

Posttraumatic Stress and Distress Tolerance in Relation to Opioid Misuse and Dependence
Among Trauma-exposed Adults with Chronic Pain

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ABSTRACT

Posttraumatic stress symptoms have been associated with opioid misuse and dependence among adults with chronic pain. Lower levels of distress tolerance have been independently associated with posttraumatic stress symptoms and opioid-related problems among non-chronic pain samples. However, there has not been a test of whether distress tolerance moderates the relation between posttraumatic stress and opioid misuse among trauma exposed persons with chronic pain. Therefore, the present study examined the moderating role of perceived distress tolerance in the relationship between posttraumatic stress symptoms and opioid misuse and dependence among trauma-exposed adults with chronic pain who were using opioids ($N = 289$; 70.9% female, $M_{\text{age}} = 37.75$, $SD = 10.83$). In partial contrast to expectation, results indicated that posttraumatic stress was statistically significantly related to current opioid misuse and opioid dependence for individuals with both lower and higher levels of perceived distress tolerance. Other analyses indicated that posttraumatic stress was statistically significantly related to number of opioids used to get high in the past month for individuals with only lower levels of perceived distress tolerance. The current findings help refine our understanding of the subgroups of persons distinguished by distress tolerance with chronic pain using opioids at greatest risk for misusing opioids. Current models of chronic pain and opioid misuse could be refined by integrating distress tolerance as a moderator individual difference factor, but also considering both ends of the dimensional variability continuum for the construct (i.e., low, and high levels of the construct). These findings could help identify subgroups of trauma exposed persons with chronic pain who may be at greater risk for opioid misuse.

Keywords: distress tolerance, posttraumatic stress, chronic pain, opioid misuse

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INTRODUCTION

The rising rate of opioid misuse and dependence has been documented as a key contributor to the number of drug overdose deaths in the United States and labeled a public health crisis (Rudd, Aleshire, Zibbell, & Gladden, 2016; Saloner et al., 2018). Beyond overdose-related deaths, opioid misuse is related to other negative health consequences, including physical health disorders (Papaleontiou et al., 2010), pain-related impairment (Garland, Froeliger, Zeidan, Partin, & Howard, 2013), negative mood (Rogers, Zvolensky, Ditre, Buckner, & Asmundson, in press), and economic burden (Degenhardt et al., 2014). Given the precedent of treating pain and pain-related conditions with prescription opioids, this population is at an increased risk for opioid misuse and dependence (Busse et al., 2013; Chou et al., 2015; Vowles et al., 2015). In fact, estimates suggest that at least 25% of adults with chronic pain misuse opioids (Vowles et al., 2015). Importantly, research demonstrates that opioids only show a small (positive) impact on chronic pain and physical functioning when compared to placebo while showing similar effects to other medications, such as nonsteroidal anti-inflammatory drugs (Busse et al., 2018). However, opioid-based treatments have historically been a first-round treatment option for pain management, despite research demonstrating the low efficacy of opioid-based treatments for chronic pain and long-term use (Busse et al., 2018; Chou et al., 2020). Further, greater severity of pain is related to higher levels of opioid misuse (Novak, Bluthenthal, Wenger, Chu, & Kral, 2016) and dependence (Blanco et al., 2016).

Among adults with chronic pain, it is important to identify subgroups at greater risk for opioid misuse and dependence (Andersen, Andersen, Zebis, & Sjøgaard, 2014). One subgroup of adults with chronic pain that may be at increased risk for opioid misuse and dependence is trauma exposed individuals experiencing posttraumatic stress symptoms, as chronic pain and

posttraumatic stress are highly comorbid (Andersen, Andersen, Vakkala, & Elklit, 2012). Research has demonstrated that the co-occurrence of chronic pain and posttraumatic stress symptoms is associated with increased pain-related problems (e.g., pain intensity) and functional impairment, as well as decreased quality of life (Akerblom, Perrin, Fischer, & McCracken, 2017; Outcalt et al., 2015; Ruiz-Párraga & López-Martínez, 2014). It is theorized that co-occurring posttraumatic stress symptoms and chronic pain may contribute to cyclical symptom exacerbation and may be mutually maintained via several shared pathways, including attentional biases to pain and threat, avoidant styles of emotional coping, and heightened anxiety sensitivity (i.e., fear of anxiety-related sensations; Brennstuhl, Tarquinio, & Montel, 2015; Sharp & Harvey, 2001). Furthermore, the mutual-maintenance model suggests posttraumatic stress and chronic pain conditions may influence each other in a way that exacerbates symptoms (Sharp and Harvey, 2001), which may result in a cycle of perpetuating distress and an increased likelihood of using opioids to cope with pain and distress (Asmundson and Katz, 2009).

In the general population, rates of trauma exposure and posttraumatic stress are elevated among opioid users, and posttraumatic stress is associated with opioid-related problems (Danovitch, 2016; Ecker & Hundt, 2018). A recent review by Santo and colleagues (2022) found that among individuals who use opioids, 18% of individuals experience co-occurring posttraumatic stress disorder (PTSD), which is disproportionately elevated compared to the general population (Mills et al., 2005). Furthermore, individuals with PTSD are more likely to use opioids for non-medical purposes (Smith et al., 2016). Despite robust associations between posttraumatic stress and substance use among persons with chronic pain, not all individuals with posttraumatic stress engage in opioid misuse (Couto, Romney, Leider, Sharma, & Goldfarb, 2009; Hassan, Foll, Imtiaz Rehm, 2017; Smith, Smith, Cercone, McKee, & Homish, 2016). Such

heterogeneity in substance use behavior underscores the need to advance understanding of malleable individual difference factors, particularly at the psychological level of analysis, that may influence posttraumatic stress-opioid misuse among persons with chronic pain. This line of inquiry has the potential to inform specialized, person-centered approaches to treatment because subgroups can be identified and thereafter targeted for intervention programming (Vujanovic, McGrew, Walton, & Raines, 2022).

