The Mediating Role of Acceptance in Multidisciplinary Cognitive-Behavioral Therapy for Chronic Pain

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Abstract: Cognitive-behavioral therapy (CBT) is the most frequently delivered psychological intervention for adults with chronic pain. The treatment yields modest effect sizes, and the mechanisms of action remain understudied and unclear. Efforts are needed to identify treatment mediators that could be used to refine CBT and improve outcomes. The primary aim of this study was to investigate whether pain-related acceptance, from the psychological flexibility model, mediates changes in outcome over time in a CBT-based treatment program. This includes comparing how this variable relates to 3 other variables posited as potential mediators in standard CBT: life control, affective distress, and social support. Participants attended a 5-week outpatient multidisciplinary program with self-report data collected at assessment, posttreatment, and 12-month follow-up. Multilevel structural equation modeling was used to test for mediation in relation to 3 outcomes: pain interference, pain intensity, and depression. Results indicate that effect sizes for the treatment were within the ranges reported in the CBT for pain literature. Pain-related acceptance was not related to pain intensity, which is in line with past empirical evidence and the treatment objectives in acceptance and commitment therapy. Otherwise, pain-related acceptance was the strongest mediator across the different indices of outcome. Accumulated results like these suggest that acceptance of pain may be a general mechanism by which CBT-based treatments achieve improvements in functioning. More specific targeting of pain-related acceptance in treatment may lead to further improvements in outcome.

Perspective: Potential mediators of outcome in a CBT-based treatment for adult chronic pain were investigated using multilevel structural equation modeling. The results highlight the role of pain-related acceptance as an important treatment process even when not explicitly targeted during treatment. These data may help clinicians and researchers better understand processes of change and improve the choice and development of treatment methods.

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Key words: Acceptance and commitment therapy, acceptance, cognitive-behavioral therapy, chronic pain, mediator, multilevel structural equation modeling.

At present, cognitive-behavioral therapy (CBT) is the most widely used psychological treatment for adults with chronic pain and is considered a standard treatment. CBT-based treatments for chronic pain are multicomponent in nature, including methods to 1) increase knowledge about pain, 2) address beliefs that may interfere with engagement in activities, 3) improve patients’ skills and change their behavior, and 4) improve physical and social activity. Many different interventions are employed under the same general rubric of CBT for chronic pain. One example is multidisciplinary treatment for chronic pain, which often is based on a cognitive-behavioral framework. This format for delivery of treatment for chronic pain is frequently employed around the world, especially in
North America and Europe, and has established benefits. The modest effects for CBT for chronic pain have drawn increasing attention to the theoretical models that underpin CBT and multidisciplinary approaches that involve CBT more broadly. Greater efforts are needed to identify “process variables” or mediators that could be used to refine CBT and improve outcomes.

A large number of psychological variables have been identified as potential CBT process variables, including pain beliefs and perceived control over pain, social support, coping, self-efficacy, helplessness, affective distress, and catastrophizing. CBT-based treatments have typically taken a broad focus on processes for change and incorporated diverse packages of methods. So far, evidence from studies of these treatments has not revealed which processes and methods are most effective or necessary in determining outcome. In fact, relatively few treatment outcome studies have undertaken to measure and analyze possible mediators or change processes in chronic pain trials.

The process of “acceptance” first appeared in a study of chronic pain more than 20 years ago (Geiser, unpublished, 1992) though it is not currently a predominant focus within treatment development. It can be defined as the conscious embrace of psychological experiences when to otherwise attempt to avoid them negatively impacts on overall functioning. It is sometimes referred to as willingness or openness. Acceptance is a component of psychological flexibility, the core therapeutic focus of acceptance and commitment therapy (ACT). Components of psychological flexibility have been identified as mediators in trials of ACT for chronic pain. Also, pain-related acceptance appears to underlie improvement in outcomes for chronic pain where acceptance is specifically targeted, as in ACT, and where it is not targeted, as in traditional CBT approaches. It has been argued that psychological flexibility is a fundamental aspect of health. Here we focus on pain-related acceptance as similarly “fundamental” to outcome for chronic pain. Further, in previous studies of pain treatment, pain-related acceptance has not been compared with other potential mediators so that their relative contribution could be examined.

