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A Preliminary Study of Associations between Discomfort Intolerance, Pain Severity/Interference, and Frequency of Cannabis Use among Individuals with Chronic Pain

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Abstract

Cannabis use is more common among individuals with chronic pain, and is often used to relieve physical discomfort. However, little is known about factors that are associated with cannabis use among individuals with chronic pain, and there is reason to suspect that perceptions of discomfort intolerance (DI) play an important role in pain-cannabis relations. The goal of this study was to conduct an initial examination of perceived DI, pain severity, and pain-related interference in relation to frequency of cannabis use among individuals with chronic pain. Specifically, we hypothesized that pain severity/interference and factors of DI (avoidance and intolerance), would each be positively associated with cannabis use frequency. Participants ($N = 109$; 44% male; $M_{\text{age}} = 27$) endorsed chronic pain and at least one instance of lifetime cannabis use. Most participants characterized their chronic pain as high intensity and low disability, and the two most commonly reported frequencies of cannabis use were “*less than monthly*” ($n = 38$), and “*daily/almost daily*” ($n = 32$). Results indicated that discomfort avoidance (but not discomfort intolerance), pain severity, and pain-related interference were each independently and positively associated with frequency of cannabis use. These preliminary findings suggest that continued examination of perceived discomfort avoidance in relation to co-occurring pain and cannabis use is warranted. Future research should replicate these results among treatment-seeking pain patients who are prescribed medical cannabis.

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Declaration of Interests Statement

None of the authors have any real or potential conflict conflicts to declare, including financial, personal, or other relationships with other organizations or pharmaceutical/biomedical companies that may have inappropriately impacted or influenced the current research and interpretation of the findings.

Keywords

cannabis; discomfort intolerance; chronic pain; pain-related interference

Introduction

Up to 100 million adults in the United States suffer from chronic pain, accounting for an estimated \$500 billion in annual health care expenses and lost productivity (Institute of Medicine, 2011). The prevalence of cannabis use and cannabis use disorder is on the rise in the United States (UNODC, 2017), and cannabis use is more common among individuals with chronic pain, relative to those without chronic pain (Smiley-McDonald et al., 2017; Zvolensky et al., 2011). Pain severity and pain-related functional impairment also tend to be greater among cannabis users (vs. non-users) with chronic pain (Degenhardt et al., 2015), and researchers have recently begun testing associations between affective components of pain and cannabis cessation/withdrawal experiences (Manning et al., 2018).

Recent work has also examined psychological constructs associated with the use of cannabis in chronic pain (Hill, Palastro, Johnson, & Ditre, 2017; Walsh et al., 2013), including potential transdiagnostic factors such as perceived discomfort intolerance (DI; Leyro, Zvolensky, & Bernstein, 2010; Schmidt, Richey, & Fitzpatrick, 2006). Perceived DI is thought to be composed of two subfactors, including discomfort intolerance (i.e., inability to tolerate uncomfortable physical sensations), and discomfort avoidance (i.e., tendency to reflexively avoid or escape uncomfortable physical sensations; Bonn-Miller, Zvolensky, & Bernstein, 2009; Schmidt et al., 2006). Greater perceived DI has been positively associated with negative-reinforcement substance use motives (Leyro, Zvolensky, Vujanovic, & Bernstein, 2008). There is evidence of an inverse relation between perceived DI and frequency of cannabis use among college students (Buckner, Keough, & Schmidt, 2007). Furthermore, several positive associations between perceived DI and somatic symptoms have been observed among adults with chronic abdominal pain (Keough, Timpano, Zawilinski, & Schmidt, 2011), and obese primary care patients (Fergus, Limbers, Griggs, & Kelley, 2018). Thus, positive relations between perceived DI and cannabis use may be more pronounced among individuals with chronic pain or other medical conditions.

Recent clinical trials indicate that pain can be inhibited following the administration of inhaled cannabis (National Academies of Sciences, 2017; Wilsey et al., 2016). Medical cannabis patients with chronic pain have reported that cannabis use “*changes perception and experience of chronic pain*” and helps them to “*tolerate the pain a little better*” (Piper et al., 2017). In addition, frequent cannabis users readily endorse the utility of cannabis in relieving aversive internal experiences (i.e., depression, nervousness; Bonar et al., 2017; Buckner, 2013), and they are more likely to expect that cannabis will also diminish physical discomfort, relative to non-cannabis users (Schafer & Brown, 1991). Results of neuroimaging studies further suggest that pain may be easier to *tolerate* following cannabis self-administration, even in the absence of a direct reduction in pain intensity (Lee et al., 2013).