Distress tolerance, reflecting the perceived and behavioral capacity to withstand distress related to affective, cognitive, and/or physical states (Simons, & Gaher, 2005; Zvolensky, Bernstein, & Vujanovic, 2011), is a transdiagnostic factor that is related to both more severe pain (Bakhshaie et al., 2021), posttraumatic stress (Akbari, Hosseini, Seydavi, Zegel, Zvolensky, & Vujanovic, 2021), and substance use behavior (Zegel, Rogers, Vujanovic, & Zvolensky, 2021) across a range of populations (Zvolensky et al., 2011). Distress tolerance is typically assessed through self-report or behavioral measures, with self-report measures believed to capture perceived ability to tolerate negative states and behavioral measures believed to capture the behavioral capacity to tolerate negative states (Simons & Gaher, 2005; Zvolensky et al., 2011). Research suggests that perceived and behavioral distress tolerance are empirically different and capture separate and distinct aspects of distress tolerance (Bernstein, Marshall, & Zvolensky, 2011; McHugh et al., 2011).

Of the work thus far completed, research supports an association between decreased perceived distress tolerance and increased pain experience and pain interference (Rogers et al., 2018; Rogers, Garrey, Allan, & Zvolensky, 2021), as well as decreased perceived distress tolerance and increased opioid misuse among adults with chronic pain (McHugh et al., 2016). Behavioral distress tolerance was not associated with opioid dependence in a recent study of

patients in residential substance use disorder treatment (Tull et al., 2020). However, in this same study, there was an interaction with gender, such that men with current opioid dependence exhibited significantly lower levels of behavioral distress tolerance (Tull et al., 2020).

The relationship between posttraumatic stress and distress tolerance is more well-documented. A recent meta-analysis review of 56 studies of this literature found consistent associations between distress tolerance and posttraumatic stress symptom severity, such that lower distress tolerance was associated with higher PTSD symptom severity and vice versa (Akhari et al., 2021). Additionally, this association was significantly more robust (i.e., larger effect sizes) in studies that used self-reported (i.e., perceived) distress tolerance compared to behavioral (i.e., observed) distress tolerance (Akhari et al., 2021). Within the larger body of comorbid PTSD and substance use disorder research, perceived distress tolerance has been negatively associated with posttraumatic stress symptoms in adults with cocaine dependence and alcohol use problems (Vujanovic, Rathnayaka, Amador, & Schmitz, 2016; Zegel et al., 2021).

There are no studies that have evaluated distress tolerance (either perceived or observed) as a moderating factor in relations between posttraumatic stress and opioid misuse among trauma exposed persons with chronic pain. Consistent with the coping with distress and self-medication hypothesis, greater posttraumatic stress symptom severity and lower distress tolerance among adults with chronic pain may be related to increased risk for opioid use to down-regulate aversive emotional or physical states (Danovitch, 2016). Individuals reporting pain often experience negative emotions, which in the context of lesser ability to tolerate these negative emotions, may be related to increased pain experience and increased likelihood of using opioids to manage pain or emotional distress (Asmundson et al., 2011). Additionally, since posttraumatic stress symptom severity is associated with lower distress tolerance (Marshall-Berenz, Vujanovic,

Bonn-Miller, Bernstein, & Zvolensky, 2010; Vujanovic, Bonn-Miller, Potter, Marshall, & Zvolensky, 2011), and lower distress tolerance has been found to account for substance use motives among trauma-exposed individuals with PTSD symptoms (Potter, Vujanovic, Marshall-Berenz, Bernstein, & Bonn-Miller, 2011; Vujanovic et al., 2011), individuals with chronic pain with lower distress tolerance and co-occurring posttraumatic stress symptoms may have a greater tendency to misuse opioids for coping-oriented reasons and be at higher risk for dependence.

The current study tested whether distress tolerance moderated the relationship between posttraumatic stress symptoms and negative opioid misuse among trauma-exposed adults with chronic pain. It was hypothesized that among those trauma exposed persons with chronic pain experiencing greater levels of posttraumatic stress, lower levels of distress tolerance would be associated with greater number of opioids used, opioid misuse, and opioid dependence. We adjusted for variables that have been shown to covary with chronic pain and opioid related problems, including age (Cleland, Rosenblum, Fong, & Maxwell, 2011), gender (Serdarevic, Striley, & Cottler, 2017), total number of experienced traumatic events (i.e., trauma load; Rogers et al., 2018), and pain intensity (Vowles et al., 2015).

METHOD

Participants

Participants were 289 trauma-exposed adults (70.9% female, $M_{\text{age}} = 37.75$, $SD = 10.83$) reporting chronic pain and prescription opioid use. Eligible participants were between 18-64 years of age, self-reported persistent (at least three months) current moderate to severe chronic pain, current use of opioid pain medication, and reported experiencing at least one traumatic event (e.g., experiencing a natural disaster, vehicular accident, physical/sexual assault; Posttraumatic Diagnostic Scale for *DSM-5*). Participants were excluded if they were younger

than 18 years, a non-English speaker (to ensure comprehension of the study questions), or were unable to provide informed, voluntary, written consent to participate.

