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Pain acceptance-based coping in complex regional pain syndrome Type I: daily relations with pain intensity, activity, and mood

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Abstract This study aimed to examine the temporal patterning of pain acceptance-based coping, activity, and mood in patients with complex regional pain syndrome Type I (CRPS-I), by using a daily diary method. A total of 30 patients with CRPS-I seeking treatment in a tertiary pain management center located in Seoul, Korea participated in the study. Multilevel random effects analyses indicated that (a) engagement in pain acceptance-based coping was significantly associated with lower same-day pain and negative mood and greater same-day activity and positive mood; (b) pain acceptance-based coping predicted increases in activity on the following day; (c) greater pain intensity was significantly associated with lower same-day pain acceptance-based coping and activity and greater same-day negative mood; and (d) pain intensity did not predict pain acceptance-based coping, activity, or mood on the following day. These findings suggest that patients with CRPS-I may benefit from responding to pain with acceptance. Further study and eventual application of this process in CRPS-I may improve upon the success of current approaches to this problem.

Keywords CRPS Type I · Pain acceptance-based coping · Activity · Mood · Diary method

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Introduction

Complex regional pain syndrome Type I (CRPS-I) is a chronic pain syndrome characterized by pain out of proportion to the original injury, usually in an extremity, and often without obvious nerve lesion (Geertzen et al., 1998; Ribbers et al., 1995). Characteristics of CRPS-I include spontaneous pain, allodynia (pain due to a stimulus that is not normally painful), and hyperalgesia (increased sensitivity to pain) (Schwartzman et al., 2006). Other clinical features include edema, changes in skin color and temperature, or sudomotor abnormalities in the affected region (Schwartzman & Popescu, 2002). CRPS-I is relatively unresponsive to traditional pain management interventions, can lead to wide ranging physical and psychosocial problems (e.g., impaired mobility, sleep difficulty, depression) (Bruehl & Chung, 2006), and is, thus, challenging for clinicians and patients alike (Moon et al., 2009).

Pain relief is a natural goal for individuals with chronic pain including CRPS-I and attempting to reach this goal is a struggle for many (Dworkin, 1991). However, this effort is often unsuccessful whether that includes medical (Turk et al., 1998) or psychological strategies (Skevington, 1995).

Until recently, psychological approaches to chronic pain have included largely strategies focused on controlling pain sensations, pain-related thoughts, and negative emotions (Turk & Okifuji, 2002). However sometimes, trying to control or avoid such experiences can produce unintended opposite effects and exaggerate their impact. In particular, unintended adverse effects can happen when attempts to control or avoid pain increase the negative influences of pain rather than decreasing them. Essentially, when a certain behavior is focused upon reducing pain, pain simultaneously becomes the dominating influence and thus pain becomes more rather than less salient. Consequently, failure and frustration can be experienced, in addition to the original pain. Thus more recently, there is an increasing emphasis on acceptance of pain, as opposed to control of it, and this emphasis appears to provide benefits. This particular approach is included in Acceptance and Commitment Therapy (ACT; Hayes et al., 1999). ACT proposes that behavior problems and suffering derive largely from psychological inflexibility. This process includes subprocesses called experiential avoidance, cognitive fusion, preoccupation with the past or future, a sense of self that lacks a separate perspective, and a lack of clear values-based or committed action. The primary therapy process in ACT is psychological flexibility, defined as "an individual's ability to be aware of thoughts, feelings and urges, defuse those that are unproductive, and choose appropriate responses" (Hayes et al., 2006).

As a component of psychological flexibility, acceptance of pain does not involve simply a passive resignation in the face of pain. Rather, it involves the pursuit of valued life activities without efforts to avoid or control pain sensations and concomitant emotional and cognitive responses (Mc Cracken et al., 2004). Numerous studies now demonstrate that pain acceptance contributes significantly to physical and psychosocial adjustment in individuals with chronic pain (Reneman et al., 2010 for a review). Furthermore, compared with predominantly control-based coping, acceptance-based coping has been shown to be a stronger predictor of patient adjustment (McCracken et al., 2007).

