Research Article

Posttraumatic stress symptoms moderate the relationship between chronic pain and adverse cannabis outcomes: A pilot study

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ABSTRACT

Objective: Increasingly, cannabis is being prescribed/used to help manage posttraumatic stress symptoms (PTSS) or chronic pain, as cannabis has been argued to be beneficial for both types of symptoms. However, the evidence on efficacy is conflicting with evidence of risks mounting, leading some to caution against the use of cannabis for the management of PTSS and/or chronic pain. We examined the main and interactive effects of PTSS and chronic pain interference on adverse cannabis outcomes (a composite of cannabis use levels and cannabis use disorder, CUD, symptoms). We hypothesized that chronic pain interference and PTSS would each significantly predict adverse cannabis outcomes, and that chronic pain interference effects on adverse cannabis outcomes would be strongest among those with greater PTSS. **Method:** Forty-seven current cannabis users with trauma histories and chronic pain (34% male; mean age = 32.45 years) were assessed for current PTSS, daily chronic pain interference, past month cannabis use levels (grams), and CUD symptom count. **Results:** Moderator regression analyses demonstrated chronic pain interference significantly predicted the adverse cannabis outcomes composite, but only at high levels of PTSS. **Conclusions:** Cannabis users with trauma histories may be at greatest risk for heavier/more problematic cannabis use if they are experiencing both chronic pain interference and PTSS.

Key words: = chronic pain; cannabis; PTSD; cannabis use disorder; trauma

While some research suggests cannabis can be useful for alleviating chronic pain compared to treatment as usual (Gruber et al., 2021; Kansagara, 2017), a systematic review found only low strength evidence to support cannabis as effective for treating chronic pain (Nugent et al., 2017). Another review acknowledged a potential relationship between medicinal cannabis and cannabis-related problems, including cannabis dependence (Yarnell, 2015).

Similarly, many trauma survivors are prescribed or use cannabis to manage posttraumatic stress symptoms (PTSS[1]; Metrik et al., 2016). Some argue cannabis is beneficial in PTSS treatment (Walsh et al., 2017). However, a longitudinal study showed continued cannabis use was associated with worse posttraumatic stress disorder (PTSD) outcomes (Wilkinson et al., 2015). Moreover, high quality evidence (i.e., randomized controlled trials) on cannabis' efficacy for treating PTSD is lacking (McKee et al., 2021). Additionally, there are high rates of comorbidity between PTSD and cannabis use disorder (CUD; Walsh et al., 2014).

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PTSD and chronic pain interference (i.e., the ways the presence of chronic pain interferes with one's daily activities) commonly co-occur and are thought to exacerbate the symptoms of the other (Asmundson & Katz, 2009). Indeed, one longitudinal study found that for injured Veterans with PTSD (vs. non-injured Veterans with PTSD), chronic pain interference mediated increases in PTSS (Lee et al., 2019). Another study found a PTSD diagnosis predicted increased pain interference in active military members (Li et al., 2021). A third (Morasco et al., 2013) identified those with PTSD (vs. without PTSD) were more likely to have a substance use disorder and were experiencing greater pain interference. Interestingly, depressive symptoms/coping strategies partially mediated this effect. Evidently, pain interference is an important facet of chronic pain that has been empirically shown to be related to PTSD.

For these reasons, cannabis interventions for alleviating either chronic pain or PTSS remain controversial, particularly with cannabis legalization occurring in many jurisdictions. Indeed, given observed associations between cannabis accessibility and increased cannabis use (Cerdá et al., 2017), cannabis self-medication for PTSS and/or chronic pain without the oversight of a prescriber is likely. While some research shows PTSD is comorbid with CUD regardless of chronic pain (Bilevicius et al., 2019), other work demonstrates PTSD-chronic pain comorbidity is more strongly associated than either disorder alone with substance dependence (Kind & Otis, 2019). Additionally, chronic pain is more severe and intrusive among those with PTSD (Siqveland et al., 2017); thus, chronic pain may be more likely to motivate cannabis use in the presence of greater PTSS. Ravn et al. (2018) found PTSS positively moderated the relationship between chronic pain and distress, suggesting PTSS may exacerbate the relationship between chronic pain and other health-relevant outcomes, including excessive/problematic cannabis use.