Despite the emergence of research suggesting that pain, perceived DI, and cannabis use may be interrelated, we are not aware of any previous work that examined covariation between these factors among individuals with chronic pain. Frequent exposure to cannabis may result in tolerance to its pain-reducing effects via downregulation of CB1 cannabinoid receptors (Cooper & Haney, 2008; D'Souza et al., 2016), which in turn may contribute to increased use, higher dosing, and the onset of unwanted effects (e.g., increase sensitivity to pain; Wallace, 2007). Cannabis use frequency is of particular clinical interest because it is a primary criterion for cannabis use disorder (DSM-5; American Psychiatric Association, 2013), and is among the most commonly examined outcomes of cannabis cessation interventions (Gates, Sabioni, Copeland, Le Foll, & Gowing, 2016).

The goal of this study was to conduct an initial test of cross-sectional associations between pain severity, pain-related functional interference, perceived DI, and frequency of cannabis use among a sample of individuals with chronic pain. First, we hypothesized that perceived discomfort intolerance and avoidance would each be independently associated with greater pain severity and pain-related interference. Second, we hypothesized that pain severity/interference and discomfort avoidance/intolerance would each be independently and positively associated with cannabis use frequency.

Method

Participants

Participants completed an online survey of substance use and health (Ditre, Zale, Heckman, & Hendricks, 2017), and were required to be at least 18 years of age, United States residents, able to read and write English, and willing to provide electronic informed consent. Survey measures were administered through socialsci.com, a web-based service that connects researchers with adult residents of the United States who agree to participate in IRB-approved research studies in exchange for small points-based rewards. The current study is based on a sub-sample of the 706 survey respondents ($n = 261$) who screened positive for chronic pain using a single item adapted from the Kansas Behavioral Risk Factor Surveillance System (Toblin, Mack, Perveen, & Paulozzi, 2011) and the National Health Interview Survey (National Health and Nutrition Examination Survey Data, 2012) that stated: *“Do you currently suffer from any type of chronic pain, that is, pain that occurs constantly or flares up frequently? Do not report aches and pain that are fleeting or minor.”* Chronic pain status and severity was further assessed using the Graded Chronic Pain Scale (GCPS; Grade I = low intensity–low interference; Grade II = high intensity–low interference; Grade III = high disability–moderately limiting; and Grade IV = high disability–severely limiting; Von Korff, Ormel, Keefe, & Dworkin, 1992). The current analyses were restricted to the subsample of respondents who also indicated having used cannabis at least once in their lifetime ($n = 109$).

Measures

Sociodemographic Characteristics and Tobacco Use—Sociodemographic and tobacco use characteristics including age, gender, race/ethnicity, education, and income are

presented in Table 1. Tobacco use was self-reported and operationalized as “never”, “former”, “current, occasional” or “current, daily”.

Anxiety Symptoms—The Generalized Anxiety Disorder–7 (GAD-7) questionnaire is a 7-item measure of anxiety symptoms that was developed as a screening tool for anxiety disorders (Kroenke, Spitzer, Williams, Monahan, & Lowe, 2007). The measure asks participants to rate how much they have been bothered by specific anxiety symptoms (e.g., *Feeling nervous, anxious, or on edge?*) over the last two weeks on a Likert-type scale from 0 (*not at all*) to 3 (*nearly every day*) (Spitzer, Kroenke, Williams, & Lowe, 2006). The GAD-7 demonstrated excellent consistency in the current sample ($\alpha = 0.90$).

Depression Symptoms—The Center for Epidemiological Studies Depression Scale (CES-D) is a 20-item measure of depressive symptomology (Radloff, 1977). The CES-D has evinced good construct validity, very high internal consistency, and adequate test-retest reliability in general population samples (Radloff, 1977). The CES-D demonstrated adequate internal consistency in the current sample ($\alpha = 0.77$).