Considerable research has examined relations between pain coping and adjustment to chronic pain (e.g., Affleck et al., 1992; Jensen et al., 1991; Keefe et al., 1992, 1997; Lefebvre et al., 1999; McCracken & Eccleston, 2003, 2006; McCracken et al., 2007; Turner et al., 2000). A few studies have focused on pain acceptance-based coping (McCracken & Eccleston, 2003, 2006; McCracken et al., 2007). However, most studies of pain acceptance have relied on retrospective assessment, which may be insensitive to changes and effects of these responses over the shorter term (Keefe et al., 1997). In the initial period, coping was conceptualized as a dynamic process of continuous interactions between a person and environment, rather than a single event (Lazarus & Folkman, 1984). Hence, coping processes ought to be assessed over time to better understand their interactions and dynamic nature. The daily diary method involving self-monitoring of coping processes across each day of the assessment period allows such dynamic finer-grained assessment. It permits within-person data analysis to capture daily changes in study variables over time and reduce random measurement errors (e.g., errors due to recalling problems when reporting study variables). Also, the analysis can control for potential confounding factors such as personality and pain duration, thus strengthening inferences with respect to temporal patterns between the study variables (Tennen & Affleck, 1996).

Keeping a daily diary can provide such advantages for assessing the dynamic feature of coping and thus has been increasingly utilized in the relevant studies. Given the intractable nature of CRPS-I, an approach that focuses on psychological flexibility, specifically acceptance of pain may be relevant. To our knowledge, no study has yet empirically investigated how the use of pain acceptance-based coping strategies on a certain day relates to changes in pain, activity, or mood both on that day and on later days in patients with CRPS-I.

The purpose of this study was to examine the temporal patterning of pain acceptance-based coping, pain intensity, activity, and mood in patients with CRPS-I, by using a daily diary method. Our primary prediction was that greater engagement in pain acceptance-based coping would be significantly associated with increases in activity and positive mood and decreases in negative mood on the following day. Also, we predicted that pain acceptance-based coping would correlate with activity and mood, independent of pain intensity. Given that acceptance of pain is not considered as a way to reduce pain per se, but rather a way to reduce the impact of pain on functioning (Dahl et al., 2005), we examined relations between acceptance of pain and pain intensity without proposing specific expected results.

Methods

Participants

Forty patients with CRPS-I were invited from a tertiary pain management center in Seoul, Korea. The inclusion criterion for the present study included meeting the diagnostic criteria for CRPS-I proposed by the International Association for the Study of Pain: (1) the presence of an initiating noxious event without nerve lesion, (2) continuing pain, allodynia, or hyperalgesia, (3) edema, changes in skin blood flow or sudomotor activity in the region of pain, and (4) other diagnoses are excluded (Harden et al., 2007). A pain physician, one of the authors of this study, verified that participants had met these eligibility requirements.

While 40 patients met the criteria, 10 (60.0 % male) of them refused to participate in the study, primarily due to severe pain at the time of invitation to the study, resulting in a final sample of 30 patients (73.3 % male). They had no treatment experience explicitly focused on pain acceptance. The mean age of the sample was 36.2 years (SD = 8.7) and most had at least a high school education (90.3 %). Around half of the sample was married (58.1 %) and most were not working (80.6 %). Demographic characteristics of the sample are presented in Table 1.

Procedure

Informed consent was obtained from 30 participants. During an initial evaluation at the pain management center, they completed a demographic questionnaire only. After the initial evaluation, they were asked to complete a daily diary including measures of daily pain acceptance-based coping, pain intensity, physical activity, and positive and negative mood for 10 consecutive days, at their home. Participants also were instructed to wear a pedometer supplied by a researcher. They were instructed to record their data on the diary at the end of each day and to report it to the researcher by email or a text message no later than the following morning. When participants did not report their data by the following morning, they received a reminder to do so by a text message. All participants were reminded of conducting self-monitoring each morning throughout the 10-day recording period, again by text message. Participants were compensated (approximately US$ 10) for their time. This procedure was approved by the Institutional Review Board.