More research is needed to test links between chronic pain, PTSS, and cannabis outcomes. Such research could help inform to whom preventative and early intervention resources should be targeted for minimizing adverse cannabis outcomes. We examined the main and interactive effects of PTSS and chronic pain interference on adverse cannabis outcomes (a composite of past month cannabis use and CUD symptom count) among trauma-exposed cannabis users with chronic pain. We hypothesized greater chronic pain interference and greater PTSS (i.e., higher PTSD symptom count) would both independently predict greater adverse cannabis outcomes (H1). We further predicted an interaction where chronic pain interference effects on adverse cannabis outcomes would be strongest among those with greater PTSS (H2).

METHODS

Participants

Fifty participants (34% male; M_{age}=32.18 years, *SD* = 10.02; 20% current/previous Military members) residing in Halifax, Nova Scotia, Canada, were recruited via social media (e.g., Facebook, Instagram) for an in-person study on trauma exposure and cannabis use (DeGrace et al., 2023a, b). Participants were required to meet inclusion/exclusion criteria in a telephone pre-screening: aged 19-65 years; no current diagnosis of serious mental illness[2]; exposure to ≥1 lifetime potentially traumatic event(s); and regular cannabis use (≥1 g/week in the past month; Gabyrs & Porath, 2019). For the current archival study, participants also had to report pain on most days in the past three months on the electronic Chronic Pain Questionnaire (eCPQ; Coyne et al., 2017), leaving a final sample of *N* = 47 (34% male; M_{age} = 32.45 years, *SD* = 10.28; 21.3% current/previous Military members).[3]

Procedure

[1] Throughout this manuscript, the acronym PTSS refers to continuous measures of PTSD symptoms, whereas PTSD refers to the categorical diagnosis.

[2] Serious mental illness was defined s bipolar disorder, schizophrenia, or other psychotic disorder.

[3] The eCPQ allows for the screening out of those who did not report chronic pain. Only those 47 who reported experiencing chronic pain on the first item of the eCPQ were included in our primary analyses for the current archival study since only those acknowledging chronic pain went on to report on the degree of chronic pain interference.

At in-person testing,[4] participants were clinically assessed for current PTSD and CUD via validated structured interviews conducted by a trained psychiatry graduate student supervised by a licenced clinical psychologist. Only instruments relevant to the current archival sub-study are described.

Measures

Demographics. Participants reported demographic information (i.e., sex, age, military status).

Trauma Exposure. The 17-item Life Events Checklist (LEC; Gray et al., 2004) was used during pre-screening to assess criterion A of a DSM-5 (American Psychiatric Association; APA, 2013) PTSD diagnosis.

PTSS. Past month PTSS were assessed using the 20-item Clinician-Administered PTSD Scale for DSM-5 (CAPS-5; Weathers et al., 2018). If participants reported exposure to >1 lifetime traumas on the LEC, they focused on their most distressing lifetime trauma for the CAPS-5. Continuous CAPS-5 scores (i.e., PTSD symptom count; possible range = 0-20; e.g., Tull et al., 2018) were used in hypotheses-testing regarding main and interactive effects of PTSS on adverse cannabis outcomes. We used CAPS-5 scoring rules for establishing DSM-5 (APA, 2013) PTSD diagnoses, for sample description purposes.[5] The CAPS-5 possesses excellent interrater reliability, test-retest reliability, and high internal consistency (α =.88; Weathers et al., 2018; α = .82, present sample).

Chronic Pain. The eCPQ (Coyne et al., 2017) is a brief measure tapping chronic pain and its characteristics. If participants indicated they had experienced pain on most days in the past three months, they continued with the remaining eCPQ items. In our hypothesis-testing of the main and interactive effects of chronic pain on cannabis outcomes, we utilized the 5-item pain interference scale. Participants rated how much their pain had interfered with functioning in the past week (0 = not at all to 10 = severe problem) in each of five life domains: usual activities, sleep, mood, cognitive functioning, and use of the senses. Items were summed (possible range = 0-50). The pain interference scale has good internal consistency (α = .82, present sample) and good concurrent and discriminant validity (Coyne et al., 2017).

Cannabis Use. Past month cannabis use levels were assessed using the Cannabis Timeline Followback (C-TLFB; Sobell & Sobell, 1992). Participants indicated on a calendar which days in the past month they had used cannabis, and how much cannabis (in grams) had been used each day. The C-TLFB has good test-retest reliability (Robinson et al., 2012), excellent inter-rater reliability (Norberg et al., 2012), and has shown validity in accurately depicting cannabis use (Hjorthøj et al., 2012). Total grams of cannabis (past month) were used as one component in our adverse cannabis outcomes composite.

