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**Pain Intensity and Hazardous Cannabis Use: The Moderating Role of Pain-Related Anxiety**

Victoria E. Carlin1,2, Lisa R. LaRowe3,4 & Joseph W. Ditre1,2

1 Department of Psychology, Syracuse University, Syracuse NY 13244, United States

2 Center for Health Behavior Research & Innovation, Syracuse University, Syracuse NY 13244

3 Mongan Institute Center for Aging and Serious Illness, Division of Palliative Care and Geriatric Medicine, Massachusetts General Hospital, Boston, MA, USA

4 Department of Medicine, Harvard Medical School, Boston, MA, USA

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Author ORCIDs: Victoria Carlin: 0009-0009-5119-1939, Lisa R. LaRowe: 0000-0003-1137-2849, Joseph Ditre: 0000-0002-8914-6908

**Corresponding Author**

Joseph W. Ditre, Ph.D.

Department of Psychology

Syracuse University

Syracuse, NY 13244

(315) 443-1052

jwditre@syr.edu

**Abstract**

Although cannabis has gained attention as a potential treatment for chronic pain, hazardous cannabis use (i.e., patterns of use that have harmful consequences) has been linked to negative health outcomes. Pain intensity is associated with greater cannabis use, and individuals with greater pain-related anxiety may be more likely to respond to pain with substance use. However, no prior work has examined the role of pain-related anxiety in hazardous cannabis use among individuals with chronic pain. The current analyses tested whether pain-related anxiety moderates associations between pain intensity and hazardous cannabis use. Participants included 80 cannabis users with chronic pain (63% male; 67% White; *Mage* = 33.6). Results indicated a positive interaction between pain intensity and pain-related anxiety on hazardous cannabis use (*p* < .05), such that pain intensity was positively associated with hazardous cannabis use among individuals with moderate and high pain-related anxiety, but not those with low pain-related anxiety, suggesting that pain-related anxiety may function as a transdiagnostic vulnerability factor for greater co-occurring pain and hazardous cannabis use. Future work should examine longitudinal associations between pain, pain-related anxiety, and hazardous cannabis use. There may be clinical utility in addressing pain-related anxiety among cannabis users with chronic pain.

*Keywords: Pain; Chronic pain; Cannabis; Pain-related anxiety*

**Pain Intensity and Hazardous Cannabis Use: The Moderating Role of Pain-Related Anxiety**

Chronic pain, or pain that persists more than 3 months (1), affects 1 in 5 adults in the United States (2) and incurs approximately $600 billion in healthcare spending and lost productivity annually (3). Cannabis has increasingly garnered interest as a potential treatment for chronic pain, and cannabis use has increased in popularity across the United States. A growing body of research supports the utility of cannabis for pain relief (4–7), and pain relief has been identified as a primary motive for cannabis use (8,9). In the empirical literature, cannabis use is conceptualized along a continuum—from problematic or hazardous use to of the presence of cannabis use disorder—with studies often relying on cutoff scores to demarcate levels of risk. However, for the purposes of this study, we employ the term "hazardous cannabis use" to describe patterns of consumption that elevate the likelihood of adverse health and social outcomes, as quantified by scores on measures such as the Cannabis Use Disorders Identification Test (CUDIT; 10). Notably, hazardous cannabis use has been associated with a variety of detrimental health outcomes, including adverse psychiatric, cognitive, respiratory, and cardiovascular effects (11,12), highlighting the importance of elucidating correlates of hazardous cannabis use among individuals with chronic pain.

A reciprocal model of pain and substance use proposes that pain and cannabis use interact in a negative feedback loop, leading to greater pain and more hazardous cannabis use over time (13). Consistent with this perspective, individuals with chronic pain are nearly twice as likely to use cannabis in comparison to the general population (14). In addition, individuals with chronic pain are more likely to meet the diagnostic criteria for cannabis use disorder (15) and engage in heavier and more hazardous patterns of use (8).

The reciprocal model further highlights the importance of transdiagnostic vulnerability factors that may augment and perpetuate pain-substance use relations (13). One such factor is pain-related anxiety (i.e., tendency to respond to pain with anxiety or fear; 16), which has been shown to play a role in tobacco (17–21), alcohol (22–24), and opioid use (25) among individuals with chronic pain, and has been linked to coping and conformity cannabis use motives among young adult cannabis users (26). Moreover, it has been hypothesized that pain-related anxiety can amplify the propensity to escape and avoid pain through substance use (20). Prior work demonstrating that pain intensity is positively associated with motivation for alcohol use among individuals with high, but not low, pain-related anxiety provides initial support for this hypothesis (27). However, we are not aware of prior research examining pain-related anxiety as a moderator of associations between pain intensity and hazardous cannabis use among individuals with chronic pain.