Table 1 Demographic characteristics of the sample (N = 30)

Variable	Statistic
Age (years)	
M	36.2
SD	8.7
Sex (%)	
Men	73.3
Women	26.7
Marital status (%)	
Married	58.1
Non-married	41.9
Education level (%)	
≥High school	90.3
Employment status (%)	
Working (including student)	19.4
Not working	80.6
Pain site (%)	
Upper extremities	23.3
Lower extremities	20.0
Both extremities	20.0
Other	36.7

Daily diary measures

Daily pain acceptance-based coping was measured by the 15-item Brief Pain Response Inventory (BPRI) (McCracken et al., 2010). For this study, a Korean speaking clinical psychologist translated the BPRI into Korean. Then, a Korean-English bilingual graduate student back-translated it into English. The back-translation version was reviewed by one of the original authors of the BPRI and revised accordingly. We employed the BPRI rather than other classical acceptance tools, such as the Chronic Pain Acceptance Questionnaire (CPAQ; McCracken et al., 2004), since the BPRI focuses on discrete responses more so than the CPAQ and this was the intended focus of the study. The BPRI consists of two subscales such as flexible action, for example, "kept doing what I was doing without letting pain stop me," and willing engagement, "avoided painful activities" (reverse-keyed). In the original BPRI each item is rated on an eight-point scale ranging from 0 to 7 (days), based on the number of days in the previous week they had acted in the ways described, in relation to their pain. In this study, all of the original items of the BPRI were retained, but its instruction and rating scale were modified to reflect the daily aspect of pain acceptance-based coping. For example, participants were asked to indicate whether in the day they had acted in the ways described, in relation to their pain (no coded 0, yes coded 1). Thus, total scores ranges from 0 to 15, with higher scores representing greater daily pain acceptance-based coping.

Daily average pain intensity was measured by a single-item numeric rating scale. The item was rated on an eleven-point scale ranging from 0 (none) to 10 (worst imaginable), with higher scores representing more severe pain.

Daily physical activity was measured by pedometer step counts, with more step counts representing greater activity levels.

Daily mood was measured by the 9-item Daily Mood Scale (DMS) (Diener & Emmons, 1985). For this study, a Korean speaking clinical psychologist translated the DMS into Korean. The DMS consists of two subscales, positive mood and negative mood. Positive mood includes happy, joyful, pleased, and enjoyment/fun and negative mood includes unhappy, depressed, frustrated, worried/anxious, and angry/hostile. Each item of the DMS is rated on a six-point scale ranging from 0 to 5. Total scores of the positive mood subscale and negative mood subscale range from 0 to 25 and 0 to 20, respectively, with higher scores representing a greater degree of the corresponding mood.

Statistical analyses

The SPSS 18.0 for Windows software was used for the analyses. We employed multilevel models to analyze temporal data of this study. Multilevel models involve a two-level approach such as specifying daily changes in the within-person factors and specifying individual characteristics/differences in the between-person part of the model. Multilevel models present several advantages over traditional approaches for analyzing temporal data (Schwartz & Stone, 1998). First, they can investigate whether the relationship between variables at one level is contingent on a variable at another level. For example, the relationship between pain coping and depression may depend on a diagnosis of pain. Second, they allow for unequal numbers of observations per participant. Third, they can deal with missing data and serial dependency (or autocorrelation between successive daily assessments of study variables) flexibly. Fourth, the unit of analysis is successive observations from the same individuals, days in the present study. Given a small sample size (N = 30) in the present study, the total number of possible observations is relatively large, in this case 300 observations for each of 5 variables (30 participants * 10 days). Because the hypotheses of this present study were related to within-person changes in the dependent variables (i.e., pain intensity, activity, and mood), only the within-person, time-varying factors were examined, and not between-person factors. This approach adjusts the resulting model estimates for correlations among the within-person variables (Heck & Thomas, 2009). The fixed effects components of the models consisted of pain acceptance-based coping (and pain intensity for reverse model), while the random effects components of the models consisted of participants' individual intercept. Also for repeated covariance structure, autoregressive variance structure was selected and applied to all of the models.