Chronic Pain-Related Interference—The *Graded Chronic Pain Scale (GCPS)* is a self-report measure that was used to characterize the severity of chronic pain-related functional interference on a linear scale (Von Korff et al., 1992). The scale yields an interference score (Range 0 – 40) that is calculated by summing items that assess pain-related interference associated with daily/work activities, social activities, and family activities (0 = *no interference*, 10 = *unable to carry on any of these activities*).

Past-Month Pain Severity—A single item derived from the Short Form Health Survey – 20 (SF-20) was used to assess the severity of past-month pain (i.e., “*How much bodily pain have you had during the past four weeks?*” (Stewart & Ware, 1992). Response options ranged from 0 (*None*) to 5 (*Severe*).

Perceived Discomfort Intolerance (DI)—The Discomfort Intolerance Scale (Schmidt et al., 2006) is a 5-item measure that indexes individual differences in the perceived capacity to tolerate uncomfortable somatic sensations. This measure of perceived DI is comprised of two subfactors (i.e., discomfort intolerance and discomfort avoidance) (Bonn-Miller et al., 2009; Schmidt et al., 2006). The discomfort intolerance subscale (3 items) measures inability to tolerate physical discomfort and pain, with higher scores reflecting less tolerance for uncomfortable physical sensations. The discomfort avoidance subscale (2 items) measures tendency to avoid or escape uncomfortable physical sensations, with greater scores reflecting stronger tendency to avoid aversive physical sensations (Bernstein, Zvolensky, Vujanovic, & Moos, 2009; Schmidt et al., 2006). The Discomfort Intolerance Scale has evidenced good test-retest reliability (Schmidt et al., 2006), and both subscales demonstrated adequate internal consistency in the current sample (discomfort intolerance $\alpha = 0.77$; discomfort avoidance $\alpha = 0.73$).

Cannabis Use Frequency—Consistent with previous research (Khazaal et al., 2015), participants who endorsed lifetime cannabis use were subsequently asked to indicate their current frequency of use via a Likert-type scale with the following response options: 0

(None), 1 (*Less than Monthly*), 2 (*A few times a month*), 3 (*A few times a week*), and 4 (*Daily or almost daily*). The distribution of the cannabis use frequency variable was examined for normality, which indicated it was only slightly platykurtic (Kurtosis = -1.49 , $SE = .46$), with no evidence of skewness (skew = $.07$, $SE = .23$). Thus, no transformation was applied.

Data Analytic Strategy

Hierarchical linear regression models were used to test relations between pain severity/interference and DI, and to test pain severity/interference and DI in relation to the criterion variable of cannabis use frequency. Age and sex were identified *a priori* for inclusion as covariates in all models because they are considered non-modifiable risk factors for chronic pain (Bartley & Fillingim, 2013; van Hecke, Torrance, & Smith, 2013). Tobacco use status was included as a covariate given high rates of comorbid cannabis and tobacco use (Schauer, King, & McAfee, 2017), positive associations between tobacco use and chronic pain (Zale, Maisto, & Ditre, 2016), and to be consistent with previous data analytic approaches (Hogan, Gonzalez, Howell, Bonn-Miller, & Zvolensky, 2010). Anxiety and depression scores were also included as covariates given positive associations with cannabis use (National Academies of Sciences, 2017). Thus, for each of the models, age, sex, tobacco use status, anxiety, and depression were entered in Step 1, with past-month pain severity, pain interference, and perceived discomfort intolerance and avoidance entered separately in Step 2. The relative contribution of each variable entered at Step 2 to the criterion outcome of cannabis use frequency was assessed by examining change in R -squared (R^2) and squared semipartial correlations (sr^2 ; see Table 2).

Results

Sample Characteristics

The sample was 44% male, with a mean age of 27 years ($SD = 8.36$). The mean GCPS interference score was 14.48 ($SD = 9.60$). The sample primarily reported scores in the low interference range ($N = 69$; GCPS grades I-II), yet a substantial portion also reported scores in the high range of pain-related interference ($N = 40$; GCPS grades III-IV). The modal frequency of cannabis use was “*less than monthly*” ($n = 38$), closely followed by “*daily/ almost daily*” ($n = 32$). The modal chronic pain grade was “*1/low intensity and low disability*” ($n = 38$), followed by “*2/high intensity and low disability*” ($n = 31$), “*3/high disability–moderately limiting*” ($n = 20$), and “*4/high disability–severely limiting*” ($n = 20$). The mean CES-D score was 26.76 (range: 0–53, $SD = 11.41$), which is above the recommended cutoff for mood disorder (Henry, Grant, & Cropsey, 2018). The mean GAD-7 score was 9.28 (range: 0 – 21, $SD = 11.41$), indicating clinically-significant anxiety symptoms (Plummer, Manea, Trepel, & McMillan, 2016).