The goal of the current analyses was to test pain-related anxiety as a moderator of associations between pain intensity and hazardous cannabis use among individuals with chronic pain. Specifically, we hypothesized that associations between pain intensity and hazardous cannabis use would be stronger among individuals with higher levels of pain-related anxiety.

**Method**

**Participants**

Participants were recruited and screened for an online survey about pain and substance use (28) through Amazon’s Mechanical Turk (MTurk), which has increasingly been used in substance use and behavioral health research (29). Prior work has shown that the accuracy and representativeness of data collected from MTurk samples are similar to that of traditional participant pools (e.g., universities; 30,31). MTurk provides a platform in which requesters may access and compensate respondents who complete online tasks, known as human intelligence tasks (HITs). To be included in the study, participants had to report current chronic musculoskeletal pain and past-month alcohol use. Participants were excluded if they were less than 21 years old, resided outside the United States, or responded incorrectly to a response accuracy check (“To monitor quality, please respond with a two for this item”). A total of 273 participants were enrolled, and current analyses were limited to 80 participants who reported any cannabis use in the past 6 months, and who provided complete data for all measures used in the analyses. All study procedures were approved by the Syracuse University IRB.

**Measures**

***Pain Intensity*.** The characteristic pain intensity scale of the Graded Chronic Pain Scale (GCPS-CPI; 32) assesses pain intensity using 3 items, which measure current pain, worst pain in past 3 months, and average pain in past 3 months. Items were scored on a scale ranging from 0 (no pain) to 10 (pain as bad as could be), and summed to generate a composite score ranging from 0-30.

***Pain-related anxiety****.* The Pain Anxiety Symptom Scale-20 item version (PASS; 16) assesses the extent to which an individual tends to respond to pain with anxiety or fear. This measure indexes cognitive anxiety symptoms, (i.e., “I can’t think straight when I’m in pain”), escape/avoidance (i.e., “I avoid important activities when I am hurt”), fearful thoughts (i.e., “when I feel pain, I am afraid that something terrible will happen”) and physiological anxiety symptoms (i.e., “pain seems to cause my heart to pound or race”). Items were rated on a scale of 0 (never) to 5 (always) and summed to generate a total score ranging from 0 – 100, with higher values indicating more pain-related anxiety.

***Cannabis Use*.** The Cannabis Use Disorder Identification Test (CUDIT; 10) is a self-report instrument that quantifies patterns and consequences of cannabis use, with higher scores reflecting an increasing likelihood of hazardous cannabis use (10). It measures dimensions such as patterns of consumption (i.e., “how often do you use cannabis” and “how many hours were you “stoned” on a typical day when you had been using cannabis”), dependence (i.e., “how often did you find that you were not able to stop using cannabis once you had started”) and negative cannabis-related consequences (i.e., “how often did you fail to do what was normally expected of you because of using cannabis”). It includes 8 items, which were rated from 0 – 4 and summed to generate a total score of 0 – 32, with higher scores indicating more hazardous cannabis use. An established clinical threshold of CUDIT total scores ≥ 13 was used to indicate elevated risk for cannabis use disorder (CUD; 10).

***Alcohol Consumption.***The consumption subscale of the Alcohol Use Disorders Identification Test (AUDIT-C; 33) includes 3 items that measure frequency of alcohol consumption, typical number of drinks consumed and frequency of binge drinking, quantified as 6 or more drinks on one occasion. Items are assigned a score from 0 – 4 and summed to generate a composite score from 0-12, with higher values denoting more alcohol consumption.

***General Anxiety****.* Generalized anxiety symptoms were assessed using the 2-item Generalized Anxiety Disorder scale (GAD-2; 34). The GAD-2 measures anxiety symptoms over the past 2 weeks. Questions are scored from 0 (not at all) to 3 (nearly every day) and are summed to generate a total score ranging from 0 – 6. This measure has been validated as an effective brief screening of anxiety severity in clinical settings (35,36) including among individuals with chronic pain (37).