Results

Of the 300 possible diary days (30 study participants * 10 days), study participants completed 299 days (99.9 %). Table 2 presents the means and standard deviations for pain acceptance-based coping, pain intensity, activity, and mood.

Daily pain acceptance-based coping with same-day pain intensity, activity, and mood

Multilevel random effects analyses were used in order to examine the association between pain acceptance-based coping and same-day pain intensity, activity, and mood.

Table 2 Means and standard deviations of daily scores for pain acceptance-based coping, pain intensity, activity, and mood

Variable	Possible range*	Mean (SD)
Pain acceptance-based coping	0–15	5.91 (4.32)
Pain intensity	0–10	6.59 (1.91)
Activity (steps)	0≤	2,597.39 (1,631.90)
Negative mood	0–35	17.75 (8.36)
Positive mood	0–30	11.23 (7.82)

* Maximum range of pedometer ratings for activity have not been established

Greater pain acceptance-based coping were significantly associated with lower same-day pain ($t = -4.77$, $p < .001$) over and above previous day's pain; lower negative mood ($t = -4.90$, $p < .001$) over and above same-day pain and previous day's negative mood; greater same-day activity ($t = 2.66$, $p < .05$) over and above same-day pain and previous day's activity; and greater positive mood ($t = 2.32$, $p < .05$) over and above same-day pain, same-day negative mood, and previous day's positive mood (Table 3).

Daily pain acceptance-based coping with next-day pain intensity, activity, and mood

It is also possible that pain acceptance-based coping could temporally precede pain intensity, activity, or mood. In other words, pain acceptance-based coping could influence pain intensity, activity, or mood on the following day. Thus, we conducted the same analyses above in order to investigate the association between pain acceptance-based coping and next-day pain intensity, activity, and mood. Unexpectedly, only pain acceptance-based coping pre-

Table 3 Summary of multilevel random effects analyses of associations between pain acceptance-based coping and same-day pain intensity, activity, and mood

	Pain acceptance-based coping as a predictor	
	β	t
Same-day		
Pain intensity[a]	−.12	−4.77***
Activity[b]	197.87	2.66*
Negative mood[c]	−.59	−4.90***
Positive mood[d]	.30	2.32*

[a] Controlling for previous day's pain intensity

[b] Controlling for same-day pain intensity and previous day's activity

[c] Controlling for same-day pain intensity and previous day's negative mood

[d] Controlling for same-day pain intensity, same-day negative mood, and previous day's positive mood

* $p < .05$; *** $p < .001$

Table 4 Summary of multilevel random effects analyses of associations between pain acceptance-based coping and next-day pain intensity, activity, and mood

	Pain acceptance-based coping as a predictor	
	β	t
Next-day		
Pain intensity[a]	−.04	−1.25
Activity[b]	97.65	1.95*
Negative mood[c]	−.01	−.13
Positive mood[d]	−.07	−.71

[a] Controlling for same-day pain intensity

[b] Controlling for next-day pain intensity and same-day activity

[c] Controlling for next-day pain intensity and same-day negative mood

[d] Controlling for next-day pain intensity, next-day negative mood, and same-day positive mood

* $p < .05$

Table 5 Summary of multilevel random effects analyses of associations between pain intensity and next-day pain acceptance-based coping, activity, and mood (reverse model)

	Pain as a predictor	
	β	t
Same-day		
Pain acceptance-based coping[a]	−.64	−4.69***
Activity[b]	−361.60	−4.00***
Negative mood[c]	1.64	8.52***
Positive mood[d]	−.01	.20
Next-day		
Pain acceptance-based coping[e]	−.27	−1.69
Activity[f]	−185.02	−1.74
Negative mood[g]	.13	.47
Positive mood[h]	.25	.95

[a] Controlling for previous day's pain acceptance-based coping

[b] Controlling for previous day's activity

[c] Controlling for previous day's negative mood

[d] Controlling for same-day negative mood and previous day's positive mood

[e] Controlling for same-day pain acceptance-based coping

[f] Controlling for same-day activity

[g] Controlling for same-day negative mood

[h] Controlling for next-day negative mood and same-day positive mood

*** $p < .001$

dicted increases in activity on the following day (t = 1.95, $p < .05$) over and above next-day pain and same-day activity (Table 4).