CUD Symptoms. CUD symptoms were operationalized as past year CUD symptom count on the 11-item Structured Clinical Interview for DSM-5, Research Version (SCID-5-RV; First et al., 2015). SCID-5 CUD symptom count scores (possible range = 0-11) were used as the second component in our adverse cannabis outcomes composite (Pellegrino et al., 2020). We used established SCID-5 scoring rules to determine DSM-5 (APA, 2013) CUD diagnoses for sample description purposes.[6] The SCID-5 has excellent reliability and diagnostic sensitivity (Osorio et al., 2019).

Data Analysis

Andrew Hayes' (2013) PROCESS (v4.1) macro was used in hypothesis-testing. The two outcomes of interest, past month cannabis use and CUD symptom count, were converted to z-scores and

[4] Participants were required to remain abstinent from cannabis, alcohol, and illicit drugs for 12 hours and from caffeine for 2 hours prior to their lab-based testing session for reasons related to the parent study (DeGrace et al., 2023a, b). Abstinence was verified using a urine test, breathalyzer, and self-report.

[5] The CAPS-5 scoring rules for establishing a DSM-5 (APA, 2013) PTSD diagnosis were: $\geq$1 symptom for each of Criteria B and C, respectively; and $\geq$2 symptoms for each of Criteria D and E, respectively.

[6] The SCID-5 scoring rules for establishing a DSM-5 (APA, 2013) diagnosis of CUD are endorsement of $\geq$2 of 11 possible CUD symptoms. Those with a CUD diagnosis were further classified as mild (2-3 symptoms), moderate (4-5 symptoms), or severe (6+ symptoms) using the DSM-5 (APA, 2013) categories for CUD severity (see First et al., 2015).

averaged to create a single composite. This composite, which we refer to as 'adverse cannabis outcomes,' was used as our primary outcome. Our model regressed adverse cannabis outcomes on pain interference scores with PTSS as the moderator. As all variables were continuous with meaningful values at zero, data were not centered for interpretation purposes (Iacobucci et al., 2016; Olvera-Astivia & Kroc, 2019). A significant interaction was probed using simple slopes analyses examining the effect of chronic pain interference on adverse cannabis outcomes at low (-1SD), mean, and high (+1SD) PTSS levels.

RESULTS

Descriptive Statistics

Table 1 shows descriptive statistics and bivariate correlations. On the eCPQ, participants reported mean chronic pain interference levels (M = 19.18, *SD* = 12.06, range = 0-50) comparable to those in patients with a clinical chronic pain condition (Coyne et al., 2017). Participants' past month cannabis use levels (*M* = 54.4 grams, *SD* = 45.5, range = 4-206) were ~5 times higher than the monthly use levels of cannabis users in the Canadian general population (Statistics Canada, 2020). The majority (70.2%) met criteria for past-year CUD (SCID-5). Amongst those with CUD, 33.3% met criteria for mild, 15.2% for moderate, and 51.5% for severe CUD. More than half (59.6%) met criteria for past-month PTSD (CAPS-5). See Supplementary Table 1 for further descriptive and clinical characteristics.

Chronic pain interference was significantly positively correlated with PTSS (medium effect). Cannabis use and CUD symptoms were significantly positively intercorrelated (medium effect). The other inter-correlations among study measures were positive but small and not statistically significant.[7]

Table 1. *Descriptive statistics and bivariate correlations.*

	1	2	3	4
1. Chronic Pain Interference	-	.494**	.251	.242
2. PTSS		-	.109	.228
3. Past Month Cannabis Use (in grams)		-	-	.333*
4. CUD Symptoms				-
M	19.18	10.52	54.40	3.72
SD	12.06	4.87	45.55	2.84
Range	0-50	2-19	4-206	0-9

Note. * $p < .05$, ** $p < .01$ (two-tailed tests). Chronic pain interference was assessed with a 5-item subscale of the eCPQ (Coyne et al., 2017); PTSS was a PTSD symptom count on the CAPS-5 interview (Weathers et al., 2018); Past Month Cannabis use was assessed using the C-TLFB (Sobell & Sobell, 1992); and CUD symptoms were a symptom count on the CUD assessment from the SCID-5 (First et al., 2015).

[7] The following parameters were used to determine the magnitude of the correlations: .1-.3 small; .3-.5 medium; and .5-1.0 large (Cohen, 1992).

[8] Values of the dependent variable at levels of the moderator are available in Supplementary Table 2.

