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Moderators of Improvement From Mindfulness-Based vs Traditional Cognitive Behavioral Therapy for the Treatment of Provoked Vestibulodynia

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ABSTRACT

Background and Aim: The goal was to evaluate the moderators of mindfulness-based cognitive therapy (MBCT) and cognitive behavioral therapy (CBT) to improve dyspareunia, reduce pain catastrophizing, and improve overall sexual function in women with provoked vestibulodynia (PVD). Both treatments effectively reduced self-reported pain, sexual dysfunction, and pain catastrophizing in women with PVD.

Methods: A total of 130 women with PVD were assigned to CBT or MBCT.

Outcomes: Potential moderators included (i) PVD subtype (primary or secondary), (ii) baseline pain intensity, (iii) trait mindfulness, (iv) treatment credibility, (v) relationship duration, and (vi) age. Outcomes were pain intensity, sexual function, and pain catastrophizing at 4 time points: before and after treatment and 6- and 12-month follow-up. Moderation was tested using multilevel models, nesting 4 time points within participants. The interaction of the moderator, time effect, and treatment group was evaluated for significance, and a simple slope analysis of significant interactions was performed.

Results: Pain reduction across 4 time points was the greatest in women who were younger, in relationships of shorter duration, and with greater baseline pain. Treatment credibility moderated pain intensity outcomes ($B = 0.305$, $P < .01$) where those with higher treatment credibility ratings (for that particular treatment) improved more in MBCT than CBT. PVD subtype moderated pain catastrophizing ($B = 3.150$, $P < .05$). Those with primary PVD improved more in the CBT condition, whereas women with secondary PVD improved more in the MBCT condition. Relationship length moderated sexual function ($B = 0.195$, $P < .01$). Women in shorter relationships improved more with MBCT, whereas women in longer relationships improved more on sexual function with CBT. No other tested variables moderated outcomes differentially across both treatment conditions.

Clinical Implications: Women who present with high credibility about mindfulness, in shorter relationships, and with secondary PVD might respond better to MBCT whereas those with primary PVD and longer relationships might respond better to CBT.

Strengths & Limitations: Clinical sample. Half the women who were not sexually active were omitted from analyses of sexual function.

Conclusion: Overall, treatment credibility, relationship length, and PVD subtype were found to moderate improvements differently in MBCT and CBT. These findings may assist clinicians in individualizing psychological treatment for women with PVD.

Clinical Trial Registration: This clinical trial was registered with clinicaltrials.gov, NCT01704456. **Brotto LA, Zdaniuk B, Rietchel L, et al. Moderators of Improvement From Mindfulness-Based vs Traditional Cognitive Behavioral Therapy for the Treatment of Provoked Vestibulodynia. J Sex Med 2020;17:2247–2259.**

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INTRODUCTION

Provoked vestibulodynia (PVD) is a chronic and distressing subtype of vulvodynia affecting approximately 8% of women.[1,2] Chronic PVD poses a significant health, emotional, and economic burden.[1,3–5] The psychological correlates of PVD are well established.[6,7] Recently, a head-to-head comparison of cognitive behavioral therapy (CBT) vs mindfulness-based cognitive therapy (MBCT) found both treatments to significantly improve pain intensity, sexual function, and pain catastrophizing[8] with effects retained at the 12-month follow-up.[9] However, the predictors of treatment outcome, including which treatment works best for whom, were not evaluated and are the focus of the current secondary analysis. The choice of potential moderators of treatment in this study was guided by theory (fear-avoidance, placebo effect) and empirical findings to date.

The fear-avoidance model of pain[10] explains the emotional and behavioral response to a chronic pain. Specifically, when an initial injury leads to pain, the pain may be interpreted in a catastrophic way, leading to fear of that pain and subsequent avoidance behaviors. There is also hypervigilance to any sign of the pain that has its own negative consequences. The fear-avoidance model was adapted to PVD by Bergeron et al[11] as follows: when painful vaginal penetration is viewed as threatening, this elicits a fear reaction which then contributes to avoidance behavior as a means of protecting oneself from the anticipated vaginal pain. Furthermore, negative affect increases in response, which can directly contribute to pain intensity. In this study, we included 3 aspects of the fear-avoidance model as outcome measures; namely, pain intensity given that this is what triggers the catastrophizing, fear, and avoidance; sexual function given difficulties in this domain may result from the hypervigilance; and pain catastrophizing, given that it is the interpretation of pain in a catastrophic way that leads to fear and avoidance behaviors.

In accordance with this model, the genesis of pain and its baseline intensity are likely to influence the effect of treatment. In support of this model, it was previously found that both CBT and MBCT led to marked reductions in pain catastrophizing both after treatment[8] and at the 12-month follow-up.[9] For those with longer history and greater intensity of pain, the fear-avoidance mechanisms may be more entrenched and therefore more resistant to treatment. Indeed, fear-avoidance variables such as greater pretreatment fear of pain were associated with worse pain intensity at the 6-month follow-up in a randomized trial of CBT for PVD but not with sexual function.[12] Stemming from the fear-avoidance model of pain for PVD, we predict that a longer duration of PVD pain and baseline (or pretreatment) pain severity would moderate outcomes because these pain characteristics would be the source of catastrophizing and fear.

PVD can be classified as primary (with lifelong symptoms) or secondary (with more recent onset after a period of pain-free penetration). Experts have hypothesized different etiologies for primary vs secondary PVD, including different genetic profiles.[13] Research has found that once sociodemographic variables are controlled for, there are no significant differences in sexual, psychological, or relational characteristics between groups of women with these 2 subtypes.[14] Although primary vs secondary subtype did not predict pain outcomes after treatment with pelvic floor physiotherapy,[15] experts have argued that there is a need for prospective, longitudinal treatment outcome data that take PVD subtype into account.[16] As a potential moderator of treatment outcome, we might speculate that those with longer standing pain (ie, primary) might experience more pain catastrophizing, a key aspect of the fear-avoidance model that elicits hypervigilance as well as sexual dysfunction[11] and thus be more resistant to improvement with treatment.

