Coping with rheumatoid arthritis pain in daily life: Within-person analyses reveal hidden vulnerability for the formerly depressed

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Received 14 January 2006; received in revised form 14 June 2006; accepted 26 June 2006

Abstract

This study examined the association between history of depression and day-to-day coping with rheumatoid arthritis (RA) pain. The sample was 188 RA-diagnosed participants, 73 of whom were identified by a structured clinical interview as having a history of major depression. None had current major depression. All participated in a 30-day prospective study in which they made end-of-day ratings of their arthritis pain, the strategies for how they coped with their pain, their appraisals of daily pain, and daily mood. Hierarchical linear models evaluated whether individuals with and without depression history differed in their average pain and the other daily measures; and separately, whether they differed in their within-person associations between pain and the daily measures (e.g., the day-to-day contingency between pain and mood). All analyses controlled for current mild depressive symptoms, neuroticism, and age. Previously depressed individuals were indistinguishable from their never depressed peers in their average pain and the other daily measures; however, the previously depressed exhibited significantly stronger associations between pain and several aspects of their daily emotional experience, suggesting more pain-contingent well-being. For individuals with a history of depression, increases in daily pain corresponded with more frequent efforts to cope with their pain by venting their emotions, significantly stronger impairments in mood, and, if they were also presently distressed, reduced perceptions of control over their pain, compared to the never depressed. Patterns suggest that formerly depressed individuals exhibit a hidden vulnerability in how they manage chronic pain. This vulnerability is best revealed by a daily process approach.

Keywords: Arthritis; History of depression; Depression; Coping; Daily diary

1. Introduction

Chronic pain conditions present considerable challenges to well-being, requiring continual efforts to cope with the pain and potentially impaired functioning across multiple areas of life. Given these challenges, it is important to understand the factors that predict individual differences in coping with chronic pain. Much is known about current depression status as a factor associated with both higher levels of pain and poorer coping (e.g., Romano and Turner, 1985; Gamsa, 1990; Croft et al., 1995; Parker and Wright, 1995; Zautra et al., 1995), but far less is known about the potential consequences of a major depressive episode that has long since resolved. Do individuals who have been depressed...
in the past — but who are no longer depressed — exhibit vulnerability in how they experience and cope with chronic pain?

Emerging evidence identifies depression history as a vulnerability factor in how people experience and cope with chronic pain. For example, in a large-scale survey of rheumatoid arthritis (RA) (Fifield et al., 1998), participants who had a history of DSM-diagnosed major depression reported experiencing greater arthritis pain compared to their never depressed peers; however, the effect was limited by the nature of the one-time retrospective report, and it was conditional, occurring only in those who also reported current dysphoria. Recognizing the value of a daily process investigation for this issue, Tennen et al. (2006) recently re-examined the relation between depression history and day-to-day pain experiences using a prospective 30-day diary study of fibromyalgia (FM) patients, some of whom had one or more prior episodes of DSM III-R-diagnosed depression. Here, individuals with a history of major depression did not report higher daily pain levels, even among those with current dysphoria, but they did exhibit stronger day-to-day associations between fibromyalgia pain and the use of certain coping strategies, perceived coping efficacy, and mood, relative to those without a history of depression. On higher pain days, individuals with a history of depression were more likely to report coping by venting their emotions, they felt less effective in their coping, and they showed a steeper decline in their feelings of pleasant mood, but not unpleasant mood, compared to their never depressed peers. If these patterns were replicated in a more normative population, they could suggest that history of depression does not report higher daily pain levels, even among those with current dysphoria, but they did exhibit stronger day-to-day associations between fibromyalgia pain and the use of certain coping strategies, perceived coping efficacy, and mood, relative to those without a history of depression. On higher pain days, individuals with a history of depression were more likely to report coping by venting their emotions, they felt less effective in their coping, and they showed a steeper decline in their feelings of pleasant mood, but not unpleasant mood, compared to their never depressed peers. If these patterns were replicated in a more normative population, they could suggest that history of depression not only predisposes people to developing later chronic pain conditions (e.g., Carroll et al., 2004; Kivioja et al., 2004; Larson et al., 2004; Currie and Wang, 2005), but that it may also moderate the co-fluctuations between daily pain and well-being once chronic pain conditions develop, suggesting additional vulnerability. Toward this aim, the present research sought to examine this vulnerability among individuals with rheumatoid arthritis (RA), a common chronic pain condition that affects roughly 1% of the US population and 2.5% of all women (Lawrence et al., 1998). RA causes inflammation of the joints, impaired movement, and chronic pain that can be intense and variable from day-to-day, and thus can require substantial coping efforts in order to function in daily life.

2. Method

2.1. Participants

Our sample consisted of 188 participants (127 female and 61 male), all with physician-diagnosed rheumatoid arthritis, who ranged in age from 23 to 86 years (M = 56.04; SD = 12.98). Eighty-eight percent were self-identified as “white”. Participants were recruited for a larger intervention study designed to compare different cognitive-behavioral treatments for chronic RA pain. Participants who received the treatment, as well as those who declined treatment but agreed to take part in the baseline assessments, which are the focus of our report, comprised the study sample. Recruiting was done via physician’s offices, newspaper advertisements, senior citizen groups, mailings to members of the Arthritis Foundation, and referrals from collaborating VA hospital rheumatologists in the greater Phoenix metropolitan area. To pass the initial screening, participants had to have a physician-confirmed diagnosis of RA, no history of Systemic Lupus Erythematosus (SLE), and not be taking any cyclical estrogen replacement therapies over the past 6 months.