The primary aim of this study was to investigate whether pain-related acceptance mediates changes in outcome over time in a CBT-based multidisciplinary pain treatment program. This includes comparing how acceptance, which was not explicitly targeted, relates to 3 other potential mediators that are intended targets in broad CBT-based treatment packages and the examined treatment program: life control, affective distress, and social support.

Two hypotheses were tested in the present study. First, improvements on measures of pain interference, pain intensity, and depression at posttreatment and 12-month follow-up would be observed and the level of improvements would be consistent with previously published efficacy studies of CBT-based treatments for adults with chronic pain. Second, pain-related acceptance would demonstrate significant and unique mediating effects in relation to changes in outcome measures during treatment even when other potential mediators are taken in to account.

Methods

Participants
Participants were 409 consecutive referrals between 2009 and 2012 admitted to a 5-week, outpatient, CBT-based multidisciplinary program at the Pain Rehabilitation Unit at Skåne University Hospital. The unit is a government-supported, regional specialist center that also offers other treatment options and assessments. Patients are admitted to the 5-week program if they meet the following criteria: 1) are between 18 and 65 years of age, 2) speak Swedish fluently, 3) have symptoms of chronic pain that impact significantly on everyday life, 4) have undergone a full medical examination and received appropriate medical treatment where indicated, and 5) are able to function in a group setting and participate in a 5-week program involving 5 to 7 hours per day 2 to 4 days a week. Patients are not admitted to the program if they have acute or severe psychiatric disorders or symptoms; are actively abusing analgesic medications (including narcotics), alcohol, or other drugs; or have already undergone similar treatment. Patients are offered transportation to the clinic or provided with accommodation if they require it.

The participating patients were 342 women and 67 men between the ages of 18 and 61 years (mean = 41.7, standard deviation = 10). The majority (82.2%) were born in Sweden or another Nordic country. Most (55.2%) had upper secondary school as their highest education level, whereas 11.2% completed secondary school and 27.9% studied at university level. Approximately half of the participants (51.3%) were currently working or studying to some degree. The mean number of pain locations in the body was 15.9, with an average duration of pain of 7.3 years. The mean self-reported usual pain intensity over the past week (rated on 0–10 scale) was 7.2 (standard deviation = 1.6). The most commonly identified diagnosis was fibromyalgia (25.2%), followed by cervicocranial syndrome (15.9%), cervicobrachial syndrome (15.9%), low back pain (5.6%), and myalgia (4.6%). All participants gave written informed consent prior to their data being used in the study, and the Regional Ethical Review Board in Lund, Sweden (2013/381), gave ethical approval for the study.

Treatment

Three multidisciplinary teams with training in CBT and extensive experience of pain rehabilitation delivered the treatment based on cognitive-behavioral principles. The teams included an occupational therapist, a clinical psychologist, a physician, a physiotherapist, and a social worker. Team members met each patient for assessment
and attended meetings with the patient to clarify their personal goals and to formulate an individual rehabilitation plan. Patients participated in group-based sessions delivered by the team members on biopsychological explanations about pain and pain medications (physician); work-related and national insurance issues (social worker); and ergonomics, time-use adaptations, and problem-solving strategies (occupational therapist). Patients also participated in practical group activities concentrated on physical exercises, body awareness, and relaxation (physiotherapist) as well as everyday occupational performance (occupational therapist). Group sessions, focused on thoughts and emotions, communication training, behavioral home tasks, and stress-management skills, were held by the psychologist.

The main psychological interventions used were psychoeducation, cognitive restructuring, and behavioral activation in accordance with personal goals of patients. A core feature of the program was the CBT framework used to guide all interventions. For example, emphasis was placed on challenging behavior patterns and beliefs systematically during the practical group activities. Likewise, relevant knowledge was provided during all group-based sessions to facilitate stepwise behavior change in line with identified goals. Treatment integrity was upheld by frequent team meetings. Furthermore, team members co-led group sessions to enhance cooperation and consistency and further integrate delivery around a cognitive-behavioral framework. Significant others were invited for a half-day to participate in education and discussions about chronic pain and pain rehabilitation. The overall goals of the treatment program were to help patients improve their strategies for managing chronic pain and its consequences, to improve their perceived quality of life, to improve their ability to participate in everyday activities, to reduce their pain experience, and to increase the knowledge of significant others regarding pain and its consequences by inviting them to participate in the rehabilitation. The treatment components were generally not based on an acceptance-oriented philosophy.