Another PVD characteristic, baseline pain severity, has received much more empirical support as a significant predictor of treatment outcomes.[17] Baseline pain intensity moderates outcomes after psychological therapy[18,19] such that higher levels of pain at baseline predicted less improvement in pain intensity after treatment. There are also likely different effects of baseline pain severity depending on the type of treatment evaluated given that higher baseline pain predicts poorer improvements in pain after CBT[20] or multidisciplinary treatment[21,22] but predicts greater improvements after MBCT.[23] Both of these PVD characteristics—PVD subtype and baseline pain intensity—will thus be examined as moderators of treatment outcome in this study, and the novelty of our study is that we will be able to directly compare moderators in the 2 treatment arms. Based on this existing literature and from a fear-avoidance theory perspective, we would expect higher baseline pain to further reinforce fear avoidance and thus to be associated with less improvement in pain, sexual function and pain catastrophizing, and this relationship may be additionally moderated by treatment.

One key element of the fear-avoidance model is the fear or catastrophizing reaction to pain. Thus, variables that affect the pain-fear connection are likely to moderate the treatment effect. Participants possessing trait mindfulness, for example, to manage their catastrophizing response to pain may respond more favorably to treatment. Pretreatment trait mindfulness, which we defined as one's level of general overall mindfulness (general tendency to be mindful in daily life), independent of a mindfulness practice, has been examined within the fear-avoidance

framework and found to moderate the relationship between pain intensity and catastrophizing[24]: for those low in mindfulness, pain intensity has a stronger association with pain catastrophizing. Interestingly, a pilot study of 4-session MBCT found no impact of baseline trait mindfulness on pain intensity outcomes.[23] Trait mindfulness was explored as a possible predictor variable in this study under a tentative directional hypothesis that those higher in baseline mindfulness might respond better to our 8-session treatment. The additional interactive effect of type of treatment was also tested as an exploratory moderator.

Placebo effects, or changes in an outcome variable that are not due to the active ingredients of the intervention, are pervasive in psychological treatment outcome studies.[25] There is a wide literature on the impact of the placebo effect on pain reduction[26] showing that belief about a treatment's efficacy can induce discrete physiological changes that reduce pain intensity.[27] One way of measuring the placebo effect is via treatment credibility or the degree to which one thinks a treatment is logical in reducing one's pain symptoms.[25] Lower treatment credibility has been found to negatively impact pain outcomes after psychological treatment of low back pain.[28] The impact of treatment credibility within psychological interventions for PVD has been minimally studied. In a randomized comparison of CBT to vestibulectomy and biofeedback, higher levels of baseline logic (ie, belief that CBT was logical for alleviating vulvar pain symptoms) were associated with lower levels of posttreatment pain with intercourse at the 6-month follow-up.[19] This finding and the finding that treatment credibility predicts outcome in other chronic pain conditions[26] led us to predict that greater treatment credibility would be associated with greater reductions in pain intensity. The potential additional impact of treatment type was also explored.

Relationship factors have been documented as being highly relevant in PVD,[29] and dyadic sexual communication, in particular, has been found repeatedly to predict pain intensity and sexual outcomes in women with PVD.[30,31] Relationship duration has only been examined minimally as it relates to PVD outcomes, but some data indicate that after treatment with CBT, those couples in longer relationships experienced significantly greater reductions in vulvovaginal pain.[32] On the other hand, a 7-year longitudinal study examining the natural history of PVD symptoms found that women who were married were significantly more likely to have persisting PVD pain, and women in longer relationships similarly showed a trend toward being in the persistent PVD pain group.[33] Given these potentially conflicting findings on the role of relationship duration as a moderator of pain outcomes, we treated this as an exploratory analysis.

Participant's age as a moderator of outcomes after CBT in chronic pain has been equivocal in research with evidence of no moderating effect of age,[34] moderating effect with older participants responding better,[15] and moderating effect with younger participants responding better.[35] In a naturalistic longitudinal follow-up study of women with PVD, women who were older at the onset of pain were more likely to have persisting PVD pain when assessed 7 years later.[33] For women with PVD, age may be relevant to treatment outcome because being a younger woman with PVD is associated with better relationship adjustment among women and their partners.[29] However, the inconsistent findings prevent us from formulating a directional hypothesis, and this examination remains exploratory. Because age is easily available to a clinician without the need for validated measures if it were found to be a significant moderator, it could easily be assessed in the clinic.

We had 3 primary outcome variables: pain intensity, sexual function, and pain catastrophizing. Pain intensity is the primary clinical feature of PVD and often the primary outcome variable in intervention studies focused on PVD. Sexual function was chosen as an outcome given chronic PVD is consistently associated with diminished sexual functioning. A circular model of sexual response in women with PVD[36] highlights that when sex is expected to be painful, the motivation (ie, desire) for such encounters is reduced, and sexual arousal is also limited as a result. Although sexual function and sexual pain outcomes would therefore be expected to be highly correlated, empirical data found low correlations between PVD pain intensity and measures of sexual function.[37,38] Therefore, both outcomes are included. The third outcome variable was pain catastrophizing. From the fear-avoidance theoretical perspective, catastrophizing is an important outcome variable that may be related to but independent from pain intensity and sexual function.