Of the 380 individuals who were screened, 262 met criteria and enrolled in the study. An additional 193 did not meet study criteria, and 125 met criteria but chose not to participate, citing time concerns as their primary consideration. Of the 262 who enrolled in the study, 212 had complete data for the present analysis. Following previous research on depression history (e.g., Tennen et al., 2006), on the basis of the structured clinical interview, we also excluded 19 individuals who met the DSM-IV criteria for a current major depressive episode occurring at the time of the study or within the past 6 months, as well as an additional six individuals who were classified as having bipolar disorder or depression due to the direct effects of a medical illness or medication. These exclusion criteria allowed us to focus our investigation on individuals with clear cases of depression history. Because the majority of these individuals (24 of 25) had complete data, excluding them brought our final sample from 212 to 188 participants. These 188 participants were mostly representative of the larger group of individuals who started the study. Comparisons between the group of 188 versus those omitted from analysis for incomplete data showed no differences in baseline demographics of gender, age, marital status, present employment, neuroticism, or years since RA diagnosis. The one exception was that our final sample had higher education levels (i.e., a greater percentage were more likely to have graduated from college), as compared to those with incomplete data. Thus, our sample may be most generalizable to college-educated individuals.

1 Fibromyalgia (FM) differs from other chronic pain conditions in that it lacks a known physiological etiology and may be associated with abnormal pain processing and other psychological risk factors (see Davis et al., 2001; Staud and Domingo, 2001; Bradley, 2005).

2 Missing data were as follows: Of the 262 who started the study, six participants did not complete the initial questionnaire. Of the remaining 256, 32 did not complete the structured clinical interview. Of the remaining 224, 12 did not complete the daily diary procedure to criterion (i.e., they did not turn in a minimum of 15/30 diary records), leaving 212 participants with complete data.

3 Comparisons were based on 44 of the 50 individuals omitted for missing data who had demographic information from the initial questionnaire. Six individuals were missing the initial questionnaire. Comparisons did not include the 25 individuals excluded for current or bipolar depression.
2.2. Measures

2.2.1. Structured clinical interview for DSM-IV (SCID)
Depression history status was measured by the mood episode module (module A) of the structured clinical interview for DSM-IV (SCID-I) (First et al., 2002). Use of the SCID-I reflected an improvement from prior research because it uses DSM-IV criteria and requires that a past mood disturbance or other depressive symptom created significant impairment to life at the time of the depressive episode. Prior research (e.g., Fifield et al., 1998; Tennen et al., 2006) used DSM III-R-based criteria (e.g., the Diagnosis Interview Schedule, DIS; Robins et al., 1989), which does not have an impairment requirement. Interviews were conducted by advanced clinical psychology graduate or post-doctoral students who were trained in the administration and coding of the SCID-I under the supervision of a clinical psychologist, also an expert SCID evaluator. For training purposes, interviewers initially completed 11 h of SCID-I training tapes followed by reliability assessment of 10 additional SCID interviews. In all 10 interviews, interviewers obtained 100% agreement for diagnosis decisions as compared to those made by their clinical supervisor and another master’s level SCID evaluator. During the period of SCID administration, the clinical supervisor held biweekly review sessions with the SCID coding group to discuss interview protocol.

SCID interviews were conducted over the phone, which have been shown to be equivalent with face-to-face protocols (Simon et al., 1993; Rohde et al., 1997), and interviews were audiotaped with participants’ knowledge and consent. To qualify for a diagnosis of major depression, a participant needed to endorse a time at least 6 months prior to study participation in which he or she experienced depressed mood or loss of interest every day or nearly every day for at least 2 weeks and that these changes in mood/interest significantly impaired his or her functioning at that time. During this period, the individual also needed to report having experienced at least four of the following symptoms: Changes in appetite or weight; sleep disturbance; fatigue or lack of energy; diminished self-worth; motor agitation or slowing; and suicidal thoughts. The depressive episode could not be due to normal bereavement, injury, illness, alcohol/drugs, or medication. In necessary cases, SCID evaluators sought consultation from an advising consultation liaison psychiatrist who assisted in determining whether prior depressive symptoms could have been due to medication and/or drug usage. Prior research has established adequate reliability in people’s ability to accurately recall the occurrence of a prior depressive episode (Thompson et al., 2004).

2.2.2. Daily pain, coping strategies, appraisals, and mood
For 30 consecutive days, participants completed a paper-and-pencil diary approximately one half hour before going to sleep for the night. In each diary, participants reported on the intensity of their arthritis pain that day, the strategies they used to cope with their pain, several appraisals of their pain, and their mood for that day. Items were mostly identical to those used by Tennen et al. (2006) except where noted. Items were imbedded in the nightly diary among others not discussed in the present report (e.g., sleep quality and everyday life events).

2.2.2.1. Pain. Participants rated their pain for that day by selecting a number between 0 and 100 that “best describes your average level of arthritis pain today: A zero (0) would mean ‘no pain’ and a one hundred (100) would mean ‘pain as bad as it can be’ ” (e.g., Jensen et al., 1988; Zautra et al., 2001).