Associations between Perceived DI and Pain Severity/Interference

Hierarchical regression analyses indicated a linear association between discomfort intolerance and pain severity ($R^2 = .15$; $R^2 = .04$, $\beta = -0.20$, $t = -2.21$, $p = .03$; 95% CI $b = -0.13$ – $-.01$). Discomfort avoidance was not related to pain severity ($p = .36$). A linear association was also observed between the criterion variable of pain-related interference and

both discomfort avoidance ($R^2 = .39$; $R^2 = .05$, $\beta = 0.25$, $t = 2.98$, $p = .004$; 95% CI $b = 0.23:1.13$) and discomfort intolerance ($R^2 = .28$; $R^2 = .03$, $\beta = -0.18$, $t = -2.17$, $p = .03$; 95% CI $b = -1.22:-.06$). Not shown in Table 2.

Associations between Pain Severity/Interference, and Cannabis Use Frequency

As hypothesized, positive linear associations were also observed between past-month pain severity and frequency of cannabis use ($R^2 = .09$; $R^2 = .04$, $p = .04$; 95% CI $b = 0.01:0.58$), and between pain-related interference and frequency of cannabis use ($R^2 = .09$; $R^2 = .04$, $p = .04$; 95% CI $b = 0.001:0.06$). Each of these pain outcomes accounted for approximately 4% of the variance in cannabis use frequency (see Table 2).

Associations between Perceived DI and Cannabis Use Frequency

Hierarchical regression analyses indicated a positive relationship between discomfort avoidance and cannabis use frequency ($R^2 = .11$; $R^2 = .06$, $p = .01$, 95% CI $b = 0.02:0.18$), such that scores on the discomfort avoidance subscale of the perceived DI measure accounted for approximately 6% of the variance in cannabis use frequency. As seen in Table 2, the positive association between perceived discomfort intolerance and frequency of cannabis use did not reach statistical significance ($p = .27$).

Discussion

This is the first study to test cross-sectional associations between perceived DI, past-month pain severity, pain-related interference, and frequency of cannabis use. As hypothesized, past-month pain severity, pain-related interference, and perceived discomfort avoidance were each positively associated with frequency of cannabis use among individuals with chronic pain. Also as predicted, perceived discomfort avoidance and discomfort intolerance were both positively associated with pain-related interference. Interestingly, positive associations between discomfort intolerance and cannabis use frequency did not reach statistical significance, suggesting that aspects relevant to the subfactor of discomfort avoidance may be of greater relevance to cannabis use frequency among individuals with chronic pain.

One potential implication of these results is that individuals with chronic pain may be motivated to use cannabis as a means of avoiding discomfort and escaping aversive physical sensations. This interpretation is consistent with negative reinforcement model of addiction motivation (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004), and is also consistent with evidence that *avoidance* of discomfort may exhibit a stronger association with aversive physical sensations than *intolerance* (Keough et al., 2010). An alternative interpretation of these results is that more frequent use of cannabis may contribute to increases in perceived DI, pain severity, and pain-related functional impairment. That is, the direction of causality in these associations remains unclear. Either way, future research examining trajectories of cannabis use frequency, discomfort intolerance, and various aspects of the chronic pain experience seems warranted. In addition, it may be useful to consider the utility of increasing tolerance for discomfort and reducing pain to assist those who are attempting to reduce or stop cannabis use. Future research should also examine pain and discomfort intolerance in relation to cannabis-related problems (Bashford, Flett, & Copeland, 2010),

cannabis withdrawal symptoms (Manning et al., 2018), cannabis use motives (Guillot, Blumenthal, Zvolensky, & Schmidt, 2018), and barriers to cessation (Zvolensky et al., 2018).