Patients were enrolled in a day treatment program lasting 25 contiguous days. Patients attended the pain clinic 5 to 7 hours per day 2 to 4 days per week (18 active treatment days), with the rest of the weekdays being used for home practice. The patients were then discharged to a “homework phase” that lasted 2 months wherein patients worked on achieving their long-term goals as identified in their individual rehabilitation plan. At the end of the homework phase, the patients underwent a 2-day follow-up assessment (the posttreatment assessment) where progress, difficulties, and future goals were discussed. Twelve months after discharge from the day treatment program, patients were mailed a number of questionnaires they were asked to complete and return (the 12-month follow-up assessment).

**Measures of Treatment Outcome**

Self-report data were collected at an initial assessment, after treatment (2 months after discharge at the 2-day follow-up assessment), and 12 months after treatment. From these, we selected 3 different outcome measures that previously have been identified as core outcome domains in trials of patients with chronic pain: pain interference, pain intensity, and depression.8,49

Pain interference was measured using the Multidimensional Pain Inventory (MPI), version 2. The MPI has satisfactory psychometric properties.23 A Swedish version was used.19 The MPI, version 2, consists of 3 parts and 61 items, where each item is rated on a 7-point scale (0 = never; 6 = very often). Only part 1, which consists of 28 items and asks about the perception of pain and pain-related consequences, was included in this study. Pain interference was measured with the pain interference subscale from part 1. The 11-item subscale measures pain-related life interference, including interference with family and marital functioning, work and work-related activities, and social-recreational activities.19,44 The mean score was calculated for the scale.

Pain intensity was measured using a numerical rating scale. This is a single-item scale where the patient is asked to rate pain intensity over the past week on a scale ranging from 0 (no pain) to 10 (worst possible pain). The numerical rating scale is commonly used and has been shown to be a valid and sensitive measure when assessing changes in pain intensity.13

Depression was measured with the Hospital Anxiety and Depression Scale.28 The Hospital Anxiety and Depression Scale is designed to detect symptoms of anxiety and depression among patients in a medical setting. The Anxiety and Depression subscales each contain 7 items rated on a 4-point scale (0–3). Both the English original and the translated Swedish version have acceptable validity and reliability.24,58

**Measures of Proposed Mediators**

Pain-related acceptance was measured with the Chronic Pain Acceptance Questionnaire (CPAQ).35 The CPAQ is composed of 20 items rated on a 7-point scale (0 = never true; 6 = always true) and includes 2 subscales: Activity Engagement and Pain Willingness. Only the total score was used in the current study to allow analysis of acceptance of pain as a single construct.31,37 The CPAQ has satisfactory psychometric properties.36,53 The Swedish version of the CPAQ used in this study has similar psychometric properties as the English original.53

Life control, affective distress, and social support were measured using the respectively named subscales from part 1 of the MPI, version 2, where each item is rated on a 7-point scale (0 = never; 6 = very often). The mean score was calculated for each subscale. The Life Control subscale consists of 4 items that focus on the perceived ability to solve problems and feelings of personal mastery and competence. The Social Support subscale consists of 3 items measuring appraisal of support received from spouse, family, and significant others. The Affective Distress subscale consists of 3 items measuring low mood, irritability, and tension.39,44
Statistical Analyses

A series of t-tests was performed to examine potential differences between participants who provided complete and those who provided incomplete data. Descriptive statistics were produced to present demographic and clinical characteristics at pretreatment and outcome at posttreatment and 12-month follow-up. Effect sizes were calculated for each outcome measure over the observed time intervals (pre- to post-treatment and pretreatment to follow-up). To correct for correlated data, within-subject effect sizes (Cohen’s d) were calculated using the formula described by Dunlap et al.24 Controlled effect sizes for CBT for chronic pain patients usually fall in the small (d = .2) to moderate (d = .5) range.24 Taking a conservative approach and assuming that the current treatment achieves outcomes in the low end of this range, power analyses suggested that a sample size of 400 was sufficient to detect a pre-to-post versus follow-up treatment effect size of d = 0.2 with 80% power and P = .05.