Data were drawn from a recently completed clinical trial comparing CBT vs MBCT for women with PVD.[8] The aim of the present study was to examine moderators of treatment outcome for MBCT and CBT. We predicted that the primary PVD subtype and higher baseline pain intensity would be associated with less improvement after treatment, whereas higher baseline trait mindfulness and higher treatment credibility (defined as the degree to which participants believed the treatment would improve their PVD symptoms after being introduced to the treatment in session 1) would be associated with more improvement after treatment. We did not form directional hypotheses for relationship duration and participant age given the equivocal literature on these moderators. Outcomes of interest focused on pain intensity, sexual function, and pain catastrophizing.

MATERIAL AND METHODS

Participants

Participants comprised a total of 130 women who were seeking treatment for PVD at 1 of 2 tertiary care academic health centers with programs specializing in sexual medicine and vulvar pain. They were diagnosed with PVD by a physician with specialized training in sexual dysfunction and PVD and selected from a larger pool of 153 women recruited from the 2 academic health centers in Vancouver, Canada. Interested women received

a description of the study via e-mail, and those requesting more information were invited to contact the study coordinator.

Inclusion criteria were as follows: (i) a diagnosis of PVD confirmed by both clinical history and by a cotton-swab test carried out by a physician; (ii) a duration of PVD of at least 6 months; (iii) an ability to attend 8 weekly treatment sessions; (iv) aged 19 years or older; (v) fluent in English; and (vi) a willingness to not begin any new treatments for PVD for the duration of the study until the 6-month follow-up point. Exclusion criteria were as follows: (i) unprovoked vulvovaginal pain; (ii) pelvic pain; (iii) a vulvar skin condition (eg, lichen sclerosus); and/or (iv) significant symptoms of dissociation (at the time of designing this study, there were no data indicating the appropriateness of mindfulness for treating symptoms of dissociation yet).[39]

As reported elsewhere,[8] 23 women who were assessed for eligibility were excluded from participating: 18 did not meet the study criteria and 5 declined to participate after receiving more information about the procedures. The study was approved by the Research Ethics Board at the University of British Columbia, #H12-02358 as well as the Vancouver Coastal Health Research Ethics Board and all participants provided written consent. The primary outcomes for this project were registered with clinicaltrials.gov, NCT01704456.

Procedure

Women who consented to participate took part in a standardized vulvar pain assessment while the trained clinician exerted a standardized amount of pressure around the vulva and asked the woman to self-report her level of pain from 0 (no pain) to 10 (worst pain ever).[40] Next, all participants were sent an individualized link to a battery of questionnaires to complete online, at least 1 week before treatment began, which was administered and stored in SurveyMonkey. Reminder e-mails and/or telephone calls were sent up to 3 times for any participant failing to complete these baseline measures. The battery of questionnaires was administered before treatment, then again at 2−4 weeks after the last session, and at the 6- and 12-month follow-up. Only the predictors and outcome variables assessed in this analysis of moderators are described in the following text.

Although this study was originally designed as a randomized clinical trial, scheduling issues related to filling sufficient numbers of women per group, plus scheduling conflicts for participants, meant that only 47 of the 130 participants (36.1%) were randomized to group; the remaining participants were assigned to group non-randomly but not as per participant preference for treatment modality. Randomization for those 47 participants was carried out by the study coordinator using an online randomization tool. As reported elsewhere,[8] there were no significant differences in outcomes or any other baseline or post-treatment measures between the randomized and assigned participants. A remuneration of $25 for each assessment point was provided.

Treatments

Both treatments were delivered over 8 weekly sessions, 2.25 hours in length (for each of the 8 sessions), by group facilitators who were clinicians with specialized training in group therapy and who had considerable expertise in the diagnosis and management of sexual disorders and PVD. Among the entire group of facilitators, those who led the MBCT groups also had additional workshop training in mindfulness, had attended at least a year of monthly mindfulness groups for clinicians, and each had a personal ongoing mindfulness practice. If a woman missed a session, she was encouraged to let the facilitators know and schedule an individual make-up session. Both interventions are described at length elsewhere.[8]

Briefly, the CBT intervention had the goal of providing psychoeducation on how PVD affects women's sexual desire, motivation, and function and on the role of stress in chronic pain and PVD; behavioral skills training (eg, progressive muscle relaxation, diaphragmatic breathing); cognitive techniques (eg, rehearsal of self-statements to cope with pain cognitive restructuring); and communication skills training, (eg, the ways a woman might speak to a current or future partner about her pain).[41]

The MBCT intervention[42] delivered psychoeducation on PVD, mindfulness exercises such as mindful eating, a body scan, mindfulness of breath, mindfulness of sounds and thoughts, and a loving kindness self-compassion practice. In addition, some of the meditations involved provoking a mild (non-genital) pain in session and provoking vestibular pain at home. A full 1 hour of each session was spent engaging in a guided mindfulness practice plus inquiry on practice.

Treatment adherence assessed on a random 20% of all group sessions indicated a very high degree of therapist adherence to both arms. Specifically, the average score was 13 of 14, indicating an extremely high degree of facilitator adherence to the manual. Among the 10 CBT group sessions that were scored, the average adherence score was 13.6, indicating near-perfect adherence to the treatment.

Measures

Demographic and Clinical Characteristics

The baseline online battery included a variety of demographic questions (eg, age, ethnicity, education, sexual orientation, relationship status, and duration) and clinical questions (eg, duration of PVD, baseline pain intensity, whether the PVD was primary or secondary, past treatments tried, and medications).

Mindfulness

Trait mindfulness was measured with the 39-item Five-Facet Mindfulness Questionnaire.[43] Each item was rated on a 5-point Likert scale ranging from 1 (*never or very rarely true*) to 5 (*very often or always true*). Total scores range from 39 to 195, with higher scores indicating greater mindfulness. The Five-Facet Mindfulness Questionnaire has been found to have adequate-to-

good internal consistency with alphas ranging from 0.72 to 0.92. In this sample, Cronbach's alpha at pretreatment was 0.89. We assessed participants' baseline (ie, pretreatment) level of trait mindfulness as a predictor of outcomes.