Most of the sample was non-Hispanic/Latino White (79.2%), with 12.5% identifying as Hispanic/Latino, 8.0% Black/African American, 3.8% Native American/Alaska Native, 3.5% multiracial, 0.7% Asian/Pacific Islander, and 1.0% other. In terms of education, 42.3% reported attaining an associate degree or higher, 29.1% reported earning high school diploma, 22.5% reported “some college,” and the remaining 6.3% reported having not completed high school. The median income bracket fell within the range of \$35,999 to \$49,999. Regarding trauma exposure, 41.2% of the sample reported experiencing a transportation accident, 37.4% reported sexual assault, 34.6% reported physical assault, 33.9% reported life-threatening illness, 26.0% reported child abuse, 22.1% reported natural disaster, and 8.3% reported military or combat zone trauma. Further, 57.4% of the current sample experienced at least two traumatic events.

Measures

Demographics Questionnaire. Demographic information including gender, race, age, education level, employment status, income, and marital status was collected.

Graded Chronic Pain Scale. The Graded Chronic Pain Scale (GCPS) is an 8-item measure of self-reported pain intensity and disability with good validity and reliability (Von Korff, Ormel, Keefe, & Dworkin, 1992). The three characteristic pain intensity items are rated on an 11-point scale from 0 (*No pain*) to 10 (*Pain as bad as could be*) and was used as a covariate ($\alpha = .82$).

Current Opioid Misuse Measure. The Current Opioid Misuse Measure (COMM) is a 17-item questionnaire designed to detect opioid misuse among chronic pain patients on opioid therapy (Butler et al., 2007). The COMM assesses aberrant opioid use behavior as well as

associated psychiatric symptoms (Rogers, Gallagher, Jamison, & Zvolensky, 2020). Items are rated on a 5-point Likert scale from 0 (*never*) to 4 (*very often*). Test-retest reliability has been established and construct validity was demonstrated via positive correlations with urine toxicology results among opioid-using adults with chronic pain (Butler et al., 2007; Wasan et al., 2007). The COMM was used as a criterion variable in the current study and demonstrated strong internal consistency ($\alpha = .97$).

Severity of Dependence Scale. The Severity of Dependence Scale (SDS) is a 5-item measure that assesses the severity of dependence and been validated for opioid use (Gossop et al., 1995). In the current study, responses were anchored to problems specifically associated with opioid use. Item are rated on a 4-point scale from 0 (*never or almost never*) to 3 (*always or almost always*), yielding a total score of 0-15 with higher scores reflecting higher levels of opioid dependence (Castillo et al., 2010). The SDS was used as a criterion variable and demonstrated good internal consistency ($\alpha = .86$).

Number of Opioids. The number of opioids used to get high in the past month was assessed using the Self-Report Opioid Analgesic Questionnaire (Smith, Rosenblum, Parrino, Fong, & Colucci, 2010). Participants were shown a list of opioids (e.g., buprenorphine, fentanyl, heroin), and asked to indicate which, if any, were used to for intoxication purposes in the past month. The reported number of opioids used in the past month was summed to create an index of total number of opioids (range = 0-15) which was used as a criterion variable.

Posttraumatic Diagnostic Scale for DSM-5. The Posttraumatic Diagnostic Scale for DSM-5 (PDS-5) is a 24-item measure of PTSD symptom severity (Foa et al., 2016). The measure is comprised of four sections including, a traumatic event checklist, identification of most distressing event, assessment of PTSD symptoms, and interference of reported symptoms. The

total score is calculated from 20 items based on the DSM-5 symptom clusters, which are rated on a 5-point scale from 0 (not at all) to 4 (6 or more times a week/severe). The PDS-5 yields a total score (range 0-80), where a score of 28 indicates probable PTSD (Foa et al., 2016). Exposure to potentially traumatic event(s) was an inclusion criterion, the number of traumatic event types endorsed was included as a covariate, and probable PTSD (dichotomous) was included for descriptive purposes in this study. The PDS-5 total score was used in the current study as a predictor and demonstrated strong internal consistency ($\alpha = .97$).

Distress Tolerance Scale. The Distress Tolerance Scale (DTS) is a self-report measure that evaluates the extent to which respondents perceive/believe they can experience and withstand distressing emotional states. Items are rated on a 5-point scale from 1 (*strongly agree*) to 5 (*strongly disagree*). The 14-item version, employed in extant research (e.g., Leyro, Bernstein, Vujanovic, McLeish, & Zvolensky, 2011; Veilleux et al., 2018), has a total summed score ranging from 14 to 70, with higher values indicating greater levels of distress tolerance (i.e., greater perceived ability to withstand negative emotion). The DTS demonstrates good psychometric properties (Simons & Gaher, 2005). The DTS total score was used as a predictor and moderator variable in the present study ($\alpha = 0.94$).

Procedure

Participants were recruited nationally through Qualtrics, an online survey management system, that has been founded to yield valid and representative data in substance use research (Smit et al., 2019; Zvolensky et al., 2019). Adults with a Qualtrics Panels account that endorsed moderate to severe chronic pain and current use of opioid pain medication were sent a notification for the current survey. Respondents were screened for eligibility (“Have you had chronic pain (pain that is present most days or every day) over the past 3 months?”; “Are

you using opioid pain medication?”) and directed to the online anonymous survey. Participants provided informed consent prior to completing the survey, which took approximately 30 minutes. To ensure valid responses, a speeding check was included – measured as one-half the median survey completion time (15.2 minutes) – to screen out those who were not responding thoughtfully. Five hundred and forty-one participants provided informed consent prior to completing the 30-minute survey, and 429 completed the survey. Data quality was screened and verified by Qualtrics staff. All participants were recruited and completed the survey in March 2018. Participants were compensated \$4.20 for their participation and the study protocol was approved by the Institutional Review Board at the sponsoring institution.

