionally, the possible illegality of certain substances in the study area may have discouraged honest responses. Since participants of all studies were distributed across the US, it is unclear which participants in which studies encountered this possible limitation. Another limitation of some studies' measurements is that a comparison of daily measurements was done with retrospective baseline measurements (Badour et al., 2023; Black et al., 2018; Possemato et al., 2015; Sanjuan et al., 2019; Simpson et al., 2014; Sullivan et al., 2020). Research shows that participants ten to report higher levels of PTSD symptoms with retrospective measurements than daily measurements (Campbell et al., 2017). This suggests that baseline measurements may be inflated in studies comparing them to daily measurements.

Strengths of the review

This review utilized momentary assessment studies to avoid bias and memory errors common in retrospective studies (Hruska et al., 2017; Shiffman et al., 2008). This approach enhances ecological validity by examining participants in real-world settings (Doherty et al.,

2020). It also reduces the influence of uncontrollable variables often encountered in laboratory studies, as participants remain in their natural environment. Furthermore, this review includes a broad understanding of substance use. This enables the development of interventions that target substance use symptoms early, thereby reducing the risk of developing an SUD over time (McQue et al., 2014; Stewart et al., 2000). The inclusion of both clinical and nonclinical patients with PTSD increases the generalizability of results, as research has shown an indistinguishable difference between clinical and nonclinical PTSD patients (Badour et al., 2023; Zlotnick et al., 2002).

Future research

A gap has been identified between research done on alcohol consumption and drug use concerning its relationship with PTSD symptoms. The majority of research has focused on alcohol use, resulting in limited information about PTSD- related drug use. To address this current imbalance and obtain more knowledge, researchers could focus on the association between PTSD symptoms and the usage of drugs. Additionally, all included studies were conducted in the United States, limited the generalizability of findings. Replicating these studies in other countries could broaden the applicability. To address the limitation of short measurement timeframes of measurements, researchers should reproduce current studies with extended durations.

Conclusion

This review synthesizes evidence of the association between daily PTSD symptom severity and substance use in clinical and nonclinical patients with PTSD. Current studies have not been conclusive in their findings, limiting general conclusions. However, evidence supports a relationship between daily PTSD symptoms and substance use in various aspects. To address existing limitations and research gaps, further studies are necessary. This can enhance knowledge and enable the development of current and new interventions.

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