**Data Analytic Plan**

All analyses were conducted using SPSS Statistics Version 27. Descriptive statistics and demographic information were examined to characterize the sample. A hierarchical linear regression model was conducted to test the interaction between pain intensity and pain-related anxiety on CUDIT score. The model included AUDIT-Consumption and GAD-2 scores as covariates given known associations with cannabis use and pain-related anxiety (38,39). Variables were entered in the following order: step 1 (covariates); step 2 (GCPS-CPI, PASS-20); step 3 (GCPS-CPI x PASS-20). The interaction was probed by testing the conditional effects of pain intensity at each level of pain-related anxiety using the PROCESS macro (40). Associations were probed at low, moderate, and high levels of the moderator (16th, 50th and 84th percentiles), which is consistent with recommendations (40).

**Results**

**Participant Characteristics**

Participants included 80 adults who endorsed past 6-month cannabis use (63% male; 67% White; *Mage* = 33.6). Participants reported moderate to high levels of pain intensity (*M*GCPS-CPI = 18.48, *SD* = 4.96), and endorsed moderate levels of pain-related anxiety (*M*PASS-20 = 53.04, *SD* = 22.74). Back pain was reported by 28.7% (*N* = 23) of participants as their primary pain location, followed by legs (13.8%, *N* = 11), neck (11.3%, *N* = 9), shoulders (10.0%, *N* = 8), head (10.0%, *N* = 8), feet (6.3%, *N* = 5), and widespread pain (5.0%, *N* = 4). Prescription pain medication was used by participants, including nonsteroidal anti-inflammatory drugs (30.0%, *N* = 24), pain relievers such as aspirin or acetaminophen (32.5%, *N* = 26), opioids (25.0%, *N* = 20), and topical treatments (15.0%, *N* = 12). In terms of frequency of cannabis use, 28% used cannabis monthly or less (*N* = 23), 15% used it 2-4 times per month (*N* = 12), 20% used it 2-3 times per week (*N =* 15), and 37% used it 4 times a week or more (*N =* 30). As indicated by a CUDIT score of 13 or above, 40.0% of participants (*N* = 32) scored above threshold for probable Cannabis Use Disorder (CUD).

**Bivariate Correlations**

Table 2 displays bivariate correlations among variables of interest. CUDIT scores were positively associated with both GCPS-CPI scores (*r* = 0.329, *p* = 0.003) and PASS-20 scores (*r* = 0.279, *p* = 0.012). Likewise, GCPS-CPI score and PASS-20 scores were positively correlated (*r* = 0.543, *p* < 0.001).

**Interaction between Pain Severity and Pain-Related Anxiety on CUDIT Score**

Pain-related anxiety moderated the association between GCPS-CPI scores and CUDIT scores (Step 3; *β* = 1.102, *p* = 0.047). Conditional analyses revealed that GCPS-CPI scores were positively associated with CUDIT scores among individuals who had moderate (*b =* 0.405, *SE* = 0.189, *p* = 0.036) and high (*b =* 0.653, *SE* = 0.233, *p* = 0.006) PASS-20 scores. GCPS-CPI scores were not significantly associated with CUDIT scores among those with low PASS-20 scores (*b = -*0.071, *SE* = 0.292 *p* = 0.808; see Table 3).

**Discussion**

This study examined pain-related anxiety as a moderator of associations between pain intensity and hazardous cannabis use among past 6-month cannabis users with chronic pain. Consistent with prior work (6,8,14,15), pain intensity was positively associated with hazardous cannabis use. Results further indicated that pain-related anxiety moderated associations between pain intensity and hazardous cannabis use. Specifically, pain intensity was positively associated with hazardous cannabis use among individuals who endorsed moderate and high pain-related anxiety, but not among individuals who endorsed low pain-related anxiety. These findings contribute to a growing literature suggesting that pain-related anxiety plays an important role in substance use among individuals with chronic pain (17–19,21–25,27).

The fear-avoidance model of chronic pain posits that fear of painful sensations leads individuals to engage in pain avoidance strategies, which may become maladaptive (41). Consistent with this perspective, results indicated a positive link between pain intensity and hazardous cannabis use among individuals with moderate to high pain-related anxiety. It is possible that pain-related anxiety amplifies this relationship, such that individuals with greater pain intensity and a propensity to engage in maladaptive pain-coping strategies engage in more hazardous cannabis use, leading to even greater pain and perpetuating the vicious cycle of pain and cannabis use. Thus, it is important to consider pain-related anxiety as a modifiable factor that contributes to associations between pain and hazardous cannabis use.