Analytic Strategy

First, sample descriptive statistics and zero-order correlations among study variables were examined. Second, to test the main and interactive effects of posttraumatic stress and distress tolerance on the criterion variables, three moderation analyses were conducted in SPSS version 26 using the PROCESS macro (Hayes & Preacher, 2013). Specifically, three-step hierarchical regression analyses were conducted for current opioid misuse and severity of opioid dependence. In each model, the first step included the following covariates: age (Cleland, Rosenblum, Fong, & Maxwell, 2011), gender (Serdarevic, Striley, & Cottler, 2017), total number of traumatic event types experienced (Rogers et al., 2018), and pain intensity (Vowles et al., 2015). Posttraumatic stress and perceived distress tolerance were then entered in the second step and an interaction term between posttraumatic stress and distress tolerance was entered in the third step. All continuous criterion variables were mean-centered (Aiken, West, & Reno, 1991, pages 30-40). Simple slope post-hoc analyses to probe significant

interactions were examined at levels of the moderator [1 SD below and above the mean] (Holmbeck, 2002). Finally, the Johnson-Neyman technique was used to identify significant transition points for the moderator (perceived distress tolerance), whereby the relationship between the predictor variable and dependent variable transitions from non-significant to significant (Bauer & Curran, 2005; Spiller, Fitzsimons, Lynch Jr, & McClelland, 2013) and signifies the value of a continuous moderator variable at which the regression slope for the predictor is significantly different from zero (Preacher, Curran, & Bauer, 2006).

Investigation of the structure of the composite score of the number of opioids used to get high in the past month showed most of the sample (60%) denied any past-month use of opioids to get high. Examination of the mean and variance of this outcome revealed overdispersion (i.e., variance larger than the mean); thus, we used a negative binomial regression to further explore the results (Hilbe, 2011). Model fit was determined using χ^2 criteria and an omnibus test of the tested model compared to the intercepts only model.

RESULTS

Bivariate Correlations

Descriptive statistics and zero-order correlations among study variables are presented in Table 1. Of the total sample, 49.1% of individuals met criteria for probable diagnosis of PTSD ($PDS-5 \geq 28$). Posttraumatic stress symptom severity was negatively correlated with perceived distress tolerance ($r = -.63$) and was positively correlated with opioid misuse ($r = .61$), severity of opioid dependence ($r = .49$), and number of opioids ($r = .46$). Perceived distress tolerance was negatively correlated with opioid misuse ($r = -.50$), severity of opioid dependence ($r = -.42$), and number of opioids ($r = -.37$).

Primary Analyses

In terms of current opioid misuse, the first step accounted for a statistically significant amount of variance ($R^2 = .22$, $F(4, 284) = 20.35$, $p < .001$) and age, gender, number of traumas, and pain intensity emerged as statistically significant predictors (see Table 2). At the second step, significant main effects emerged for posttraumatic stress ($B = .31$, $SE = .05$, $p < .001$), and perceived distress tolerance ($B = -.23$, $SE = .07$, $p = .001$), accounting for an additional 24% variance in the full model. The addition of the interaction term between posttraumatic stress and perceived distress tolerance in step three was statistically significant and accounted for an additional 1.4% variance in the full model ($B = -.006$, $SE = .002$, $p = .007$). Simple slope analyses (Figure 1) revealed that posttraumatic stress was statistically significantly related to current opioid misuse for individuals with both low ($B = .38$, $SE = .05$, $p < .001$) and high levels of perceived distress tolerance ($B = .20$, $SE = .06$, $p = .001$). The Johnson-Neyman test revealed that the statistically significant transition point for perceived distress tolerance was 64.91 (89.97% of observations were below this value and the effect of the focal predictor was statistically significant at these values).

For severity of opioid dependence, the first step accounted for a statistically significant amount of variance ($R^2 = .15$, $F(4, 284) = 12.06$, $p < .001$) and age, gender, and pain intensity emerged as statistically significant predictors (see Table 2). In step two, statistically significant main effects emerged for posttraumatic stress ($B = .05$, $SE = .01$, $p < .001$) and perceived distress tolerance ($B = -.05$, $SE = .02$, $p = .004$), accounting for an additional 17% variance. The addition of the interaction term between posttraumatic stress and perceived distress tolerance in step three was statistically significant and accounted for an additional 1.1% variance in the full model ($B = -.001$, $SE = .001$, $p = .031$). Simple slope

analyses (Figure 2) revealed that posttraumatic stress was statistically significantly related to severity of opioid dependence for individuals with both low ($B = .07, SE = .01, p < .001$) and high levels of perceived distress tolerance ($B = .03, SE = .02, p = .036$). The Johnson-Neyman test revealed that the statistically significant transition point for perceived distress tolerance was 57.76 (83.05% of observations were below this value and the effect of the focal predictor was statistically significant at these values).

Post-hoc Analysis

For the number of opioids used for intoxication purposes (versus pain management) in the past month, the negative binomial regression model fit the data well ($\chi^2(285) = 641.03, p < .000$). The overall model was statistically significant (Model $\chi^2(3) = 128.78, p < .001$).