Multilevel structural equation modeling (SEM) was used to evaluate change in treatment outcome measures across the assessment points and to investigate the indirect effects of the proposed mediators. The mediating or indirect effect refers to processes through which changes take place.27 Mediation analyses investigate the influence of a mediating variable (M) on a relationship between an independent (X) and a dependent (Y) variable. A mediating variable partly or fully accounts for the treatment effect. Complete mediation refers to an absence of treatment effect when the mediator has been controlled. Partial mediation occurs when the treatment effect is reduced by a nontrivial amount when the mediator has been controlled.1

Note that we apply the term “mediator” here specifically to the observed within-group or over time effect in a single-treatment cohort. This is to distinguish it from the more common use of the term in between-group designs. A single-treatment condition can contribute to an understanding of mediation processes but yields weaker evidence than studies with a control group and random assignment.29 Nevertheless, and in accordance with recommendations on the analysis of mediation,23,29 this study tested a model of mediation developed prior to undertaking the data analyses, attempted to address possible concerns about temporality by assessing change with a longitudinal design, utilized an adequate sample size, and examined multiple mediators simultaneously. By considering several mediators at the same time, we were able to evaluate the relative contribution of each mediator to outcome, although all mediators may be active and working in parallel.

A detailed description of multilevel SEM is beyond the scope of this article (see 40 for a detailed description). An advantage of multilevel SEM is that it permits grouping of data hierarchically at different levels. These “nested” groups can have independent or additive effects on results. For example, data can be grouped by time (level 1) (eg, pre- and posttreatment/follow-up) across all participants to investigate if change occurred across time.

Data can also be nested at the between-person level (level 2) to determine whether change differed across time between individuals. Multilevel SEM is suited to complex models and among other things allows one to simultaneously investigate the importance of 2 or more mediators.

In the present study, multilevel models were used to investigate if changes in pain interference, pain intensity, and depression (outcome measures) over time were mediated by changes in pain-related acceptance, life control, affective distress, and social support (mediators). Time was used as a proxy for treatment. Data were nested on 3 levels—time, between-person, and group—with approximately 10 patients in each treatment group. We did not have an a priori hypothesis regarding group effects because it was assumed that treatment delivery was essentially uniform and any group differences were assumed to be small. Thus, we used a 2-level modeling approach, stratifying data using the group variable. A similar analytical approach was employed by Vowles et al 57 in their study of mediation in adult chronic pain patients treated with ACT.

Version 7 of Mplus 38 was used to test a lower-level mediation model, a so-called 1-1-1 design as recommended by Preacher et al. 40 In this approach, the independent variable (time), mediators (eg, pain-related acceptance), and outcome (eg, depression) were assessed on level 1 with random intercepts and random slopes on level 2 (between-person). This type of estimation model permits structural coefficients to vary randomly across clusters. In other words, the analysis takes random factors, which are part of the data set, into account and therefore produces robust and realistic findings. The significance of the indirect effect was estimated using the product of coefficients and 95% confidence estimates.12 This method directly assesses the significance of the indirect, or mediating, effects.26

Age, education, and gender were grand-mean centered and included as level 2 (between-person) covariates in all multilevel models.11 All mediators were examined separately to test for individual mediating effects. Thereafter, all significant individual mediators were examined simultaneously to investigate the importance (variance accounted for) of each mediator in these parallel processes and to see if there was any overlap between them.