Treatment Credibility

Immediately after their first treatment session, participants in both groups were asked, "To what extent do you think the treatment you will receive is logical in terms of alleviating your PVD?" This item was rated on a 0 (*not at all logical)* to 10 (*completely logical)* scale. This variable was important to assess as close-to-baseline moderator given that it might comprise part of the non-specific treatment response in psychological treatment studies.[25]

Outcome Variables

Pain Intensity

Pain intensity, as measured by the numeric rating scale, was a main outcome, and participants were asked to rate the "intensity of pain during vaginal penetration attempts with sexual intercourse or penetration over the past 4 weeks." This question was rated on a 0−10 scale from *no pain* to *worst possible pain.* Women who did not engage in vaginal penetration over the past 4 weeks received a *not applicable* score for this question at baseline and were not included in follow-up analyses.

Sexual Function

We used the Female Sexual Function Index[44] to measure sexual functioning. This validated 19-item scale asks about the frequency and intensity of a variety of domains of sexual response and satisfaction and generates a total score ranging from 7.2 to 36. The Female Sexual Function Index has good discriminant validity, correctly identifying 70.7% of women with sexual dysfunction using a cutoff score of 26.55. Any woman who did not engage in sexual activity during the preceding 4 weeks was coded as *not applicable* and her Female Sexual Function Index total score was missing ($n = 32$). In this sample, Cronbach's alpha at pretreatment was 0.81.

Pain Catastrophizing

We administered the Pain Catastrophizing Scale,[45] a 13-item self-report measure that asks participants to indicate the degree to which they have certain thoughts or feelings when experiencing pain and that includes the following aspects: rumination (eg, inability to keep pain out of mind), magnification (eg, fear pain will worsen), and helplessness (eg, feeling overwhelmed by pain). We specifically asked participants to complete the Pain Catastrophizing Scale in relation to their vulvar pain. Items were rated on a scale from 0 (*not at all*) to 4 (*all the time*), with higher scores indicating higher levels of catastrophizing. The total score is a sum of all items and ranges from 0 to 52. In the current sample, Cronbach's alpha was high at 0.94.

Data Analysis Plan

The moderating impact of our variables of interest was examined using cross-level interactions in multilevel mixed-model analysis. Treatment group and moderator baseline values were entered in the model as level-2 variables and allowed to interact with individual's outcome scores at each time point (level-1 "time" variable). A significant 3-way cross-level interaction indicated a moderation effect and is interpreted as impact of baseline moderator on changes in outcome variable across time, conditioned on the treatment group. Simple slopes were calculated for each combination of low and high values of the moderator and the 2 treatments using an established approach.[46]

Following the IMMPACT recommendations,[47] we reported results without correction for multiple tests. The consortium recommends that when secondary endpoints are analyzed to better understand treatment effects, and such analysis is accompanied by significant effects of treatment for all primary endpoints (as is the case in our study), then the correction for multiple comparisons is not necessary and the prespecified alpha level ($P < .05$) can be used to avoid loss of power.[48] However, because 18 interaction models were analyzed, the number of tests may still warrant a concern about excessive type I error rates. Therefore, we also report which findings remain significant under the Benjamini-Hochberg (B-H)[49] correction allowing for 10% of false positive findings (roughly 2 significant findings of 18 tested models). The B-H method has been recommended as a better alternative to Bonferroni adjustments[50] and has been widely used in genetics research and increasingly in clinical psychology[51] and behavioral health research.[52] In this method, the findings are rank ordered as per their *P*-values, and each *P*-value is compared with the one calculated using the B-H formula. If a finding's *P*-value is smaller than the B-H one, that finding and all findings preceding it with smaller *P*-values are considered significant.

RESULTS

Participant Characteristics

As shown in Figure 1, a total of 130 women were either randomized or assigned to a treatment arm, and this formed the analytic sample. Participant demographic characteristics and descriptive statistics for moderators are presented in Table 1. The treatment groups were similar with the exception of the mean length of time since PVD diagnosis, $t\ (128) = -3.3$, $P = .001$, indicating that women in the MBCT group had a diagnosis of PVD for significantly more years than women in the CBT group. We therefore first included this variable as a covariate in all moderation analyses, and after finding that it did not affect the pattern of significant findings, length of time since diagnosis was dropped from the final models.

Women in the CBT (n = 63) and MBCT (n = 67) arms did not significantly differ on demographic characteristics of relationship status, relationship satisfaction, length of relationship, ethnicity, or education level (Table 1). Pain characteristics, for