Examination of results revealed that distress tolerance was negatively associated with number of opioids ($B = -.02, SE = .01, 95\% CI = -.04, -.002, \chi^2(1) = 4.65, p = .03$) and PTSD symptom severity was positively associated with number of opioids used ($B = .03, SE = .01, 95\% CI = .009, .04, \chi^2(1) = 9.78, p = .002$). The interaction of PTSD symptom severity and distress tolerance was not statistically significant ($\chi^2(1) = .01, p = .92$).

DISCUSSION

The present study examined whether perceived distress tolerance interacted with posttraumatic stress in terms of opioid misuse and dependence as well as total number of non-prescribed opioids used in a trauma-exposed sample with chronic pain, after accounting for theoretically relevant covariates including age, gender, pain intensity, and number of traumatic event types. As hypothesized, posttraumatic stress was significantly related to the severity of opioid misuse and dependence, as well as the number of opioids used for intoxication in individuals with lower perceived distress tolerance. However, unexpectedly, posttraumatic stress symptoms were also

significantly related to opioid misuse and dependence in individuals with higher perceived distress tolerance. The effect sizes for the interactions were small, as is typically evident for moderating effects (Wilkinson & Task Force on Statistical Inference, 1999). However, all observed interactive effects were evident above and beyond the variance accounted for by covariates and the main effects. Thus, there is apt to be clinical significance to the observed interactive effects (Abelson, 1985).

Results from the current study are, to the best of our knowledge, the first to document that perceived distress tolerance interacts with posttraumatic stress symptoms in terms of opioid-related problems among individuals with trauma exposure and chronic pain. These findings are in line with past work that has found that perceived distress tolerance has been negatively associated with posttraumatic stress symptoms in adults with substance use disorders (Vujanovic, Rathnayaka, Amador, & Schmitz, 2016; Zegel, Rogers, Vujanovic, & Zvolensky, 2021). Yet, the current work also documents that greater opioid misuse and dependence may be evident among individuals with high levels of distress tolerance. That is, the tendency to tolerate very high levels of distress among trauma-exposed persons with chronic pain may be related to a greater risk for opioid use-related problems (Lynch & Mizon, 2011). The current data suggest that theoretical models (e.g., self-medication hypothesis, coping) of opioid misuse for persons with chronic pain and posttraumatic stress may benefit from refinement by denoting the role of both ends of the distress tolerance dimensional variability. Overall, such results suggest that posttraumatic stress symptoms and distress tolerance are important variables among trauma-exposed persons with chronic pain in terms of better understanding opioid use.

Additional analyses focused on examining relations of posttraumatic stress and distress tolerance with number of opioids used for intoxication purposes in the past month. There was no

statistically significant interaction for this criterion variable. However, there were statistically significant main effects for perceived distress tolerance (negative direction) and posttraumatic stress (positive direction). Given that the Self-Reported Opioid Analgesic Abuse questionnaire asks participants to indicate how many of the listed opioids they used “to get high” in the past month, it is possible that some individuals may use their prescribed opioid medications more often than prescribed (i.e., misuse) but not necessarily to “get high.” Though this may not be the most robust measure of opioid misuse, in combination with the other measures of the study, we believe this provides clinically relevant information on opioid use in this population. These results highlight the need to consider the functions of opioid use in future research as it is possible that not all opioid use is the same and therefore distinctions could be made in terms of the motivational basis of use.

Clinically, the results from the current study suggest it may be advisable to assess and perhaps ultimately address both high and low perceived distress tolerance to better manage posttraumatic stress symptoms and opioid related problems in chronic pain populations with trauma exposure. Specifically, it may be clinically important for providers to assess perceived distress tolerance prior to beginning treatment for pain, especially among those with trauma exposure, and to employ specific therapeutic tactics for addressing difficulties with distress tolerance. Indeed, distress tolerance may predict treatment outcomes for individuals with posttraumatic stress and substance use disorders (Vujanovic et al., 2022). For example, individuals with low levels of distress tolerance (i.e., distress intolerance) may benefit from interventions to increase their distress tolerance skills, while individuals with high levels of distress tolerance (i.e., distress over tolerance; Lynch & Mizon, 2011) may benefit from interventions that increase awareness of one’s thoughts, emotions, and behaviors, such as

mindfulness. Dialectical Behaviour Therapy (DBT), which includes mindfulness, emotion regulation, and distress tolerance skills, has been shown to be effective in individuals with substance use and PTSD alone (Harned et al., 2021; Warner & Murphy, 2022), and may be useful treatment modality for this population (Berghoff & Tull, 2019). Furthermore, distress tolerance may predict treatment outcomes for people with posttraumatic stress and substance use (Banducci et al., 2017).