2.2.2.2. Pain coping strategies. Participants completed the Daily Coping Inventory (Stone and Neale, 1984) adapted for chronic pain coping (Tennen et al., 2006). Participants were given a list of seven statements and asked to “indicate [by checking the No or Yes box] what you did or thought, if anything, to cope with the arthritis pain you experienced today”. The seven statements each corresponded with a different coping strategy: (1) direct action: “did something to try to reduce the pain”; (2) relaxation: “did something to help me relax”; (3) distraction: “diverted attention from the pain by thinking about other things or engaging in some activity”; (4) reappraisal: “tried to see the pain in a different light that made it seem more bearable”; (5) vent emotions: “expressed emotions to reduce my anxiety, frustration, or tension about the pain”; (6) spiritual comfort: “sought spiritual comfort or support”; and (7) emotional support: “sought emotional support from loved ones, friends, or professionals”.

2.2.2.3. Pain and coping appraisals. Participants were then asked about various perceptions of their efforts to cope and adapt with their pain that day. First, participants responded to two items (“I worried my pain would never end” and “I felt my pain was so bad I could not stand it anymore”) using a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree) assessing the extent to which their pain was unbearable. The two items, which were drawn from the coping strategies questionnaire (Rosenstiel and Keefe, 1983), were averaged to create a pain “catastrophizing” index (a = .80). Second, participants rated their control over their pain by selecting a number between 0 and 10 that “best describes how much personal control you were able to exert over the amount of pain you experienced today? A zero (0) would mean “no control at all” and a ten (10) would mean “complete control” (Tennen et al., 2006). Unique to this paper, we also measured positive appraisals of pain by having participants indicate whether they “thought about some of good things that have come from living with my pain” on a 5-point Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree) (benefit reminding; Tennen and Affleck, 2002).

2.2.2.4. Mood. Participants rated how they felt each day using a series of emotion adjectives rated on a 5-point scale from 1 (very slightly/not at all) to 5 (extremely). For each adjective, they were asked “How much have you felt this way today?” Whereas Tennen et al. (2006) used only two-item measures of mood (‘happy’ and ‘cheerful’ for pleasant; ‘sad’ and ‘blue’ for unpleasant), we increased the number of items to six for

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4 Alpha reliabilities for the composite diary measures were all computed at the daily level (across all individuals and all days). In every case, this value was similar to alphas obtained when sampling on several randomly selected days, for example, on days that occurred early (day 2, a = .74), middle (day 14, a = .77) and late (day 25, a = .84) in the study. Alpha reliabilities generally increased across the study, as can occur with repeated assessments.

Please cite this article as: Tamlin S. Conner et al., Coping with rheumatoid arthritis pain in daily life: Within-person ..., Pain (2006), doi:10.1016/j.pain.2006.06.033.
more reliable measurement. Reports of ‘happy’, ‘cheerful’, ‘inspired’, ‘enthusiastic’, ‘relaxed’, and ‘calm’ were averaged for a measure of pleasant mood (z = .92), and reports of ‘sad’, ‘blue’, ‘irritable’, ‘nervous’, ‘upset’, and ‘distressed’ were averaged for a measure of unpleasant mood (z = .87). These additional items were selected to adequately represent all combinations of valence (pleasant/unpleasant) and arousal (high/low activation) (Feldman, 1995).

2.2.3. Current depressive symptoms

Although we excluded participants who met DSM-IV criteria for a present or recent major depressive episode, participants could still be presently distressed (i.e., showing subclinical depressive symptoms; Fifield et al., 1998; Santor and Coyne, 2001). Thus, it was important to determine whether depression history was associated with the diary measures independently from current depressive symptoms. Depressive symptoms were measured by a brief checklist administered as part of the daily diary. This daily approach provided a stringent measure of current depressive symptoms by mapping symptoms onto the same interval in which pain and the other outcomes were assessed without reliance on recall over days or weeks. Each day, participants were asked to indicate whether they had experienced each of five depressive symptoms, which we selected from the nine standard DSM-IV criteria for major depression (American Psychiatric Association, 1994). The five items were: lack of interest in today’s activities; increase or decrease in appetite; feeling ‘restless’ or ‘slowed down’; feeling down on myself; and difficulty concentrating or making decisions. We omitted the two symptoms ‘feeling fatigued or lack of energy’ and ‘difficulty falling or staying asleep’ because these symptoms covary with chronic pain and may not be indicative of depression in this population. We also omitted symptoms of ‘depressed mood’ to minimize overlap with our mood measures. Lastly, because of the repeated nature of the daily diary protocol, we refrained from asking people on a daily basis whether they had thoughts of death or suicide. The five included items were summed each day and averaged across the 30 days to obtain a single aggregate indicator of current depressive symptoms for each participant. Alpha reliability computed at the daily level (i.e., by computing a coefficient alpha across the five items for all days and all participants) was modest (z = .58), indicating that there was variability in the co-occurrence of these five symptoms, which was expected given their distinctiveness.5

2.2.4. Neuroticism

In addition, Neuroticism, N, was included as a trait control variable as past research shows that N is related to depression, pain intensity, and several pain contingencies (e.g., pain-coping relations; Affleck et al., 1992). N was measured once using the NEO-FFI subscale (Costa and McCrae, 1992). In this 12-item questionnaire, participants rated from 1 to 5 the extent to which they agreed with statements measuring neurotic behavioral tendencies (e.g., ‘When I’m under a great deal of stress, sometimes I feel like I’m going to pieces’). Statements were averaged (z = .83).