[9] A sensitivity analysis was conducted with the full sample of $N = 50$ from the larger study (DeGrace et al., 2023a, b). Minimal possible values for chronic pain interference were given to the $n = 3$ participants who reported no chronic pain on the first question of the eCPQ and the analyses were rerun. We also conducted another set of sensitivity analyses with the subsample reporting chronic pain ($N = 47$) where the analyses were repeated for past month cannabis use (on the C-TLFB) and CUD symptom count (on the SCID) separately (see Supplementary Tables 3 and 4, respectively). Simple slopes analyses replicated the main results in all cases: the association between chronic pain interference and the adverse cannabis outcome in question was significant, but only at high (but not average or low) PTSS levels. A final sensitivity analysis of our regression model without the interaction effect on the adverse cannabis outcomes composite score failed to produce main effects of PTSD ($p = .693$) or pain ($p = .223$). Sensitivity analyses are available from the corresponding author on request.

Regression

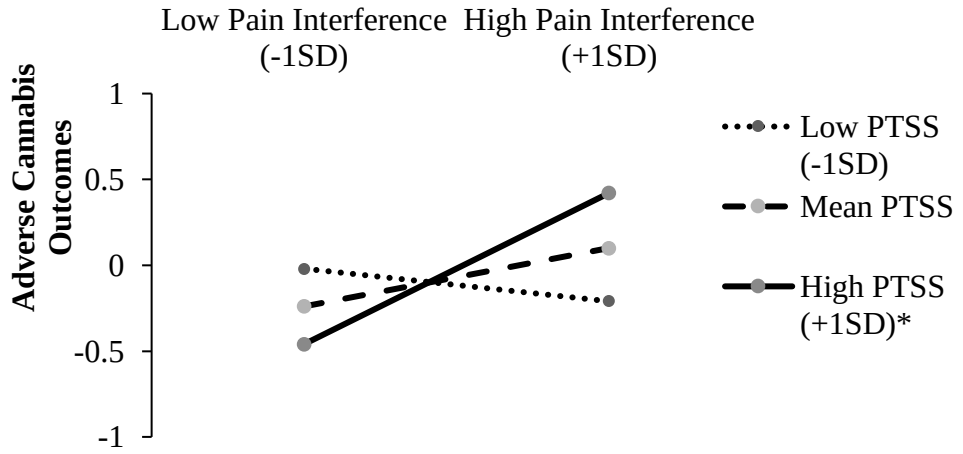
Inconsistent with H1, neither significant main effects of chronic pain interference nor PTSS were observed on our adverse cannabis outcomes composite. However, a significant pain interference x PTSS interaction was observed.[8] Consistent with H2, simple slopes analyses demonstrated greater chronic pain interference significantly predicted greater adverse cannabis outcomes only at high (but not average or low) PTSS levels (see Table 2, Figure 1)[9]

Table 2. *Regression analysis results with chronic pain interference, PTSS, and their interaction predicting the adverse cannabis use outcomes composite (top panel); simple slopes across three levels of the moderator (bottom panel).*

Effect	*b*	*t*	*p*
Chronic Pain Interference	-.035	-1.48	.144
PTSS	-.084	-1.74	.089
Chronic Pain Interference x PTSS	.005	2.33	.024*
Simple Slopes			
Low (-1SD) PTSS	-.008	-.547	.587
Mean PTSS	.015	1.36	.179
High (+1SD) PTSS	.037	2.53	.015*

Note. *$p < .05$; regression coefficients are unstandardized.

Figure 1. *Simple slopes analyses of chronic pain interference predicting the adverse cannabis use outcomes composite across three levels of PTSS: low (-1 SD), mean, and high (+1 SD).*



Note. Significant simple slopes (p <.05) indicated via asterisk (*).

DISCUSSION

Our pilot study is the first to examine the possible interactive effects of chronic pain and PTSS on adverse cannabis outcomes (i.e., past-month cannabis use and CUD symptom count). Consistent with one of our two study hypotheses (H2), the chronic pain interference x PTSS interaction predicted concurrent severity of adverse cannabis outcomes among trauma-exposed cannabis users with chronic pain. Specifically, a significant positive effect of chronic pain interference on levels of adverse cannabis outcomes (composite and each outcome individually) was observed only among those with a high PTSS count. However, neither chronic pain interference nor PTSS alone was associated with adverse cannabis outcomes, in contrast to our other hypothesis (H1); just having life-interfering

effects of chronic pain or just having high levels of PTSS was not sufficient to elevate risk for concurrent adverse cannabis outcomes. Thus, heavier/more problematic cannabis use is more likely when life-interfering levels of chronic pain are accompanied by high levels of PTSS.