There are several limitations to the present study. First, given the cross-sectional nature of these data, causal or temporal relations cannot be explicated. Future prospective studies are necessary to determine the directional effects distress tolerance and posttraumatic symptom severity for opioid related problems. Second, women comprised most of the sample. Future work involving larger samples of men and diverse people identifying with diverse gender identities is needed to test the utility of the present models more comprehensively across the gender spectrum. Additionally, the national sample identified primarily as non-Latinx and white. Consequently, the results may not generalize to more racially/ethnically diverse populations. Third, the current study did not screen for the presence of PTSD using structured clinical interviews. Thus, future work may benefit from examining the observed associations among clinical samples with PTSD, ascertained via structured interviews. Fourth, we focused on opioid misuse, opioid dependence, and the number of opioids used for intoxication in the current study given that these variables are most frequently employed to index the nature of opioid-related problems (Becker, Sullivan, Tetrault, Desai, & Fiellin, 2008; Brady et al., 2014; Edlund et al., 2010). However, future research could explore other theoretically relevant variables, including opioid withdrawal symptoms, severity of craving, and motives for opioid use to obtain a greater degree of precision in understanding perceived distress tolerance in the opioid epidemic. Fifth,

we did not measure the actual type of opioid use (e.g., type) or treatment history, although all participants were prescribed opioids by virtue of the study inclusion criteria. Finally, we did not have data on the source of pain or pain-specific treatment history. Future research should attempt to provide a more granular measurement of the nature of opioid use and treatment history (e.g., nature, type) as well as pain source (e.g., type of chronic pain problem) and history (e.g., was their chronic pain related to traumatic events).

Together, the current findings provide evidence for the nuanced role of perceived distress tolerance and posttraumatic stress with chronic pain. Results suggest that individuals with posttraumatic stress symptoms, chronic pain, and significantly low, as well as high, levels of distress tolerance may be at increased risk of opioid misuse and dependence. It appears that too much of a good thing (i.e., distress tolerance) may in fact be unhelpful, just as too little may not be helpful enough. Specifically, results indicated that posttraumatic stress was statistically significantly related to current opioid misuse and opioid dependence for individuals with both lower and higher levels of perceived distress tolerance. These findings could help identify subgroups of trauma-exposed persons with chronic pain who may engage in greater opioid misuse.

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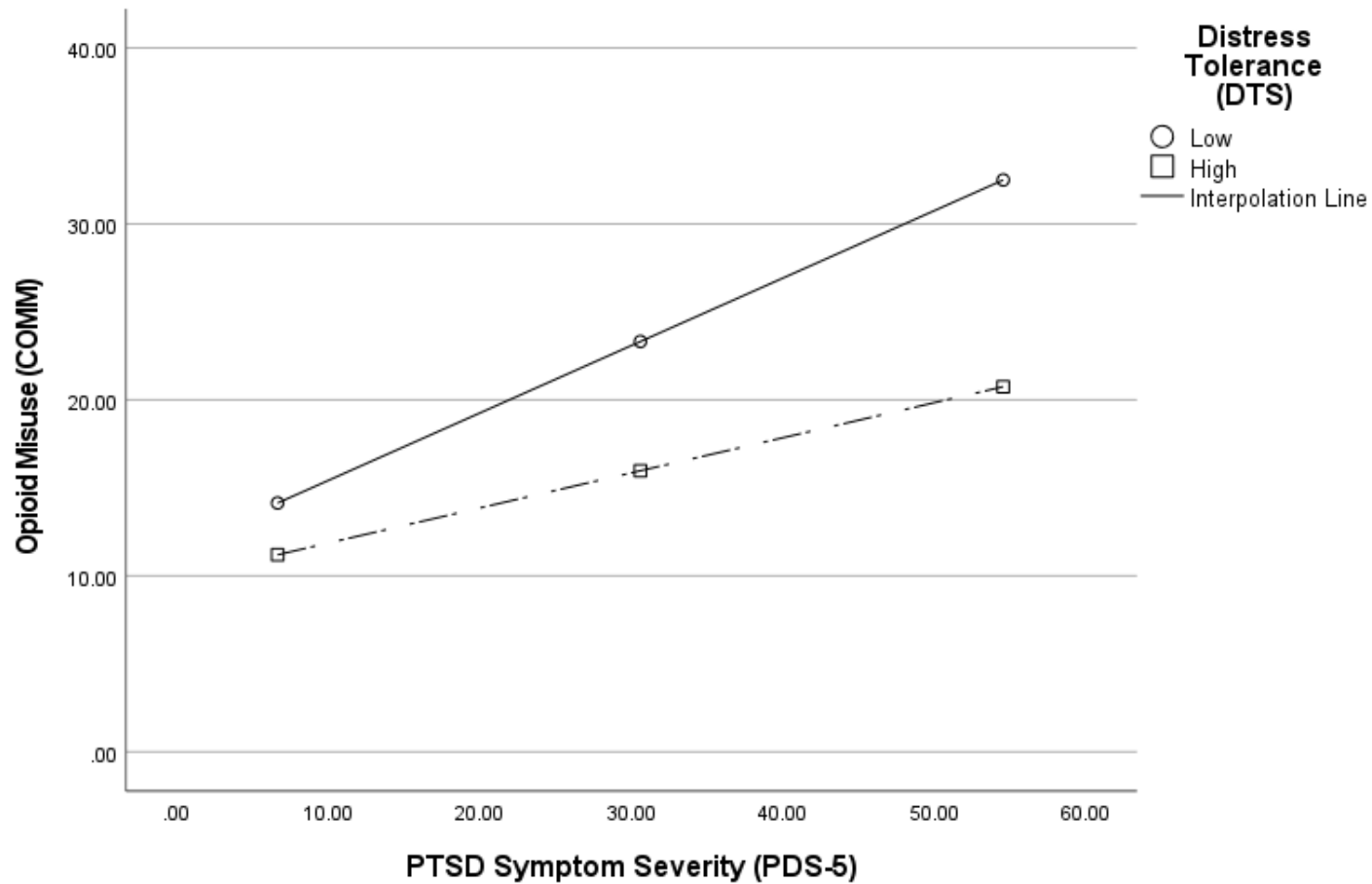
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Table 1*Descriptive statistics and bivariate correlations among study variables.*