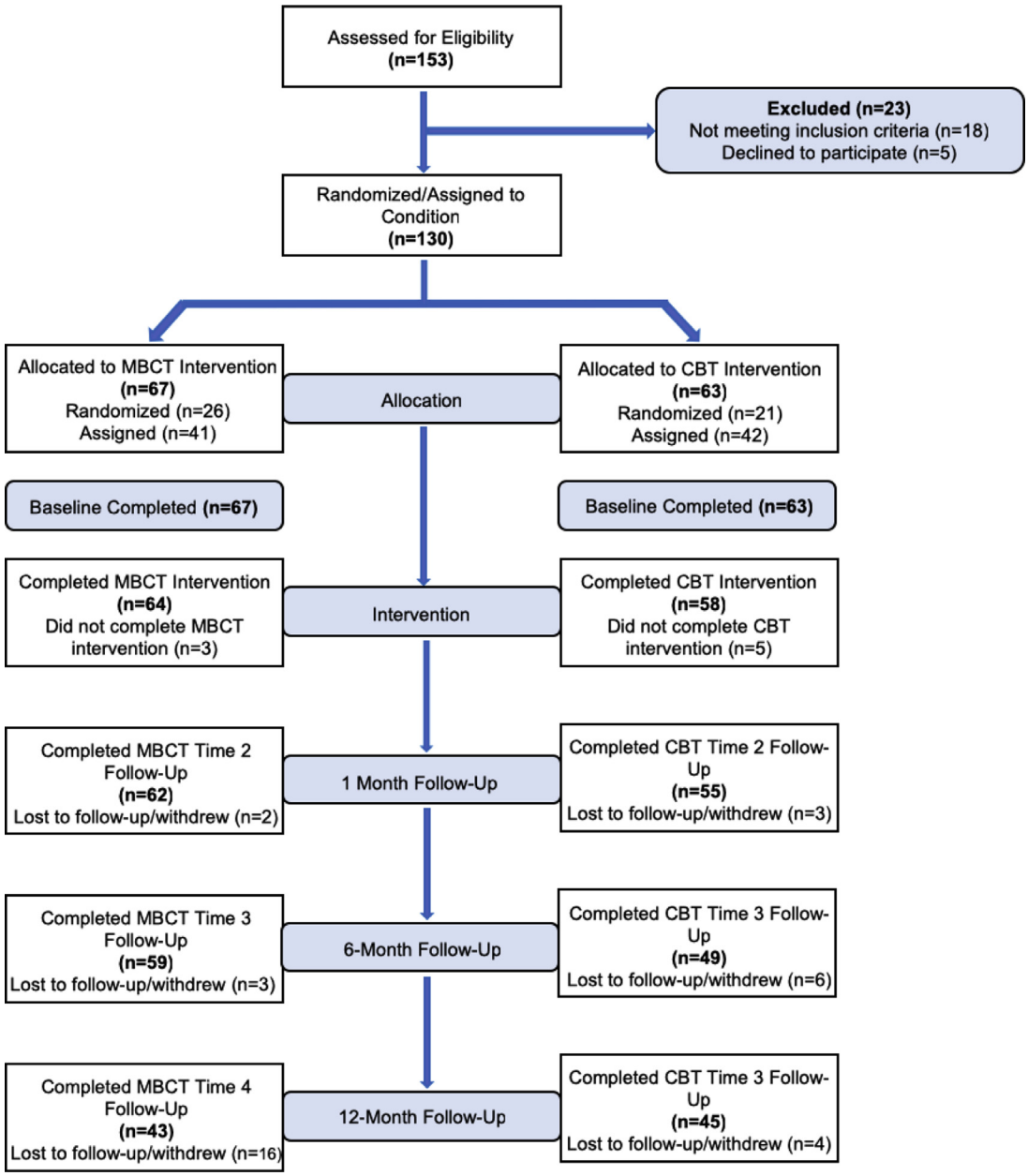

Figure 1. CONSORT diagram for participants in mindfulness-based cognitive therapy (MBCT) and cognitive behavior therapy (CBT). Figure 1 is available in color online at www.jsm.jsexmed.org.

example, baseline pain intensity and baseline self-report of highest pain intensity, were also similar between women in the CBT and MBCT groups.

With regards to moderators, no significant differences existed between treatment groups. Raw means for all 3 outcomes (pain intensity, sexual function, and pain catastrophizing) are presented in Table 2. Past publications have shown that both treatment groups improved on all 3 outcomes from the baseline to 12-month follow-up.[8,9]

All results of 2-way (time × moderator) and 3-way (time × moderator × treatment) interactions are shown in Table 3. The table first presents 2-way interactions of time and moderators. Baseline pain intensity predicted improvements in pain intensity with treatment: women with higher baseline pain had greater reductions in pain regardless of treatment. There was also a significant interaction of time and age for pain intensity, indicating that younger women reported greater reduction in pain than older women regardless of the treatment modality. However, this finding should be treated with caution because it does not meet the threshold of significance under the B-H false discovery rate adjustment. There was also a significant interaction of time and relationship length indicating that women in shorter relationships experienced a greater reduction in pain than women in longer relationships regardless of treatment type and age (age was controlled in that analysis). In terms of pain catastrophizing, there was a significant interaction of time and treatment credibility such that

Table 1. Baseline demographic and clinical characteristics (including moderators) of women assigned/randomized to cognitive behavioral therapy (CBT; n = 63) and those assigned/randomized to mindfulness-based cognitive therapy (MBCT; n = 67)

Measure	CBT	MBCT	Total
Sample description			
Relationship status			
Married/common-law	41 (66.1)	45 (67.2)	86 (66.7)
Dating	13 (21)	11 (16.4)	24 (18.6)
Single	8 (12.9)	11 (16.4)	19 (14.7)
Satisfaction with relationship closeness (/10)	7.79 ± 1.99	7.26 ± 2.29	7.52 ± 2.15
Ethnicity			
Euro-Canadian	38 (62.3)	46 (70.8)	84 (66.7)
South/East Asian	11 (18)	10 (15.4)	21 (16.7)
Other	12 (19.7)	9 (13.8)	21 (16.7)
Education			
High school	2 (3.6)	1 (1.7)	3 (2.6)
Some college	17 (30.4)	10 (16.9)	27 (23.5)
University degree	24 (42.9)	31 (52.5)	55 (47.8)
Postgraduate	13 (23.2)	17 (28.8)	30 (26.1)
Level of worst pain (/10)	8.23 ± 1.32	8.23 ± 1.10	8.23 ± 1.21
Years since diagnosis*	6.02 ± 4.72	9.85 ± 7.72	7.95 ± 6.67
Received past treatments for PVD	29 (46.0)	36 (53.7)	65 (50.0)
Receiving medication to treat PVD at baseline	11 (17.5)	8 (11.9)	19 (14.6)
Moderators of treatment			
PVD history			
Lifelong	37 (58.7)	43 (64.2)	80 (61.5)
Acquired	26 (41.3)	24 (35.8)	50 (38.5)
Level of typical pain (/10)	5.96 ± 2.11	6.04 ± 1.82	6.00 ± 1.9
FFMQ	125.0 ± 19.1	124.6 ± 15.9	124.8 ± 17.4
Treatment credibility	7.4 ± 1.9	7.1 ± 1.9	7.3 ± 1.9
Length of relationship in years,	7.56 ± 6.79	7.77 ± 6.16	7.67 ± 6.5
Age in years	31.24 ± 8.99	33.72 ± 7.48	32.35 ± 8.21