Results are consistent with research showing that Veterans dealing with chronic pain and PTSS are more likely to endorse maladaptive coping strategies compared to Veterans experiencing chronic pain alone (Alschuler & Otis, 2012). Given some limited evidence of efficacy of cannabis in managing chronic pain (Nugent et al., 2017), greater cannabis use levels might be argued to be adaptive amongst those with elevated chronic pain and PTSS. However, this pattern of moderation was observed not only for cannabis use levels but also for CUD symptom count in our sensitivity analyses, suggesting greater cannabis use among those with both elevated chronic pain and PTSS should be considered risky.

Previous research has been inconsistent as to whether chronic pain and PTSS interact in the prediction of adverse cannabis outcomes. While one previous study found PTSD was associated with comorbid CUD regardless of chronic pain (Bilevicius et al., 2019), a literature review showed PTSD-chronic pain comorbidity was associated with greater substance dependence relative to either PTSD or chronic pain alone (Kind & Otis, 2019). Our results are more consistent with the latter than the former result given our findings of interactive effects of chronic pain interference and PTSS, but no main effects of PTSS, on our adverse cannabis outcome composite (and its individual components in sensitivity analyses).

Prior research suggests a possible mechanism to explain our interactive effects of chronic pain and PTSS on adverse cannabis outcomes. Higher levels of distress (i.e., depression, anxiety) in those with both chronic pain and elevated PTSS (Rayn et al., 2018) may motivate greater cannabis use to cope, and thereby promote development of heavier and more problematic cannabis use. In future, research might explore a moderated mediation model, with PTSS and chronic pain interacting to predict distress (the mediator), which in turn may contribute to heavy/problematic cannabis use. Such work might identify a mechanism (i.e., heightened distress) to explain how PTSS and chronic pain interact to contribute to adverse cannabis outcomes; this mechanism (i.e., distress) could be targeted in future interventions. Indeed, clinicians working with trauma-exposed patients who experience concurrent chronic pain should adopt an integrated approach that targets both pain interference and PTSS simultaneously. This involves comprehensive assessment, trauma-informed therapies such as Cognitive Behavioral Therapy (CBT), and effective pain management strategies such as physical therapy (Weisfield & Dunleavy, 2020). Moreover, psychoeducation about the risks of heavy cannabis use, alongside regular monitoring and patient-centered care, help ensure the patient is responsive to treatment, ultimately reducing the risk of adverse cannabis outcomes and improving patient well-being (Bell et al., 2024). Given our sample used cannabis at 5x more grams per month compared to the general Canadian population (Statistics Canada, 2020), the implications for clinical practice derived from this study might be most relevant to heavy cannabis users.

Potential limitations of this archival pilot study should be acknowledged. First, the data were cross-sectional, which precludes drawing causal conclusions from this moderation effect; longitudinal research is needed to determine if PTSS and chronic pain interact in predicting escalations in adverse cannabis outcomes over time. Second, we used symptom counts on structured clinical interviews to quantify PTSS and CUD symptoms. Future studies may wish to use established measures assessing PTSD and CUD symptom *severity*, as symptom counts may underestimate effects of interest. Third, our quantification of cannabis use (in grams) did not consider cannabinoid (i.e., THC, CBD) dose or ratio and may not be easily estimated by those using concentrates or edibles. Fourth, our pilot study sample size was relatively small and results should be replicated in a larger sample.

Our pilot findings may have important clinical implications if extended longitudinally. First, chronic pain interference and PTSS were moderately positively correlated, pointing to the importance of clinicians regularly assessing for the other issue among patients presenting with either problem. Second, our modelling suggested individuals with both chronic pain and PTSS are more likely to experience adverse cannabis outcomes. If replicated longitudinally, targeted interventions could be developed to intervene

early or prevent adverse cannabis outcomes in this comorbid PTSS-chronic pain group. Third, individuals seeking treatment for chronic pain or PTSS may not be aware of the elevated risks associated with using cannabis for pain or PTSS management among individuals with both conditions. Prescribers should discuss risks in addition to benefits of cannabis with their patients, prior to prescribing cannabis for those suffering chronic pain and PTSS concurrently. Moreover, for heavy cannabis users such as those in our sample, provision of psychoeducation on such risks (e.g., by family physicians) may be particularly important for patients using cannabis without a prescriber's oversight.

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