2.2.5. Procedure

After being screened into the study, participants returned an informed consent form by mail along with documents authorizing the researchers to contact their physician to confirm their diagnosis of RA. After confirmation of diagnosis, participants were sent and returned, by mail, an initial packet of questionnaires containing questions on age, income, other demographic information, and personality measures including Neuroticism. After completing the initial questionnaire, participants were interviewed over the telephone by a trained clinical graduate or post-doctoral student. During this interview, the mood episodes module of the SCID-I interview was administered.

After the completion of the SCID, participants were sent a packet of 30 paper diary questionnaires and 30 postage paid envelopes. Before beginning the diaries, they were called by a member of the research staff and given instructions on how to fill out the diaries each day. Participants were instructed to place the previous night’s completed diary in the prepaid envelope in the mail each morning and told that post-mark verification would be monitored to track compliance. The majority of the diary records were returned on time (i.e., post-marked the next day, 66%, or by the second day, 87%), a compliance rate similar to other mail-based diary studies (e.g., Todd et al., 2003). Diaries with late post-marks were retained in the final analyses, as analyses revealed identical results whether these records were included or excluded. Participants were compensated S2 for each completed diary and a bonus of $1 for each diary when completing 25 or more, to a maximum of $90. For our final sample of 188, the number of completed diaries ranged from 18 to 30 (M = 29.31; SD = 1.64), with nearly all individuals (N = 184/188) completing 25 or more diaries. Post-mark and completion rates did not vary by participants’ depression history status, degree of current depressive symptoms, neuroticism, gender, or age.

3. Results

3.1. Descriptive statistics

3.1.1. SCID and questionnaire measures

From the SCID interview, 115 participants were classified as never depressed (61.2%; 73 women; 42 men) and 73 were classified as having a history of depression (38.8%; 54 women; 19 men). Of the 73 formerly depressed, the number of prior episodes ranged from 1 to 25 (M = 2.56, SD = 3.27), with most participants

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5 We also computed alpha reliability at the aggregate level. Reports for each symptom were averaged across the 30-day period, yielding five aggregate symptom variables for each person. The alpha reliability for these five aggregate items was adequate (z = .78), indicating that there was consistency in the occurrence of each symptom over the reporting period, i.e., people who frequently reported a ‘lack of interest in today’s activities’ also frequently reported ‘increases or decreases in appetite’, although not necessarily on the same day. Indices of current depressive symptoms computed by summing these five aggregate items were nearly identical to the indices computed by summing the five symptoms for each day and averaging across days.
(70 out of 73) reporting between 1 and 6 episodes; 1 episode was the median and the mode (37/73). Their most recent episode occurred from 6 months to 39.50 years prior to the study, with a mean of 8.40 years (SD = 8.32 years). Individuals with a history of depression did not differ from their never depressed peers on gender, education, marital status, present employment, or years since RA diagnosis, but they did differ on age. Individuals with a history of depression were younger (M = 53.4 years) than individuals without a history of depression (M = 57.71 years), t(185) = −2.25, p < .05. Accordingly, we incorporated age as an additional covariate in all analyses involving depression history.

Neuroticism scores were normally distributed and ranged from 1 to 4.91 (M = 2.56, SD = .66), which is within norms for adult populations (Costa and McCrae, 1992). Formerly depressed individuals scored higher in N (M = 2.81) compared to the never depressed (M = 2.40) (t(186) = 4.42, p < .001).

3.1.2. Daily diary measures

Scores on the current depressive symptoms index ranged from .00 (on average, no symptoms per day) to 3.73 (on average, four symptoms per day) and were positively skewed (Mdn = .47, M = .68, SD = .67). Individuals diagnosed with a history of depression reported more current depressive symptoms (Mdn = .67) compared to those without a history of depression (Mdn = .37). χ²(1) = 7.08, p < .01, although many of the formerly depressed showed little or no current depressive symptoms (i.e., 46 out of 73 reported fewer than one symptom per day on average). Individuals with more current depressive symptoms also scored higher in N (r = .36, p < .001).

Descriptive statistics for the remaining daily diary measures are shown in Table 1. As seen in the first row of this table, there was considerable range in the average levels of pain reported by participants on this 100-point scale, with some individuals reporting low average levels of pain across the sampling period (Min = 1.73) and others reporting high average levels of pain (Max = 85.27) (M = 34.15; SD = 18.60). In terms of coping, participants reported taking direct action as well as using relaxation and distraction strategies most often, whereas they reported using positive reappraisal and venting emotions the least often. Participants also reported neutral to mildly positive appraisals about their pain and coping, and they reported experiencing more pleasant than unpleasant mood states on average, although there was considerable individual variation.