Data are means ± *SD* or *n* (%).
FFMQ = Five-Facet Mindfulness Questionnaire; PVD = provoked vestibulodynia.
*significant difference between the groups, $P < .01$.

those who reported lower treatment credibility after session 1 of treatment experienced greater reduction in pain catastrophizing than women espousing higher treatment credibility.

Treatment credibility also showed a significant 3-way interaction with treatment type and time (Figure 2) when predicting pain intensity reduction. Those who expressed high treatment

Table 2. Raw means for pain during intercourse, sexual function, and pain catastrophizing outcomes by time of assessment and treatment group

Outcome and group	Baseline *M (SD)*	Post-treatment *M (SD)*	6-mo follow-up *M (SD)*	12-mo follow-up *M (SD)*
Pain Intensity[1]				
CBT	5.86 (2.13)	4.65 (2.21)	4.03 (2.11)	3.97 (2.51)
MBCT	6.69 (1.91)	4.34 (2.22)	3.39 (1.89)	3.24 (2.47)
Sexual function (FSFI)				
CBT	21.18 (6.10)	23.41 (5.72	23.20 (5.45	24.75 (5.07
MBCT	19.56 (6.29)	21.79 (6.83)	24.75 (5.62)	25.08 (6.64)
Pain catastrophizing[3]				
CBT	25.62 (11.97)	12.57 (8.13)	10.83 (7.66)	9.56 (9.03)
MBCT	26.92 (12.86)	15.64 (12.54)	11.55 (9.91)	11.93 (12.00)

Possible range of scores: [1]0 to 10; [2]7.2 to 36; [3]0 to 52.
CBT = cognitive behavioral therapy; FSFI = Female Sexual Function Index; MBCT = mindfulness-based cognitive therapy.

Table 3. Unstandardized beta coefficients for moderation models including 2- and 3-way interactions

	Numeric rating scale	FSFI	PCS
	B (SE)	B (SE)	B (SE)
Interaction of moderator × treatment (time)			
PVD type (primary vs secondary) × time	−0.047 (0.215)	0.362 (0.459)	−2.336 (3.356)
Typical pain intensity × time	−0.150 (0.061)*,‡	0.082 (0.118)	−0.176 (0.183)
FFMQ × time	0.009 (0.007)	0.015 (0.013)	.010 (0.020)
Treatment credibility × time	0.092 (.057)	−0.008 (0.121)	0.529 (0.193)†,‡
Relationship length × time	0.046 (.019)*,‡	−0.018 (0.035)	0.070 (0.056)
Age × time	0.031 (0.015)*,§	−0.005 (0.028)	0.064 (0.041)
Interaction of moderator × treatment (time) × treatment group			
PVD type × time × treatment	0.392 (0.429)	0.451 (0.921)	3.150 (1.211)*,‡
Typical pain intensity × time × treatment	0.135 (0.124)	−0.133 (0.238)	−0.297 (0.366)
FFMQ × time × treatment	−0.015 (0.013)	0.015 (0.026)	−0.009 (0.041)
Treatment credibility × time × treatment	0.305 (0.112)†,‡	−0.069 (0.242)	0.139 (0.385)
Relationship length × time × treatment	−0.050 (0.038)	0.195 (0.070)†,‡	−0.150 (0.114)
Age × time × treatment	0.004 (0.030)	0.104 (0.056)	−0.109 (0.083)

FSFI = Female Sexual Function Index; FFMQ = Five-facet Mindfulness Questionnaire; PCS = Pain Catastrophizing Scale; PVD = provoked vestibulodynia.
*Significant interaction at $P < .05$.
†Significant interaction at $P < .01$.
‡A finding is significant with the Benjamini-Hochberg adjustment with false discovery rate of .10 (10%).
§A finding is not significant with the Benjamini-Hochberg adjustment with false discovery rate of .10 (10%).

credibility at session 1 improved more with MBCT than with CBT in terms of pain intensity, whereas women low in treatment credibility at the baseline improved to the same degree regardless of treatment arm. Relationship length interacted with time and treatment when predicting improvements in sexual function (Figure 3). Women in shorter relationships improved more in MBCT than in CBT, whereas the opposite took place for women in longer relationships—those in CBT treatment improved more than those in MBCT treatment. The 3-way interaction between treatment group, time, and PVD subtype (primary vs secondary) as a moderator was significant when predicting pain catastrophizing improvements after treatment (Figure 4). Women who had primary PVD improved more with CBT than MBCT, whereas the opposite was true for women with secondary PVD: women in MBCT treatment improved more in their pain catastrophizing than women in CBT.

Simple slopes for all 3-way interactions are presented in Table 4. These slopes of treatment (time) predicting improvements in outcomes were computed separately for each treatment (CBT versus MBCT) and at preselected moderator points. For continuous moderators (sexual function and pain catastrophizing), these points were mean ±1 SD, and for PVD subtype, the slopes were computed separately for primary and secondary type. Most of the slopes were significant indicating that participants improved across the levels of moderators. However, the levels of moderators affected the size of improvement effects.