Interestingly, although pain intensity and pain-related anxiety were both positively associated with hazardous cannabis use in unadjusted models, our adjusted hierarchical linear regression model indicated no significant associations. Prior research has found direct associations between both pain intensity and pain-related anxiety on cannabis use outcomes (8,15,26). In contrast, the current results suggest that the interaction between pain intensity and pain-related anxiety, rather than the individual effect of each construct, may be more important for understanding hazardous cannabis use.

Future work should consider the potential clinical utility of addressing pain-related anxiety among individuals with chronic pain and who use cannabis. Treatments such as Acceptance and Commitment Therapy and graded in vivo exposure have been shown to successfully reduce pain-related anxiety among individuals with chronic pain (42). Likewise, individuals with chronic pain, particularly those high in pain-related anxiety, may benefit from pain-coping skills training that encourage healthy coping strategies (43), rather than cannabis use, to manage pain. These approaches can be tailored for individuals with chronic pain who engage in hazardous cannabis use using approaches such as personalized feedback interventions [(i.e.](https://www.zotero.org/google-docs/?mlS7s2) 44).

Several important limitations should be noted. First, the cross-sectional nature of the data precludes any causal inferences. Future research should examine temporal associations between pain, pain-related anxiety, and cannabis use. Second, this analysis focuses on hazardous cannabis use. Future studies should investigate the role of cannabis use motives, expectancies, and perceptions regarding pain-cannabis interrelations (45,46). Third, the current study did not assess which cannabis products were preferred by participants, and previous research has shown variability in dependence and negative consequences as a function of preferred cannabis product (47–49). Further research would benefit from examining whether pain, pain-related anxiety or CUDIT score vary as a function of preferred cannabis product. Fourth, the current sample consists of past month drinkers, so alcohol consumption, as indicated by the Alcohol Use Disorder Identification Test, Consumption score (33), was included as a covariate in the present analyses, as previous research has identified positive associations between heaviness of alcohol and cannabis consumption (50). Cannabis and alcohol use commonly co-occur, as estimates suggest that more than 70% of past month cannabis users also endorse past month drinking (51). Future research may benefit from examining covariation between past and current patterns of alcohol and cannabis consumption, particularly in the context of chronic pain. Fifth, although generalized anxiety was included as a covariate in the present analysis, the degree to which other types of anxiety (e.g., social anxiety, specific phobias) may contribute to maladaptive behaviors such as hazardous patterns of cannabis use remains unclear. Further research would benefit from examining the relative contribution of multiple sources of anxiety in the onset and persistence of hazardous cannabis use patterns. Sixth, the present analysis includes individuals who engage in both medical and recreational cannabis use. Although recent estimates suggest that up to 80% of medicinal users endorse concurrent recreational use (52,53), future research should examine whether pain-related anxiety is uniquely associated with medical versus recreational patterns of use. Future research should also examine relations between pain-related anxiety and cannabis use in other contexts, including non-drinkers and among individuals without chronic pain. Likewise, future research should explore relations between pain-related anxiety and co-use of cannabis and other substances, such as alcohol or tobacco, in the context of chronic pain.

Disclosures: The authors report there are no competing interests to declare.

Data availability: The data that support the findings of this study are available from the corresponding author, J.W.D., upon reasonable request.