Results

Descriptive and Attrition Analyses

Based on the results of the power analysis, 409 patients were recruited to the study. A total of 8 dropped out of treatment because of medical or personal reasons. The remaining patients completed treatment but had some missing data points owing either to the patient’s failing to complete a particular measure or staff’s failing to administer a particular measure or to record the information in the electronic journal for that patient. Of the 409 patients enrolled in the study,
had missing values on the time variable, the covariates, cases were excluded analysis by analysis if they participants in the subsequent multilevel SEM analyses. and hence we used all available data from the 409 par- boxes indicated that scores on all measures were unrelated to treatment outcome, and hence we used all available data from the 409 participants in the subsequent multilevel SEM analyses. Cases were excluded analysis by analysis if they had missing values on the time variable, the covariates, or all variables except the time variable and the covariates. Visual inspection of histograms, normal Q-Q plots, and boxplots indicated that scores on all measures were approximately normally distributed. Outliers were identified by computing standardized scores and using absolute Z values larger than 3 as a cut-off (n = 15). Findings were consistent whether the analyses were conducted with or without outliers. Hence, few outliers (n = 15) were included in all subsequent analyses.

### Table 1. Means and Within-Subjects Effect Sizes for Treatment Participants

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>PRETREATMENT (M, SD)</th>
<th>POSTTREATMENT (M, SD)</th>
<th>12-Mo FOLLOW-UP (M, SD)</th>
<th>PRE- TO POSTTREATMENT COHEN'S d</th>
<th>12-Mo FOLLOW-UP TO TREATMENT COHEN'S d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain interference</td>
<td>4.6 (.9)</td>
<td>4.5 (.9)</td>
<td>4.2 (1.1)</td>
<td>.15</td>
<td>.35</td>
</tr>
<tr>
<td>Pain intensity</td>
<td>7.3 (1.4)</td>
<td>6.4 (2.1)</td>
<td>6.4 (2.1)</td>
<td>.48</td>
<td>.48</td>
</tr>
<tr>
<td>Depression</td>
<td>8.9 (4.1)</td>
<td>7.1 (4.4)</td>
<td>7.0 (4.6)</td>
<td>.43</td>
<td>.43</td>
</tr>
<tr>
<td>Mediator</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain acceptance</td>
<td>43.1 (16.5)</td>
<td>50.4 (15.2)</td>
<td>55.0 (16.0)</td>
<td>−.47</td>
<td>−.73</td>
</tr>
<tr>
<td>Life control</td>
<td>2.6 (1.1)</td>
<td>3.3 (1.2)</td>
<td>3.4 (1.2)</td>
<td>−.67</td>
<td>−.70</td>
</tr>
<tr>
<td>Affective distress</td>
<td>3.7 (1.0)</td>
<td>3.2 (1.2)</td>
<td>3.1 (1.3)</td>
<td>.50</td>
<td>.54</td>
</tr>
<tr>
<td>Social support</td>
<td>4.4 (1.4)</td>
<td>4.3 (1.2)</td>
<td>4.1 (1.4)</td>
<td>.09</td>
<td>.21</td>
</tr>
</tbody>
</table>

Abbreviations: M, mean; SD, standard deviation.

NOTE. Pain-related acceptance was measured with the CPAQ, pain intensity with the numerical rating scale, and depression with the Hospital Anxiety and Depression Scale. Pain interference, life control, affective distress and social support were assessed with the MPI. n = 171.

### Multilevel Mediation

All mediators were analyzed using all available data. Multilevel models were used to investigate whether significant changes in pain interference, pain intensity, and depression (outcome variables) over time were mediated by changes in pain-related acceptance, life control, affective distress, and social support (proposed mediators). The multilevel analyses for the mediating effects (univariate) on each outcome variable are presented in Table 2.

The a-path represents the effect of time on the mediator and the b-path the effect of the mediator on the outcome controlling for time. The c-path represents the total effect of time on outcome, and the c'-path represents the direct effect of time on outcome when controlling for the mediator. The mediating or indirect effect refers to the effect of the mediator on the relationship between time (a proxy for treatment) and changes on the outcome variables. The cross-product a*b directly assesses the significance of this effect. Confidence intervals are derived from the obtained distribution of a*b scores. If lower and upper bounds do not contain zero, the indirect effect is significant at the level specified in the analysis. The cross-product a*b is equivalent to the difference between the total effect of time (treatment) on outcome and the direct effect of time (treatment) on outcome when adjusting for the mediators (c-c').