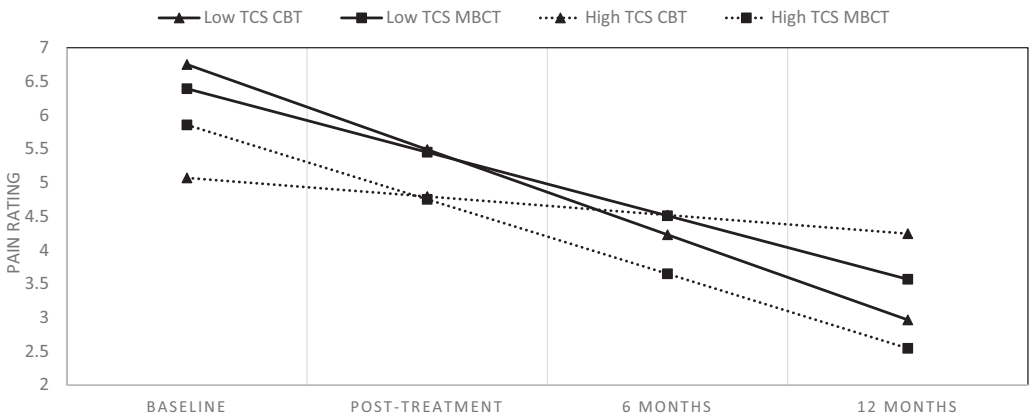

Figure 2. 3-way interaction effect of group, time, and baseline treatment credibility on pain intensity. CBT = cognitive behavioral therapy; MBCT = mindfulness-based cognitive therapy; TCS = treatment credibility score.

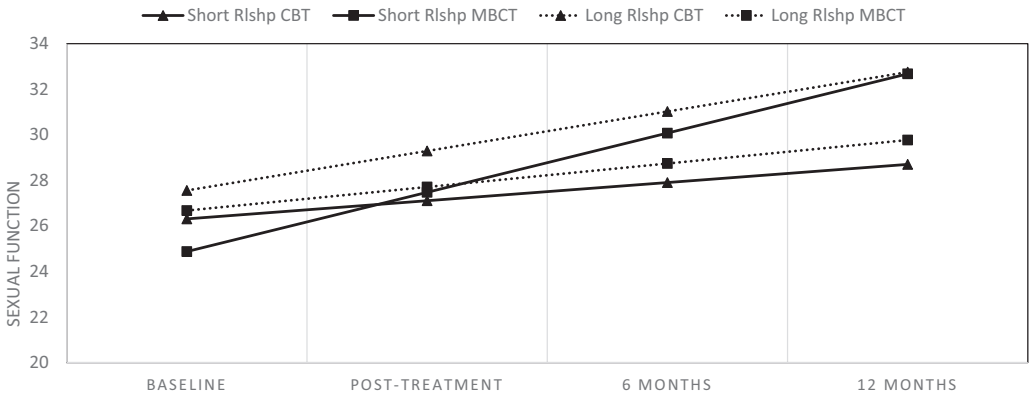

Figure 3. 3-way interaction effect of group, time, and baseline relationship length on sexual function. CBT = cognitive behavioral therapy; MBCT = mindfulness-based cognitive therapy; Rlshp = relationship.

DISCUSSION

The goal of the present study was to identify baseline moderators of treatment improvement for women receiving MBCT vs CBT for PVD. Both modalities are recommended as first-line treatments[7] and have shown excellent results[8,31] such that clinicians may wish to identify women most likely to benefit regardless of available treatment type. When MBCT and CBT are both feasible and accessible, predictors of outcome of each therapy may be particularly useful.

Greatest reduction of pain with sex was reported by women with more intense pain at baseline and those in shorter relationships regardless of treatment type. Some significant 3-way interactions are interesting: Women indicating higher treatment credibility after session 1 improved more with MBCT than with CBT in terms of pain intensity, whereas women lower in treatment credibility at the baseline improved to the same degree regardless of the treatment arm. Because the placebo response is widely accepted to account for some of the positive effects of (either pharmacologic or psychological) treatment,[25] measuring participants' expectations about treatment impact is important. Our finding that women with higher treatment credibility at baseline improved more on pain intensity with MBCT may be partly attributed to mindfulness' growing popularity[53] and to its greater reliance on patient "buy-in" for success compared with CBT, with its emphasis on behavioral skills training. When treatment credibility was lower, women improved the same regardless of their treatment group. Our findings differ somewhat from others who found that treatment credibility predicted improvements in women with vulvodynia 6 months after treatment with CBT.[19] These findings highlight the importance of clinicians assessing the degree to which patients believe a particular treatment will work for them, particularly as it appears with reference to belief in MBCT.

A second significant 3-way interaction points to the impact of relationship length on treatment induced improvements in sexual function. Women in shorter relationships improved more with MBCT than with CBT, whereas the opposite took place for women in longer relationships—those in CBT treatment improved more than those in MBCT treatment. Long-term dyspareunia may distance couples, and the behavioral components of CBT might bring both partners closer together to renew some physical intimacy and benefit sexual function generally. On the other hand, having one member of the couple engaged in a mindfulness practice in solitary might not have similar effects. In addition, because women's sexual function is markedly influenced by the partner, possibly CBT more easily inspires hope to