3.2. Depression history and average pain, coping, appraisals, and mood

In this first set of analyses, we sought to determine whether history of depression was associated with differences in the average levels of pain and the other states reported during the 30-day diary procedure. Analyses used multi-level modeling procedures (HLM v5; Rubin et al., 2000) with the day-to-day reports of pain, coping, appraisals, and mood (at level-1) nested within individuals (at level-2). For every diary measure, an intercept-only model was run to determine each person’s average (or “intercept”), and simultaneously, to test how these intercepts varied as a function of each person’s depression history status, current depressive symptoms, neuroticism, and age (all controlling for each other) as level-2 variables. Example equations are presented in the Appendix A. In this way, we could ascertain the unique association between depression history and the intercepts, over and above the unique association between current depressive symptoms and the intercepts (and above the associations for the other covariates as well). Also, because prior work has found relations between depression history and pain that were conditional on current level of distress (i.e., Fifield et al., 1998 found that depression history predicted greater pain only in those who had elevated current depressive symptoms), we modeled the higher order interaction terms between depression history and current depression. None of the interaction terms was significant and so we omitted these terms from the final analyses. Furthermore, following prior work (Tennen et al., 2006), all intercept models except for daily pain included average pain (i.e., pain reports averaged for each person across the 30 days) in the level-2 equation as an additional control. Adjusting for participants’ average pain

Table 1

<table>
<thead>
<tr>
<th>Measure</th>
<th>Mean</th>
<th>Min</th>
<th>Max</th>
<th>SD</th>
</tr>
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<tbody>
<tr>
<td>Pain</td>
<td>34.15</td>
<td>1.73</td>
<td>85.27</td>
<td>18.60</td>
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<tr>
<td>Coping strategies</td>
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<td>Direct action</td>
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<td>.00</td>
<td>1.00</td>
<td>.35</td>
</tr>
<tr>
<td>Relaxation</td>
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<td>.00</td>
<td>1.00</td>
<td>.34</td>
</tr>
<tr>
<td>Distraction</td>
<td>.60</td>
<td>.00</td>
<td>1.00</td>
<td>.36</td>
</tr>
<tr>
<td>Reappraisal</td>
<td>.21</td>
<td>.00</td>
<td>1.00</td>
<td>.30</td>
</tr>
<tr>
<td>Venting emotions</td>
<td>.20</td>
<td>.00</td>
<td>1.00</td>
<td>.25</td>
</tr>
<tr>
<td>Spiritual comfort</td>
<td>.34</td>
<td>.00</td>
<td>1.00</td>
<td>.41</td>
</tr>
<tr>
<td>Emotional support</td>
<td>.22</td>
<td>.00</td>
<td>1.00</td>
<td>.27</td>
</tr>
<tr>
<td>Pain and coping appraisals</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catastrophizing</td>
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<td>1.00</td>
<td>3.88</td>
<td>.67</td>
</tr>
<tr>
<td>Control over pain</td>
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<td>.00</td>
<td>10.00</td>
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<tr>
<td>Benefit reminding</td>
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<td>1.00</td>
<td>4.97</td>
<td>.89</td>
</tr>
<tr>
<td>Mood</td>
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</tr>
<tr>
<td>Pleasant mood</td>
<td>2.85</td>
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<tr>
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<td>1.42</td>
<td>1.00</td>
<td>3.19</td>
<td>.40</td>
</tr>
</tbody>
</table>

Note. Descriptive statistics were computed by averaging the daily reports across the sampling period separately for each participant. Mean is the grand mean of all 188 averages; Min and Max are the lowest and highest individual averages, followed by SD, the standard deviation of those averages. For coping strategies, numbers reflect the proportion of total days in which that strategy was used to cope with pain.
safeguarded against obtaining multiple significant effects simply due to redundant relations between pain and the other diary variables.

Results are presented in Table 2, which shows the unique associations between depression history and the diary measures (first column), and, for completeness, the unique associations between current depressive symptoms and the diary measures (second column). As seen in the first column, history of depression was not significantly associated with the average daily levels of pain or the other measures. This lack of association replicates prior work (Tennen et al., 2006). By contrast, as seen in the second column, current depression was associated with many of the measures, including average daily pain. Examination of the unstandardized coefficient for pain shows that for every one additional depressive symptom, the typical pain level was 39.38 for participants high in current depressive symptoms versus 28.92 for participants low in current depressive symptoms – a difference of approximately 10 pain points. Significant associations were also found between depressive symptoms and the coping variables. Converting the logit coefficients shown in Table 2 into predicted probability scores (Raudenbush and Bryk, 2002), we observed that individuals high in current depressive symptoms reported more frequent coping by reappraisal, venting emotions, and seeking spiritual and emotional support (predicted probabilities of .22, .23, .41, .23, reflecting their use on 7–12 of the total reporting days), as compared to participants low in current depressive symptoms (predicted probabilities of .03, .05, .07, and .06, reflecting their use on 1–2 days). Reports of catastrophizing and unpleasant mood were also associated with current depressive symptoms, as would be expected.6,7

Note. Coefficients for depression history and depressive symptoms are unstandardized maximum likelihood estimates from hierarchical linear modeling, except for coping strategies, which reflect logit coefficients from hierarchical non-linear modeling. Average pain was controlled in all intercept analyses except for the pain intercepts. Neuroticism and age were controlled in all analyses except for the average slopes. Significant effects are bolded.

A significant interaction was found between depression history and current depressive symptoms for this variable.

p < .05.

*p < .01.

**p < .001.

6 The associations for current depression symptoms remained relatively unchanged when we used a log transformed variable to eliminate positive skew.

7 All of the above analyses controlled for differences in trait Neuroticism and age, which also uniquely predicted several intercepts. N was associated with higher average reports of catastrophizing (b = .200, p < .01) and worse mood (pleasant b = –.400, p < .001; unpleasant b = .159, p < .001). N was not significantly associated with pain levels (b = 3.72, p < .11) primarily because it shared variance with current depressive symptoms. When omitting current depressive symptoms from the model, N was a significant predictor of average pain (b = 6.29, p < .01). Age was significantly associated with less unpleasant mood (b = –.006, p < .001), but not any greater pleasant mood (b = –.002, ns). Age was not associated with pain levels (b = .103, p < .3).