Reverse relationships

It is possible that the intensity of pain itself may serve as a stressor and initiator of changes in pain acceptance-based coping, activity, and mood. Thus, pain on one day could lead to decreases in pain acceptance-based coping, positive mood, and activity and increases in negative mood on the following day. Using multilevel random effects analyses, we examined the possibility of the relationship and the results showed that greater pain was significantly associated with lower same-day pain acceptance-based coping (t = −4.69, $p < .001$) over and above previous day's pain acceptance-based coping; lower same-day activity (t = −4.00, $p < .001$) over and above previous day's activity; and greater in same-day negative mood (t = 8.52, $p < .001$) over and above previous day's negative mood; but not associated with same-day positive mood (Table 5). Also, pain intensity did not predict pain acceptance-based coping, activity, and mood on the following day (Table 5).

Discussion

The purpose of this study was to examine the temporal patterning of daily pain acceptance-based coping, pain intensity, activity, and mood in patients with CRPS-I. These temporal relations were examined in a within-person level across time, using multilevel modeling, an approach with several advantages over traditional approaches for analyzing such data (Schwartz & Stone, 1998). Overall, daily pain acceptance-based coping was a significant predictor of pain intensity, activity, and mood on the same day, and of activity on the following day. These findings are important in that this is the first study, to our knowledge, to examine daily fluctuations in pain acceptance-based coping, pain intensity, activity, and mood in a prospective diary design with patients with CRPS-I.

Same-day within-person analyses showed that greater pain acceptance was significantly associated with lower same-day pain intensity and negative mood and greater same-day activity and positive mood. These findings were consistent with the prior retrospective studies (Reneman et al., 2010 for a review). A stronger case for causal temporal relations may be drawn from our findings of lagged effects of pain acceptance-based coping on activity on the following day. These sequential daily analyses indicated that pain acceptance-based coping predicted increases in activity, but not in pain intensity and mood on the following day. These findings suggest that pain acceptance-based coping may temporally precede activity, but not pain intensity and mood. Acceptance-based coping is an in-the-moment process and at the same time patterns of

acceptance-based coping are likely to have some consistency over time, such as one day and the next. Given that pain acceptance-based coping primarily involves pursuit of life activities regardless of pain (McCracken et al., 2004), activity engagement may be the most direct and consistent outcome of acceptance-based coping. On the other hand, pain intensity and mood may vary and correlate with acceptance-based coping, but these relations may be less direct and more easily disintegrated.

It is important to understand how pain intensity and pain acceptance-based coping relate to activity engagement because in general patients with CRPS-I frequently miss work or quit work and disengage from daily life activities due to pain (Correll et al., 2004). Such disengagement may lead to or exacerbate harmful physical and psychosocial consequences, such as physical disability, depression, and social isolation (Bruehl & Chung, 2006; van den Berg-Emons et al., 2007). Activity engagement is conceptually related to pain acceptance-based coping which primarily involves pursuit of life activities regardless of pain (McCracken et al., 2004). Thus, pain acceptance-based coping may play an important role in a person's choices to engage in an activity when pain is present, and this could lead to longer term benefits. Although we did not examine the contribution of activity to pain intensity and mood in this study, research has long demonstrated that greater activity is predictive of better physical and psychosocial functioning in patients with chronic pain (e.g., Hoffman & Hoffman, 2007; Janal et al., 1994; Nichols & Glenn, 1994). Future studies may examine consequences of persistent acceptance over longer time frames.