As can be seen in Table 2, changes in pain interference during treatment were mediated (separately) by changes

### Multilevel SEM of Treatment Effect

Using all data available, a significant effect of time was observed on all outcomes at each assessment point in the multilevel SEM models. Specifically, decreases were observed in pain interference (n = 232) (B [standard error] = −.156 [.031], P < .001), pain intensity (n = 231) (B [standard error] = −.453 [.059], P < .001), and depression (n = 233) (B [standard error] = −.804 [.115], P < .001). No cross-level interaction between levels 1 and 2 was observed for any of the analyses. Thus, age, gender, and years of education (the level 2 covariates) had no significant impact on outcome in the present sample.
in each of the proposed mediators. However, changes in pain intensity and depression were mediated only by changes in pain-related acceptance, life control, and affective distress. All significant mediators were partial mediators because they reduced the effect of time on outcomes by a nontrivial amount.

Next, mediators found to be significant on the univariate level were examined in a multivariate fashion in relation to each outcome measure (see Table 3). All direct effects (c*) were nonsignificant when controlling for the combined effect of the mediators included in the analyses. Thus, the effect of time (treatment) on outcome was completely mediated by the combined effect of the proposed mediators included in the analyses. Specifically, changes in pain-related acceptance, life control, affective distress, and social support all mediated change in pain interference during treatment, but pain-related acceptance had the strongest indirect effect. For outcome as indexed by pain intensity, only changes in life control and affective distress were simultaneous and significant mediators. For depression, changes in pain-related acceptance, life control, and affective distress all significantly and simultaneously mediated changes in depression. However pain-related acceptance was the strongest mediator.

Discussion

Consistent with the treatment outcome literature, a multidisciplinary, 5-week, CBT-based treatment delivered in a specialist pain unit in southern Sweden produced significant improvements in overall functioning for adults with chronic pain. In line with published trials, the improvements at the 12-month follow-up were modest, with uncontrolled effect sizes of .35 for pain interference, .48 for pain intensity, and .43 for depression. Although not the primary aim of this study, the present findings contribute to a larger body of evidence indicating that CBT-based approaches are empirically supported for chronic pain but could be improved.

We undertook multilevel SEM to assess both the individual and simultaneous effects of change in 4 proposed mediators of treatment outcome. Life control, affective distress, and social support are considered legitimate potential processes of change in treatments such as the one studied here. Although not the primary aim of this study, the present findings contribute to a larger body of evidence indicating that CBT-based approaches are empirically supported for chronic pain but could be improved.

Table 2. Results of Univariate Mediator Analyses

<table>
<thead>
<tr>
<th>Outcome</th>
<th>n</th>
<th>Mediator</th>
<th>Path</th>
<th>Point Estimate (SE)</th>
<th>95% CI</th>
<th>Results for Indirect Effects A*b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain interference</td>
<td>233</td>
<td>Pain acceptance</td>
<td>a</td>
<td>.331* (.030)</td>
<td>-.153* (.024)</td>
<td>-.214 - -.114</td>
</tr>
<tr>
<td>Life control</td>
<td>235</td>
<td>a</td>
<td>b</td>
<td>-.462* (.050)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Affective distress</td>
<td>235</td>
<td>a</td>
<td>b</td>
<td>-.256* (.034)</td>
<td>-.095* (.017)</td>
<td>-.139 - -.068</td>
</tr>
<tr>
<td>Social support</td>
<td>235</td>
<td>a</td>
<td>b</td>
<td>.057* (.006)</td>
<td>-.079* (.016)</td>
<td>-.120 - -.053</td>
</tr>
<tr>
<td>Pain intensity</td>
<td>237</td>
<td>Pain acceptance</td>
<td>a</td>
<td>.337* (.031)</td>
<td>-.167* (.040)</td>
<td>-.270 - -.101</td>
</tr>
<tr>
<td>Life control</td>
<td>238</td>
<td>a</td>
<td>b</td>
<td>-.495* (.112)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Affective distress</td>
<td>238</td>
<td>a</td>
<td>b</td>
<td>-.638* (.070)</td>
<td>-.239* (.037)</td>
<td>-.334 - -.178</td>
</tr>
<tr>
<td>Social support</td>
<td>238</td>
<td>a</td>
<td>b</td>
<td>.511* (.065)</td>
<td>-.143* (.029)</td>
<td>-.217 - -.095</td>
</tr>
<tr>
<td>Depression</td>
<td>235</td>
<td>Pain acceptance</td>
<td>a</td>
<td>.326* (.031)</td>
<td>-.556* (.080)</td>
<td>-.761 - -.425</td>
</tr>
<tr>
<td>Life control</td>
<td>236</td>
<td>a</td>
<td>b</td>
<td>1.704* (.193)</td>
<td>-.537* (.0729)</td>
<td>-.722 - -.418</td>
</tr>
<tr>
<td>Affective distress</td>
<td>236</td>
<td>a</td>
<td>b</td>
<td>-.1447* (.126)</td>
<td>-.097* (.017)</td>
<td>-.140 - -.069</td>
</tr>
<tr>
<td>Social support</td>
<td>236</td>
<td>a</td>
<td>b</td>
<td>-.148* (.033)</td>
<td>.018 (.024)</td>
<td>-.044 .058</td>
</tr>
</tbody>
</table>