	1	2	3	4	5	6	7	8	9
1. Age ^a	1	.02	.01	.14*	-.27**	.15*	-.27**	-.17**	-.17**
2. Gender ^a		1	-.15*	-.01	.06	-0.03	.27**	.22**	.19**
3. Number of Trauma Types ^a			1	.20**	.36**	-.17**	.15*	.11	.12*
4. Pain Intensity ^a				1	.22**	-.16**	.18**	.22**	.17**
5. Posttraumatic stress ^b					1	-.63**	.61**	.49**	.46**
6. Distress Tolerance ^d						1	-.50**	-.42**	-.37**
7. Opioid Misuse ^c							1	.70**	.64**
8. Severity of Opioid Dependence ^c								1	.61**
9. Number of Opioids ^c									1
Mean/n	37.79	205	2.19	7.31	30.59	41.75	21.02	4.83	2.40
Standard Deviation (%)	10.83	70.9%	1.41	1.71	23.93	14.93	17.90	3.90	4.26

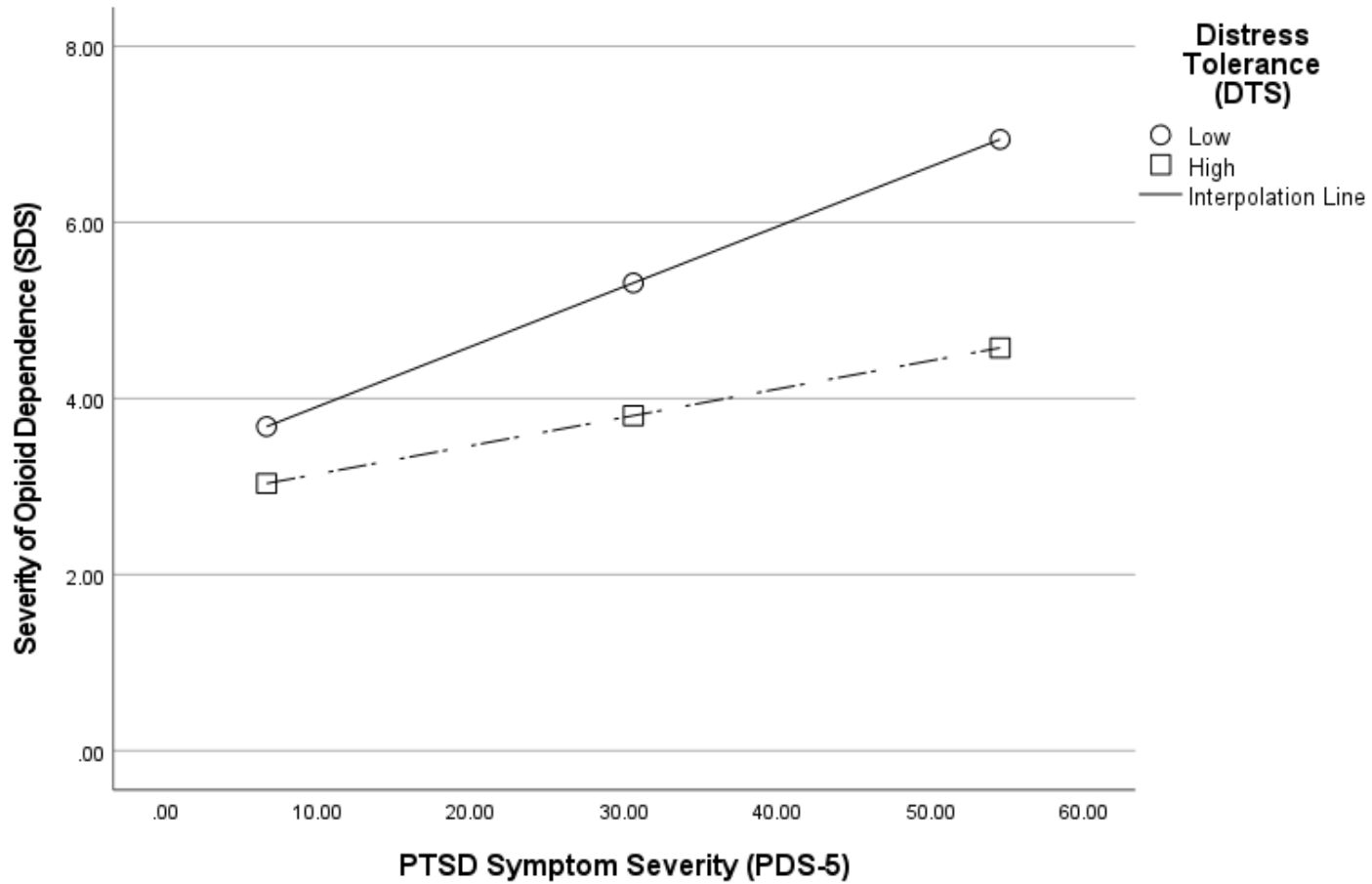
Note. N= 289; * $p < .05$, ** $p < .01$. ^a Covariate. ^b Predictor. ^c Outcome. ^d Moderator. Age = age in years; Gender = % listed as female (Coded: 0 = female, 1 = male); Number of Trauma Types = PDS-5 Traumatic Events Checklist (Foa et al., 2016); Pain Intensity = Graded Chronic Pain Scale-Pain Intensity Subscale (Von Korff et al., 1992); Posttraumatic stress = Posttraumatic Diagnostic Scale for DSM-5 (Foa et al., 2016); Distress Tolerance = Distress Tolerance Scale (Simons & Gaher, 2005); Opioid Misuse = Current Opioid Misuse Measure (Butler et al., 2007); Severity of Opioid Dependence = Severity of Dependence Scale (Gossop et al., 1995); Number of Opioids = Self-Report Opioid Analgesic Questionnaire (Smith et al., 2010).