Generalizability of these findings is limited by our recruitment of a predominantly White and well-educated sample that self-selected to participate in a study for small point-based rewards. It is also important to note that our online survey required internet access, and precluded biochemical verification of cannabis use. Future research should examine cannabis use among more racially diverse samples. For example, African-American cannabis users are more likely than White users to meet criteria for cannabis use disorder (Kerridge, Pickering, Chou, Saha, & Hasin, 2018). Another limitation is that although frequency of cannabis use is a clinically-meaningful outcome (Gates et al., 2016), it was measured via a self-report and on a Likert scale which may result in loss of variance, and is not sufficient to characterize potentially dynamic cannabis use profiles. Future research may wish to specifically recruit for varying degrees of cannabis use. In addition, smoking topography studies indicate an imperfect association between self-reported cannabis use and puff volume and duration (McClure, Stitzer, & Vandrey, 2012), and the potency of cannabis may further modulate patterns of use (Heishman, Stitzer, & Yingling, 1989). Puff topography could be a useful strategy for testing or correcting for exposure to the active constituents in cannabis smoke, as users may adapt smoking behavior based on THC content (van der Pol et al., 2014).

Conclusions

Overall, the present study revealed positive associations between pain severity, pain-related interference, perceived discomfort avoidance, and cannabis use frequency among individuals reporting chronic pain. Discomfort avoidance and pain severity could be important clinical targets among individuals with chronic pain who are interested in reducing their cannabis use. Future research is needed to test patterns of cannabis use following experimental manipulation of perceived discomfort intolerance (Farris & Metrik, 2016), and which extends these analyses to samples of medical cannabis patients (Haug et al., 2017).

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Table 1

Sociodemographic and Clinical Characteristics by Cannabis use Frequency (N =109)

Variable		Full Sample (n = 109)	No Current Use (n =9)	Less than Monthly Use (n = 38)	A Few Times per Month (n = 14)	A Few times per Week (n = 16)	Daily or Almost Daily (n =32)
		N (SD)	N (SD)	N (SD)	N (SD)	N (SD)	N (SD)
Gender							
	Male	48 (44.0)	4 (44.4)	16 (42.1)	5 (35.7)	10 (62.5)	13 (40.6)
Income (USD)							
	< 10K	8 (7.3)	2 (22.2)	3 (7.9)	2 (14.3)	0 (0)	1 (3.1)
	10 – 25K	24 (22)	0 (0)	7 (18.4)	4 (28.6)	4 (25)	9 (28.1)
	25 – 50K	31 (28.4)	3 (33.3)	11 (28.9)	3 (21.4)	2 (12.5)	12 (37.5)
	50 – 75K	20 (18.3)	1 (11.1)	7 (18.4)	3 (21.4)	3 (18.8)	6 (18.8)
	75 – 100K	16 (14.7)	2 (22.2)	6 (15.8)	2 (14.3)	4 (25)	2 (6.3)
	> 100K	10 (9.2)	1 (11.1)	6 (15.8)	0 (0)	3 (18.8)	2 (6.3)
Education							
	< High School	2 (1.8)	0 (0)	1 (2.6)	0 (0)	0 (0)	1 (3.1)
	High School or GED	11 (10.1)	1 (11.1)	3 (7.9)	1 (7.1)	2 (12.5)	4 (12.5)
	Some College	47 (43.1)	6 (66.7)	14 (36.8)	9 (64.3)	6 (37.5)	12 (37.5)
	Technical School/ Associates Degree	6 (5.5)	0 (0)	3 (7.9)	0 (0)	0 (0)	3 (9.4)
	Four-Year College	30 (27.5)	2 (22.2)	12 (31.6)	2 (14.3)	6 (37.5)	8 (25)
	Some Beyond College/ Professional	13 (12.0)	0 (0)	3 (7.9)	2 (14.3)	2 (12.5)	4 (12.5)
Race							
	Black	6 (5.5)	0 (0)	2 (5.3)	1 (7.1)	1 (6.3)	2 (6.3)
	White	93 (85.3)	8 (88.9)	33 (86.8)	13 (92.9)	12 (75)	27 (84.4)
	Other	10 (9.2)	1 (11.1)	3 (7.9)	0 (0)	3 (18.8)	3 (9.4)
Ethnicity							
	Hispanic	10 (9.2)	0 (0)	3 (7.9)	2 (14.3)	2 (12.5)	3 (9.4)
Tobacco Use Status*							
	Never	26 (23.9)	2 (22.2)	14 (36.8)	3 (21.4)	3 (18.8)	4 (12.5)
	Former	33 (30.3)	6 (66.7)	11 (28.9)	1 (7.1)	3 (18.8)	12 (37.5)
	Current, Occasional	24 (22)	0 (0)	6 (15.8)	4 (28.6)	5 (31.3)	9 (28.1)
	Current, Daily	26 (23.9)	1 (11.1)	7 (18.4)	6 (42.9)	5 (31.3)	7 (21.9)
Variable		M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)
Age		26.97 (8.36)	30.56 (13.95)	27.67 (9.22)	23.14 (4.47)	26.75 (7.39)	27 (6.77)
Anxiety Symptoms ¹		9.28 (5.47)	5 (5.27)	10.05 (5.39)	9.28 (5.94)	8.69 (4.89)	9.87 (5.42)
Depression Symptoms ²		26.76 (11.41)	20.11 (7.42)	28 (11.43)	30.71 (12.83)	24.94 (12.15)	26.34 (10.93)
Pain-Related Interference ³		14.48 (9.6)	7.22 (6.34)	14.29 (9.61)	13 (8.83)	15.25 (9.8)	17.03 (9.9)