Abbreviations: SE, standard error; CI, confidence interval.
NOTE. The indirect effect is statistically significant if the CI does not include zero. A 95% CI is equivalent to a value of $P \leq .05$. Asterisks indicate a statistically significant effect ($P < .05$).
Distress during treatment also significantly partially mediated outcomes on all measures. Changes in social support were found to significantly partially mediate pain interference but not pain intensity or depression. Once again, our use of the term mediate here applies to a within-group effect over time in a treated sample and not to a between-group effect between a treatment group and control group.

When examining the mediators in a multivariate fashion, the relative importance of the potential mediators appears more clearly. First, pain-related acceptance remained a significant independent contributor to changes in outcome as measured by pain interference and depression, over and above the effects of changes in life control, affective distress, and social support during treatment. When considering outcome as indexed by pain interference, a primary outcome measure across treatment trials, pain-related acceptance was the strongest of the mediators evaluated (.72 for pain-related acceptance versus .15 for life control, .13 for affective distress, and .31 for social support).

Pain-related acceptance, in contrast to the other proposed mediators, was not related to pain intensity in the multivariate analyses. The univariate analyses suggested that pain-related acceptance was only weakly related to change in pain intensity. These results are compatible with past empirical evidence and with the explicit treatment objectives of ACT, which seeks to improve functioning by increasing psychological flexibility rather than reductions in pain or distress. The current findings suggest that, as process variables, changes in life control and affective distress were most important to treatment outcome as indexed by pain interference and depression—and not as indexed by pain interference. In contrast, changes in social support appeared to have little relation to changes in pain interference, pain intensity, or depression. The theoretical model underpinning CBT as it is usually applied certainly includes a role for life control, affective distress, and social support.

Out of this range of theoretically consistent mediators, which were specifically targeted during the program, life control stood out as an important mediator.

Abbreviations: SE, standard error; CI, confidence interval; na, not applicable.
NOTE. The indirect effect is statistically significant if the confidence interval does not include zero. A 95% confidence interval (CI) is equivalent to a value of P ≤ .05. Asterisks (*) indicate a statistically significant effect (P < .05).
interventions that are directed at the weaker mediators or to reconsider the relative value of interventions that target these mediators in multicomponent treatment packages. Certainly, future studies are needed with designs that allow treatment components to be targeted to address mediator or process variables that are relevant to particular patients.

Previous investigations examining potential process variables in CBT approaches for chronic pain have focused largely on pain beliefs and perceived control over pain, social support, coping, self-efficacy, helplessness, affective distress, and catastrophizing. These process variables have been investigated because they reflect typical targets of traditional multicomponent CBT packages, and evidence suggests that changes in these variables indeed are associated with the treatment outcomes observed. Findings from the present study and those of Vowles et al and Baranoff et al suggest that changes in an additional process variable that is not considered a target of traditional CBT, namely, pain-related acceptance, may also play an important role in the outcomes achieved within the approach. We were constrained here by the available data and did not analyze pain beliefs, catastrophizing, coping, self-efficacy, and helplessness. We therefore cannot comment on the relative importance of these process variables in relation to pain-related acceptance, nor can we comment on potential interactions between them. Further studies are needed that examine a wide range of theoretically driven process variables, involving large sample sizes, control groups, and more frequent monitoring of process variables.