Please cite this article as: Tamlin S. Conner et al., Coping with rheumatoid arthritis pain in daily life: Within-person ..., Pain (2006), doi:10.1016/j.pain.2006.06.033.

Table 2
The association between depression history, current depressive symptoms and the average diary measures (intercepts) and daily pain contingencies (slopes)

<table>
<thead>
<tr>
<th>Measure</th>
<th>Intercepts</th>
<th></th>
<th>Slopes</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Depression history</td>
<td>Depressive symptoms</td>
<td>Average slope</td>
</tr>
<tr>
<td>Pain</td>
<td>–.067</td>
<td>7.81***</td>
<td>n/a</td>
</tr>
<tr>
<td>Coping strategies</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Direct action</td>
<td>.278</td>
<td>.196</td>
<td>.045***</td>
</tr>
<tr>
<td>Relaxation</td>
<td>.195</td>
<td>.133</td>
<td>.016</td>
</tr>
<tr>
<td>Distraction</td>
<td>.273</td>
<td>.307</td>
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<td>Reappraisal</td>
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<td>.033***</td>
</tr>
<tr>
<td>Venting emotions</td>
<td>.027</td>
<td>.867**</td>
<td>.044***</td>
</tr>
<tr>
<td>Spiritual comfort</td>
<td>.166</td>
<td>1.11†</td>
<td>.017</td>
</tr>
<tr>
<td>Emotional support</td>
<td>.069</td>
<td>.763**</td>
<td>.028***</td>
</tr>
<tr>
<td>Pain and coping appraisals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catastrophizing</td>
<td>–.032</td>
<td>.194**</td>
<td>.014***</td>
</tr>
<tr>
<td>Control over pain</td>
<td>–.052</td>
<td>–.151</td>
<td>–.036</td>
</tr>
<tr>
<td>Benefit reminding</td>
<td>.080</td>
<td>.143</td>
<td>–.002</td>
</tr>
<tr>
<td>Mood</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pleasant mood</td>
<td>.002</td>
<td>–.114</td>
<td>–.011***</td>
</tr>
<tr>
<td>Unpleasant mood</td>
<td>–.040</td>
<td>.345***</td>
<td>.006***</td>
</tr>
</tbody>
</table>

Note. Coefficients for depression history and depressive symptoms are unstandardized maximum likelihood estimates from hierarchical linear modeling, except for coping strategies, which reflect logit coefficients from hierarchical non-linear modeling. Average pain was controlled in all intercept analyses except for the pain intercepts. Neuroticism and age were controlled in all analyses except for the average slopes. Significant effects are bolded.
3.3. Depression history and the daily contingencies associated with pain

Next, we turn to the contingency models. Here, we determined whether history of depression was related to differences in the daily associations (or “contingencies”) between pain and the other diary measures (coping, appraisals, and mood). This was accomplished in HLM using a series of slope models (see Appendix A). Specifically, we determined the within-person association (or “slope”) between daily pain (as the level-1 predictor variable) and each of the other measures (as the level-1 outcome variable) and simultaneously tested how these slopes varied as a function of depression history, current depressive symptoms, neuroticism, and age (all as level-2 predictors, and controlling for each other). Larger within-person slopes indicated greater contingency between daily pain and that outcome (i.e., increases/decreases in daily pain predicted increases/decreases in daily mood, for example). Again, higher order interaction terms between depression history were tested and retained when significant. Pain was not included as a level-2 control since it was the level-1 predictor.

Table 2, column 3 shows the typical within-person association between daily reports of pain and the other diary measures, i.e., the average slope across the sample, irrespective of level-2 factors. Specifically, these unstandardized slopes in column 3 reveal the degree of change in each daily measure that accompanied a 1-point increase in daily pain (on a 100-point scale). As expected, as daily pain increased, participants reported more frequent efforts to cope, a decrease in the quality of their appraisals, and relatively worse mood. While these slopes may appear small (e.g., for every 1 U increase in daily pain, there was a .011 decrease in pleasant mood on a 5-point scale), they are not as small when one considers these changes are modeled at the daily level and indicate associations across a relatively short interval of time (i.e., during any given 24-h period). Also, one needs to consider that changes in pain from one day to the next ranged from 0 (no change) to as much as 85 points, although the typical next day change was 9.25 points (SD = 11.49). Thus, for a day-to-day change in pain of 20 points (+1 SD of change), a slope of .011 for pleasant mood would translate to a .22 scale difference in positive mood to the next day – a difference one-third of a standard deviation in pleasant mood. Likewise, if we also consider that the typical range in pain observed across the 30-day period was just over 46 points (min_range = 4; max_range = 100; M = 46.21, SD = 22.76), a slope of .011 for pleasant mood would translate to a .5 scale difference in positive mood on the highest versus lowest pain days – a difference that is equal to nearly one full standard deviation of change in pleasant mood.