Variable	Full Sample (n = 109)	No Current Use (n =9)	Less than Monthly Use (n = 38)	A Few Times per Month (n = 14)	A Few times per Week (n = 16)	Daily or Almost Daily (n =32)
	N (SD)	N (SD)	N (SD)	N (SD)	N (SD)	N (SD)
Past-Month Pain Severity ⁴	2.84 (0.96)	2.22 (0.83)	2.84 (0.94)	2.71 (0.99)	2.81 (1.11)	3.1 (0.89)
DI – Avoidance ^{5*}	9.4 (3.48)	7.33 (1.73)	8.42 (3.28)	10.43 (4.05)	10.31 (3.62)	10.25 (3.37)
DI – Intolerance ⁵	3.61 (2.77)	4.11 (2.62)	3.84 (2.9)	3.64 (3.34)	3 (2.07)	3.47 (2.81)

Notes.

¹ Generalized Anxiety Disorder–7 item

² Center for Epidemiological Studies Depression Scale

³ Graded Chronic Pain Scale – Four-Item Interference Score

⁴ Short-Form Health Survey–20 item

⁵ Discomfort Intolerance Scale.

* $p < .05$ indicating significant omnibus test of group differences (interval data) or chi-square (count data).

Table 2

Hierarchical Regression Models

Criterion Variable: Cannabis Use Frequency					
	β	sr^2	t	$b (SE)$	p
Step 1 (Models 1–3)					
<i>Age</i>	−0.11	−.01	−1.11	−0.02 (0.02)	.42
<i>Gender</i>	0.00	.00	−0.04	0.01 (0.27)	.85
<i>Tobacco Use Status</i>	0.20	.04	2.11	0.26 (0.12)	.04*
<i>Anxiety Symptoms</i> ¹	0.08	.00	0.63	0.02 (.03)	.53
<i>Depression Symptoms</i> ²	−0.12	−.01	−0.90	−0.01 (.02)	.37
Step 2 (Model 1)					
<i>Pain Severity</i>	0.20	.04	2.03	0.30 (0.15)	.04*
Step 2 (Model 2)					
<i>Pain-Related Interference</i> ³	0.22	.04	2.02	0.03 (.02)	.04*
Step 2 (Model 3)					
<i>DI – Avoidance</i> ⁴	0.25	.06	2.55	0.10 (0.04)	.01**
Step 2 (Model 4)					
<i>DI – Intolerance</i> ⁴	−0.10	−.01	−1.02	−0.05 (0.05)	.31

Note.

¹Generalized Anxiety Disorder – 7 item (GAD-7)²Center for Epidemiological Studies Depression Scale (CES-D)³Graded Chronic Pain Scale – Four-Item Interference Score⁴Discomfort Intolerance Scale (DIS)*
 $p < .05$ **
 $p < .01$