Findings from the present study must be viewed within the context of certain statistical and design limitations. According to Maric et al, mediation studies can be viewed as falling on a continuum or ladder of evidence. As the current study involved a single-treatment condition, it falls at the lower end of this ladder. Studies at every level can help us understand mediation processes, but the strongest evidence is found in studies with a control group and random assignment. Mediation findings from a study involving a single-treatment condition, such as the present study, must be interpreted with caution as time effects are not necessarily due to the effects of treatment. Nevertheless, as Maric argues, a single-group design can still contribute to an understanding of mediation processes, and this is evidenced by several recent investigations of mediation in single-treatment groups.

The statistical approach employed here (in the absence of a control group) uses time as a proxy for treatment. Although inferences must be drawn cautiously when using such a design, we note that participants in this study reported a mean number of pain locations in the body of 15.9, with an average duration of pain of 7.3 years. It seems unlikely that the current patients would have significantly improved during the investigated time period without treatment. Furthermore, process variables were measured at the same time as the outcome variables at pre- and posttreatment and at follow-up. More frequent measurement of the process and outcome variables may have permitted a more detailed analysis of temporality, where change in the mediator is shown to precede change in the outcome variable.

To use the available data to maximum advantage, and to ensure that the studied sample would be representative of patients admitted to treatment at a specialist pain treatment center, we included patients in our analyses who had missing data on 1 or more of the studied variables at 1 or more of the assessments. Although it cannot be completely ruled out, attrition and sensitivity analyses strongly suggested that missing data did not bias our findings for either outcome or mediation. Missing data appear to reflect failures in data collection, as only 8 patients dropped out of treatment. Other limitations include the exclusive reliance on self-report measures and the fact that treatment was not delivered according to a manualized protocol. Generalizability of the findings may also be limited, as 83.6% of the participants were women, and 27.9% studied at university level. This demographic makeup is somewhat unusual in comparison to epidemiologic studies of pain in Sweden, but similar to patients seen at other tertiary pain clinics, as described in the 2015 report from the Swedish Quality Registry for Pain Rehabilitation (76% women and 25% studied at university level).

Finally, a limitation of this study and of multidisciplinary-delivered, multicomponent CBT treatment programs in general is the difficulty pinpointing the interventions that carry the largest impact on treatment processes and/or outcomes. To be clear, this study was not designed to isolate the impact on acceptance of any individual treatment component. We cannot specify whether an individual or combination of interventions had an impact on this process. Nonetheless, it would seem reasonable to think that staff modeling of acceptance or interventions such as behavioral activation, goal setting, and physical exercise that help to coordinate greater activity without requiring that reduction in pain or psychological discomfort happen first are likely key ingredients in treatment. If improved outcomes are to be achieved in multidisciplinary, multicomponent CBT programs, further studies are needed to identify specific components that are “active” in relation to pain acceptance, other relevant mediators, and outcome.

In summary, these data from clinical practice highlight the role of pain-related acceptance as a potential key therapeutic process in a treatment not specifically designed to target acceptance, a treatment based on a traditional CBT model. Acceptance of pain is a part of the psychological flexibility model that underpins ACT. The psychological flexibility model includes processes that encourage the individual to act in accordance with their personal values, in the presence of potentially interfering thoughts and feelings, and with a greater appreciation of what the current situation or context allows. The model is explicit about its core scientific strategy and philosophical assumptions. A major strength of the model is also that it can be considered integrative because it specifies 6 key processes that seem able to organize wide-ranging treatment-related...
variables into a smaller number of functional dimensions. As a result, this model may support a degree of theoretical integration, a clear focus on treatment process, and may hasten progress in the field of pain management. We propose that more precise targeting of acceptance and other facets of psychological flexibility may increase the effectiveness of multidisciplinary treatments based broadly within CBT, and this proposal remains to be further investigated.

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