**Table 1**. Sociodemographic, cannabis use, and pain characteristics

|  |  |
| --- | --- |
|  | Total (*N =* 80) |
|  | *n* (%) |
| **Gender** |  |
| **Female** | 30 (37.0%) |
| **Race** |  |
| **White** | 54 (66.7%) |
| **Black or African American** | 14 (17.5%) |
| **American Indian/Alaska Native** | 2 (2.5%) |
| **Asian** | 7 (8.8%) |
| **Other** | 3 (3.8%) |
| **Ethnicity** |  |
| **Hispanic** | 18 (22.5%) |
| **Income** |  |
| **< $10,000** | 4 (5.0%) |
| **$10,000 - $25,000** | 14 (17.3%) |
| **$25,000 - $50,000** | 36 (45.0%) |
| **$50,000 - $75,000** | 16 (20.0%) |
| **$75,000 - $100,000** | 5 (6.2%) |
| **> $100,000** | 5 (6.2%) |
| **Education** |  |
| **High school graduate/GED or less** | 7 (8.6%) |
| **Some college** | 16 (19.8%) |
| **Technical school/Associate’s degree** | 14 (17.3%) |
| **4-year college degree** | 37 (45.7%) |
| **School beyond 4-year college degree** | 7 (8.6%) |
| **Cannabis Use Frequency** |  |
| **Monthly or less** | 23 (28.7%) |
| **2-4 times per month** | 12 (15.0%) |
| **2-3 times per week** | 15 (18.8%) |
| **4+ times per week** | 30 (37.5%) |
| **Medical Cannabis Prescription** | 25 (31.3%) |
| **CUDIT Threshold for Cannabis Use Disorder**  **risk a** | 32 (40.0%) |
|  | *M* (*SD*) |
| **Age** | 33.60 (9.86) |
| **AUDIT-Consumption Score** | 4.99 (2.54) |
| **Anxiety b** | 4.33 (1.95) |
| **Characteristic pain intensity c** | 18.48 (4.96) |
| **CUDIT Score d** | 10.65 (7.61) |
| **Cannabis use per day e** | 3.71 (6.57) |
| **Pain-related anxiety f** | 53.04 (22.74) |

*Note.*; a Cannabis Use Disorder Identification Test scores ≥ 13 Clinical threshold indicating elevated risk for Cannabis Use Disorder; b Generalized Anxiety Disorder scale – 2item; c Graded Chronic Pain Scale - Characteristic Pain Intensity Subscale; d Cannabis use disorder Identification Test; e Average times used cannabis per day in past week; f Pain Anxiety Symptoms Scale – 20 item

**Table 2.** Bivariate correlations between variables of interest.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variable** | 1 | 2 | 3 | 4 | 5 |
| **1. GCPS-CPI a** | -- |  |  |  |  |
| **2. PASS-20 b** | .543\*\* | -- |  |  |  |
| **3. CUDIT-R c** | .329\*\* | .279\* | -- |  |  |
| **4. AUDIT-C d** | .042 | -.012 | .156 | -- |  |
| **5. Anxiety e** | .217 | .453\*\* | .238\* | .034 | -- |

*Note.* a Graded Chronic Pain Scale, characteristic pain intensity sub-score; b Pain Anxiety Symptom Scale – 20 items; c Cannabis use disorder Identification Test; d Alcohol Use Disorder Identification Test, Consumption sub-score; e Anxiety subscale of the 4-item Patient Health Questionnaire; \**p* < .05, \*\**p* < .01.

**Table 3.** Linear regression model of effects of pain intensity and pain-related anxiety on CUDIT score among past 6-month cannabis users.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***CUDIT Score*** | | | | | |
|  | ***β*** | ***t*** | ***p*** | ***ΔR2*** | ***p* *for ΔR2*** |
| **Step 1** |  |  |  | .078 | .043\* |
| AUDIT-C a | .148 | 1.35 | .181 |  |  |
| Anxiety b | .233 | 2.125 | .037\* |  |  |
| **Step 2** |  |  |  | .082 | .031\* |
| Pain Intensity c | .248 | 1.962 | .053 |  |  |
| Pain-Related Anxiety d | .081 | .586 | .560 |  |  |
| **Step 3** |  |  |  | .044 | .047\* |
| Pain Intensity \* Pain-Related Anxiety | 1.102 | 2.023 | .047\* |  |  |

*Note.* a Alcohol Use Disorder Identification Test, Consumption subscore; b Anxiety subscale of the 4-item Patient Health Questionnaire; c Graded Chronic Pain Scale, characteristic pain intensity subscore; d Pain Anxiety Symptom Scale – 20 items; \**p* < 0.05.

**Figure 1**. Conditional Effects of Pain Intensity on Hazardous Cannabis Use

**Fig 1.** Conditional effects of pain-related anxiety on associations between pain intensity and CUDIT score. *Note:* Pain intensity – Graded Chronic Pain Scale, Characteristic Pain Intensity; Pain-related anxiety – Pain anxiety symptoms scale – 20; Levels of pain-related anxiety include 16th, 50th, and 84th percentiles; Conditional effects: Low (*b* = -0.0710, *SE* = 0.292, *p* = 0.808), Moderate (*b* = 0.405, *SE* = 0.189, *p* = 0.036), High (*b* = 0.653, *SE* = 0.233, *p* = 0.006).

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