Figure 1. Interaction of PTSD symptom severity and distress tolerance in relation to current opioid misuse.



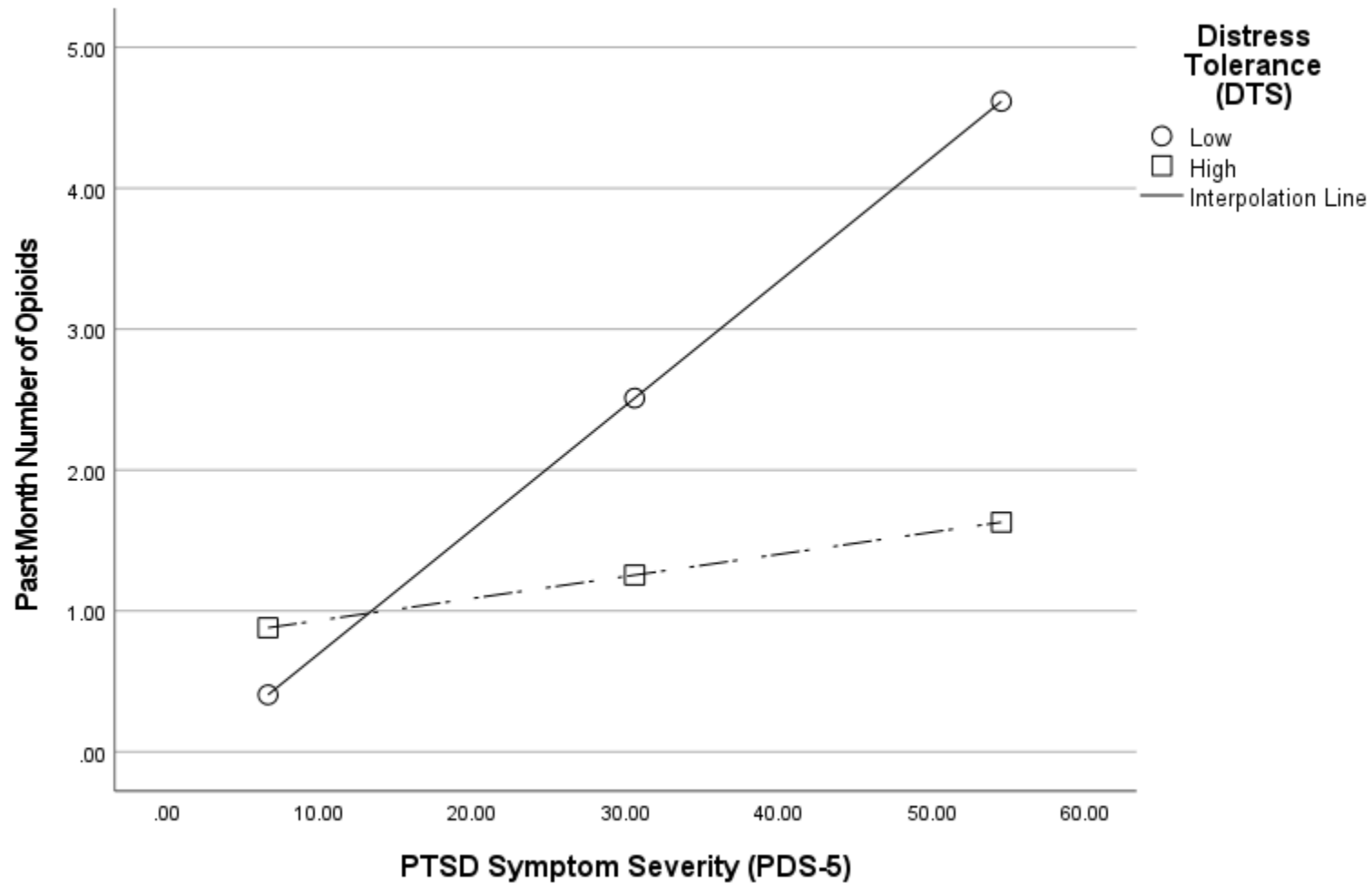
Note. PDS-5 = Posttraumatic Diagnostic Scale for DSM-5 (Foa et al., 2016); DTS = Distress Tolerance Scale (Simons & Gaher, 2005); COMM = Current Opioid Misuse Measure (Butler et al., 2007).

Figure 2. Interaction of PTSD symptom severity and distress tolerance in relation to current opioid dependence severity.



Note. PDS-5 = Posttraumatic Diagnostic Scale for DSM-5 (Foa et al., 2016); DTS = Distress Tolerance Scale (Simons & Gaher, 2005); SDS = Severity of Dependence Scale (Gossop et al., 1995).

Figure 3. Interaction of PTSD symptom severity and distress tolerance in relation to current opioid dependence severity.



Note. PDS-5 = Posttraumatic Diagnostic Scale for DSM-5 (Foa et al., 2016); DTS = Distress Tolerance Scale (Simons & Gaher, 2005); Past Month Number of Opioids = Self-Report Opioid Analgesic Questionnaire Smith et al., 2010).