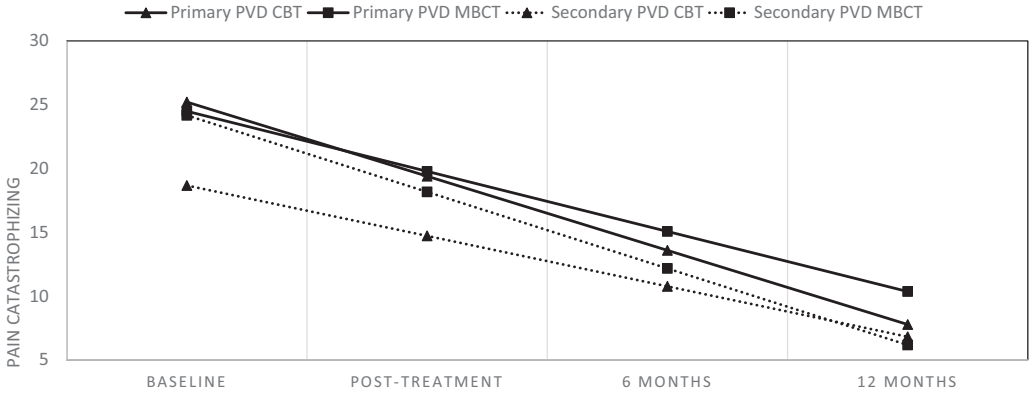

Figure 4. 3-way interaction effect of group, time, and PVD type on pain catastrophizing. CBT = cognitive behavioral therapy; MBCT = mindfulness-based cognitive therapy; PVD = provoked vestibulodynia.

Table 4. Simple slopes of treatment (time) predicting improvements in outcomes calculated at each of 2 treatment types and selected values of moderators (mean ± SD for treatment credibility and relationship length)

	Treatment			
	CBT		MBCT	
Moderators	*B(SE)*	*P*	*B(SE)*	*P*
Treatment credibility (predicting pain intensity)				
Low	−1.263 (0.254)	<.001	−0.942 (0.199)	<.001
High	−0.276 (0.180)	.1245	−1.105 (0.210)	<.001
Relationship length (predicting sexual function)				
Short	0.798 (0.417)	.0558	2.600 (0.474)	<.001
Long	1.731 (0.440)	<.001	1.032 (0.437)	.0181
PVD type (predicting pain catastrophizing)				
Primary	−5.813 (0.633)	<.001	−4.712 (0.586)	<.001
Secondary	−3.953(0.750)	<.001	−6.002 (0.828)	<.001

CBT = cognitive behavioral therapy; MBCT = mindfulness-based cognitive therapy; PVD = provoked vestibulodynia.

the partner—note that resuming penetrative sex is an early feature of the CBT program. This might change the partner's potential maladaptive behavior in response to their predicament.

Another study[32] found that longer relationship length was a moderator of improvement in pain intensity after CBT, yet a different study evaluating women with PVD found that relationship length did not predict unique variance on pain intensity 7 years later.[33] Here, we found that shorter relationships predicted greater improvements (regardless of treatment) on pain intensity. We and others[33] have also found that younger women reported greater reductions in pain with treatment than older women. Combined, it may be that younger age and shorter relationship duration work synergistically to predict greater improvements in pain. Future research should continue to explore the impact of relationship length and women's age on treatment outcomes in PVD to understand the mechanisms by which these variables may decrease pain intensity.

For women with primary PVD, CBT was modestly more effective than MBCT in reducing pain catastrophizing, whereas women with secondary PVD improved more with MBCT. Interestingly, there was a significant overall effect of treatment on pain catastrophizing, regardless of treatment group,[8] but the current findings indicate that this effect is impacted by whether women have primary vs secondary PVD. It is possible that women who acquired PVD after a period of pain-free sex respond better with MBCT's cultivation of acceptance and tolerance of anxiety-fueled catastrophic thoughts, in part because they recall a period of their life, pre-PVD, when they did not have vulvar pain and catastrophizing. On the other hand, women with a lifelong pattern of PVD may respond better to mastering the skill of altering thoughts to be more evidenced-based to reduce their pain catastrophizing. Indeed, others have concluded that women with primary PVD may fare worse than women with secondary PVD in terms of some psychosocial measures (eg, social and emotional functioning),[54] and it is possible, based on our findings, that CBT may be more effective in this situation for targeting pain catastrophizing.

Putative moderators that did not significantly interact with time and treatment type included age, baseline pain intensity, and mindfulness. That the latter did not moderate improvements after MBCT for any outcome measured may encourage physicians to recommend MBCT for treatment of PVD[8] regardless of how much baseline trait mindfulness a patient holds.

Although this study was originally designed as a randomized clinical trial, we were only able to meet randomization with approximately one-third of our participants. Owing to scheduling conflicts, which meant that a participant could not attend the group she was randomized to, or owing to changes in group schedule as a result of facilitator availability, most of our participants were not randomly assigned to group. While this may be viewed as a weakness in study design on the one hand, it also speaks to the purely clinical nature of our sample, which has a higher likelihood of generalizing study findings to other similar clinical samples.

Another significant limitation is that our primary treatment outcome, self-reported pain with sexual intercourse/penetration, was completed by only half of the sample given that it required women to have engaged in sexual activity in the previous 4 weeks to be valid. Different measures of pain outcomes likely tap into different aspects of the pain experience for women with PVD,[37,38] so our primary outcome measure may capture only a segment of women's experience. Moreover, the experiences of women who did not engage in sexual activity are unknown in regards to this outcome, and it may be that the significant moderators identified in this study may not hold for women who are not sexually active.

Overall, these findings provide information to clinicians to inform their choice of psychological treatment for PVD. Specifically, in the spirit of personalized health approaches,[55] we can conclude that patients who present with a high level of credibility about mindfulness, those in shorter relationships, and those with secondary PVD might be recommended mindfulness. On the

other hand, CBT might be recommended for women with primary PVD and women in longer term relationships despite a low level of expectation of benefit from this modality. Finally, since baseline pain intensity did not moderate outcomes differently by arm, clinicians might consider either MBCT or CBT to target pain intensity among patients with PVD.

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