Column 4 presents the unique associations between depression history and these within-person slopes. As predicted, history of depression moderated several of the within-person slopes between pain and the daily measures, including coping by venting emotions. This pattern is shown in Fig. 1 and precisely replicates that of Tennen et al. (2006). As can be seen in this figure, as pain intensified, people who reported a history of major depression were much more likely to report coping by “expressing emotions to reduce anxiety, frustration, or tension about the pain”, compared to those without a history of depression. Fig. 1 reveals that even on a moderately high pain day (e.g., pain = “80 points”), the probability that someone with a history of depression responded to their pain by venting emotions was approximately double (predicted probability, pp = .60) that of their never depressed peers (pp = .28). This difference was ameliorated on lower pain days. As with Tennen et al., history of depression did not moderate any of the other pain-coping associations.

For the appraisal variables, depression history moderated the contingency between daily pain and perceptions of control – an association that was conditional upon current depressive symptoms (two-way interaction b = .009, t(182) = 2.23, p < .05). This pattern is shown in Fig. 2. Although all individuals reported feeling less in control of their pain as pain increased (i.e., all slopes were negative), this tendency was especially pronounced for individuals who had both a history of depression and who were currently distressed. In fact, we see that on the highest pain days, individuals with a history of depression who also scored +1 SD above the mean in current depressive symptoms reported approximately 30% less perceived control over their pain, relative to the other participants. On moderate and lower pain days, participants were mostly indistinguishable in their perceptions of control over their pain.

![Fig. 1](image-url) Fig. 1. For individuals with a history of depression (top curve), the tendency to vent emotions increased sharply on higher pain days compared to those without a history of depression (bottom curve).
History of depression also moderated the contingencies between pain and daily mood, as shown in Fig. 3. As seen from the top graph, the day-to-day contingency between reports of pain and pleasant mood was stronger for individuals with a history of depression (simple slope $b_{\text{hx}} = -.014$, $p < .001$), and weaker, although still significant, for individuals without a history of depression ($b_{\text{no hx}} = -.008$, $p < .001$). These simple slopes indicated that for every 1-point increase in daily pain, there was a .014 decrease in reports of pleasant mood for participants with a history of depression, but only a .008 decrease in reports of pleasant mood for participants without a history of depression. Again, while this difference may appear small, it is not as small when one considers that having a history of depression nearly doubles the observed contingency between daily pain and mood ($b_{\text{hx}} = .014$ versus .008 for those with versus without a history of depression). Thus, for a 20-point increase in pain, an individual with a history of depression would show a decrease in pleasant mood of .28 points (or .38 standard deviations on the mood scale), whereas pleasant mood would decrease only by .16 (or .22 standard deviations on the mood scale) for those without a history of depression. A similar pattern was found for reports of unpleasant mood. As seen in the bottom of Fig. 3, the daily contingency between reports of pain and unpleasant mood was nearly twice that for individuals with a history of depression (simple slope $b_{\text{hx}} = .009$, $p < .001$), compared to those without a history of depression ($b_{\text{no hx}} = .005$, $p < .001$). Thus, for a 20-point increase in pain, an individual with a history of depression would be expected to report an increase in unpleasant mood of .18 points (or .45 standard deviations on the mood scale), compared to .10 points (or .25 standard deviations on the mood scale) for those without a history of depression. We consider the clinical significance of these findings in the discussion.

Current depressive symptoms moderated two of the within-person pain contingencies (fifth column in Table 2). Greater distress corresponded with weaker contingencies between pain and the probability to report “trying to see the pain in a different light that made it seem more bearable” (direct action), in part, because those who were currently distressed were already close to ceiling in terms of this coping frequency. Greater distress also corresponded with relatively stronger contingencies between pain and reports of catastrophizing. Current depressive symptoms did not moderate any of the pain-mood associations.8

4. Discussion

Depression history was uniquely related to several of the day-to-day contingencies associated with chronic RA pain reported across a 30-day period. On higher pain days, individuals who reported a past depressive

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8 Again, all of the contingency analyses controlled for differences in Neuroticism and age, which uniquely predicted several pain contingencies. Both N and age were related to weaker associations between pain and reports of coping by direct action (Neuroticism $b = -.023$, $p < .05$; age $b = -.001$, $p < .05$). Age was also related to weaker associations between pain and reports of both coping by distraction ($b = -.001$, $p < .05$) and catastrophizing ($b = -.0002$, $p < .05$).
episode were more likely to report coping by venting their emotions and to show steeper declines in mood, and, if presently distressed, they reported fewer perceptions of control over their pain, as compared with individuals who did not report a past major depressive episode. Depression history was unrelated to the day-to-day contingencies between pain and the tendency to use relaxation, distraction, or any of the other coping or appraisal variables, suggesting that depression history is most strongly tied to contingencies of a distinctly emotional nature (i.e., venting emotions and mood). These patterns have now been replicated in two different chronic pain populations (fibromyalgia by Tennen et al., 2006; rheumatoid arthritis), using DSM-IV criteria, and when controlling for current depressive symptoms, neuroticism, and age.

From our perspective, greater contingency between pain and emotion-related experiences may reflect a hidden vulnerability for the formerly depressed. One marker of psychological health is the ability to regulate emotions and maintain stability in one’s emotional life in the face of changing circumstances (John and Gross, 2004). These characteristics are especially important when people are managing chronic physical pain (Davis et al., 2001; Hamilton et al., 2005). Yet, individuals with a history of depression appear less able to maintain their well-being from their challenging physical state (or vice versa, see Limitations), relative to never-depressed individuals. In fact, reports of venting emotions and mood were nearly twice as strongly yoked to daily pain for individuals with a history of depression versus not. While on the one hand, more pain-contingent emotional experiences might seem to confer some benefit (e.g., if pain lessens, formerly depressed RA patients may report greater emotional relief compared to their never depressed peers), this benefit is relatively small compared to the potential long-term costs. For example, use of venting emotions as a long-term coping strategy may eventually alienate friends and loved ones who are likely to be on the receiving end of these emotional episodes. Likewise, if pain has a causal relation with mood, then worsening pain over time should produce significantly more detrimental changes in mood, possibly leading to the onset of a new depressive episode. Indeed, such an outcome would be consistent with work showing that stronger contingencies between mood and daily stressors, called ‘affective reactivity’, are a risk factor for developing subsequent depression (Cohen et al., 2005).