The findings above need to be understood in light of those of the reverse-model analyses that investigated pain intensity as a predictor of pain acceptance-based coping, activity, and mood on the following day. The reverse-model analyses indicated that greater pain intensity was significantly associated with lower pain acceptance-based coping, lower activity, and greater negative mood on the same-day. However, pain intensity was not predictive of them on the following day. Considering the findings overall, pain itself might serve as a stressor leading to changes in pain acceptance-based coping, activity, and negative mood on the same-day, but not the following day. On the other hand, pain acceptance-based coping may exert its effects on activity until the following day. Given these findings, patients with CRPS-I may benefit from understanding that the negative impact of life activity does not stem as much from pain intensity, but from the lack of acceptance of pain. Thus, if these results are further confirmed, health professionals may consider assisting patients in using acceptance-based coping methods for pain.

The findings of this study may have implications for treatment strategies in patients with CRPS-I. From an ACT perspective, treatment is designed to promote patients' willingness to face pain sensations and concomitant dysfunctional thoughts and feelings, and to emphasize their efforts to engage in behaviors that improve flexible and effective daily functioning in the long run. This may be achieved by integrating mindfulness (observing inner experience non-judgmentally, acting with awareness), acceptance (making room for unavoidable negative inner experience such as pain), and values-based behavioral change strategies (choosing to take action consistent with values). Such strategies relevant to chronic pain have been well described elsewhere (e.g., Dahl et al., 2005; Robinson et al., 2004). Also, many health professionals consider the primary role of coping in directly attenuating distress and emotional suffering (Keefe et al., 1997). Acceptance-based coping may have an incremental benefits, on current mood and both current and subsequent activity, over and above its impact on pain intensity. These positive impacts are worth considering and possibly worth incorporating into current treatment methods.

Daily diary data may be useful to evaluate fluctuations in pain acceptance-based coping that happens during treatment. Moreover, keeping a daily diary may be a useful therapeutic tool (Stark, 1990). For example, presenting the patterns obtained in this study to the patients who show similar patterns may strengthen their pain coping efforts, while leading to increase in awareness of relations between pain coping and health-related outcomes. In addition, daily diary data can provide the patients and health professionals information on how pain acceptance-based coping fluctuates, especially over the course of episodes of increased pain intensity (Keefe et al., 1997). Although we did not track the study variables frequently over the course of the day, our findings suggest that patients with CRPS-I who report low-level pain acceptance-based coping in the face of increased pain intensity may experience worsening pain, activity, and mood. For more accurate tracking of such relations, future research should record them more frequently over the course of the day.

Some additional limitations should be considered. First, we used day as the unit of analysis being considered advantageous over traditional retrospective approaches, resulting in a total of 299 observations. Nevertheless, the number of self-monitored observations was relatively small compared, for example, to hourly ratings. Also, the participants had to record their data on the diary at the end of each day. These data are susceptible to retrospective or recall biases, to some extent. Second, the majority of the sample was men (73.3 %). It has been known that CRPS-I is three times more common in women than men (Veldman et al., 1993). Such skewed sex ratios of the sample, in fact, represent the sex ratios of patients that are treated at the center conducted in this study. Perhaps the findings would have differed more women had participated in the study.

Considering both the above limitations together, future research may benefit from examining the effects of sex on the temporal relations shown in the present study, over longer periods of time (e.g., 30 days) and with more frequent self-monitoring. Third, pedometers may be more accurate index of activity level than self-reports (Parkinson et al., 2006), but they may not be the best choice. Pedometers only measure the number of steps, which is only one part of the actual level of activity, and does not provide information on what kind of activities patients were doing. Given that engaging in activities may serve to differ against subsequent suffering, such effect may be particularly important when it concerns valued-directed activities.

In conclusion, patients with CRPS-I cope with pain on a daily basis, and they experience fluctuations in their pain, activity and mood across days. Acceptance has been shown to be correlated with positive pain-related outcomes (McCracken et al., 2007), and this was replicated in this study. Particularly given the intractable nature of CRPS-I, the findings suggest that patients with CRPS-I may benefit from responding to pain with acceptance. Incorporating this process into further research and treatment development may improve clinical outcomes for this group.

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