4.1. Limitations

Although we treated pain as a predictor variable, our analyses were correlational, and so we cannot assume that changes in RA pain were driving changes in coping, appraisals, and mood. While increases or decreases in RA pain should certainly affect how people cope and feel emotionally in a given day, it is also the case that how people cope and feel emotionally may influence their experience of pain (i.e., by reducing or intensifying it). Without multiple reports per day, we could not examine the within-day lead-lagged associations between pain, coping, and mood that would have allowed us to resolve this issue. However, we were able to address this issue somewhat by examining lead-lagged associations from one day to the next. In supplemental analyses available from the first author, we tested whether present day pain uniquely predicted next day coping, appraisals, and mood (controlling for present day coping, appraisals, and mood); and, conversely, whether present day coping, appraisals, and mood uniquely predicted next day pain (controlling for previous day pain). We found that pain was a stronger predictor of subsequent coping, appraisals, and mood rather than vice versa, suggesting more evidence for pain as a causal factor.

Likewise, although we confirmed a link between depression history and pain contingencies, it is not known whether stronger contingencies are the byproduct of the earlier major depressive episode, or whether this tendency towards more contingent well-being might have been present before or even contributed to the previous episode. On the one hand, research shows that day-to-day affective reactivity plays a role in the etiology of depression (Cohen et al., 2005). On the other hand, the ‘kindling’ hypothesis posits that an episode of major depression lowers the stress threshold required for events to trigger subsequent changes to well-being (Kendler et al., 2000). Thus, a previous depressive episode should diminish an individual’s capacity to deal with everyday stressors, including high levels of pain among chronic pain patients. Without long-term prospective studies on pain contingencies, these causal antecedents cannot be determined.

There are several other study limitations as well. First, participants were mostly college-educated Caucasians, as were those of Tennen et al. (2006), so it is not known whether patterns will generalize to individuals from different ethnic and educational backgrounds. It would be important in future research to determine whether patterns are replicated in different populations. Second, we used a paper-and-pencil rather than a computerized diary protocol, and so we cannot guarantee that participants completed their reports each night before going to bed. Although we monitored compliance by post-marks, participants could have completed their diaries the next day, thus introducing some element of memory bias. However, the consistency between our findings and those of Tennen et al. who used an electronic diary protocol diminishes this concern somewhat. Third, although we included both men and women in the sample, our gender split was uneven, which prevents us from adequately testing whether patterns for depres-
sion history differed by gender. Nevertheless, we ran these analyses and results showed that gender did not significantly interact with depression history in predicting either the intercepts or slopes, although again, our ability to detect such findings was underpowered. Fourth, the daily coping items were limited to a yes/no format, which does not capture frequency of use. Future research may benefit from more fine-grained measurement of coping strategies, including the contexts under which strategies are deployed.

4.2. Notes on replication

Previous research found no relation between depression history and the day-to-day association between pain and unpleasant mood (Tennen et al., 2006), but we did. Our inclusion of higher activation unpleasant mood items appears to drive this difference, as follow-up analyses showed that depression history only moderated the contingency between pain and these higher activation items (‘irritable’, ‘nervous’, ‘upset’, and ‘distressed’) but not the lower activation items (‘sad’ and ‘blue’), which comprised previous research. These findings warrant replication as they suggest that depression history moderates the contingency between daily pain and feelings of distress, rather than sadness per se. Second, like Tennen et al. (2006), we found only minimal evidence for an interaction between depression history and current depressive symptoms. Whereas they found a significant interaction for the pain–pleasant mood association, we found an unconditional relation between depression history and the pain–pleasant mood association, and a new significant interaction for the pain-control association. We are not sure what factors account for these differences, but we offer the observation that our measures of depression history and current depressive symptoms were more stringent – reflecting DSM-IV criteria and a diary-based measure of ongoing depressive symptoms, respectively. Stronger measurement may have given us more power to detect previously conditional effects (i.e., pleasant mood) and uncover effects that might have gone undetected previously (i.e., control). Regardless of these differences, however, interactions between depression history and current depressive symptoms appear to be more the exception than the rule.

4.3. Implications

There are several additional implications of the present research. First, findings underscore the utility of examining daily within-person associations related to pain. Had we only examined the average pain-related experiences, or perhaps used a retrospective cross-sectional design (i.e., asking people about their typical pain, coping, etc., over the past 2 weeks), depression history could have been dismissed as a significant factor. Using a within-person design (also called a daily process design; Affleck et al., 1999) revealed how depression history moderated the dynamics of pain-related experiences in daily life. For this reason, we encourage the use of daily process designs in pain research and caution that non-significant effects at the between-person level do not rule out potentially important effects at the within-person level (see also Keefe et al., 1997). Second, our research suggests that depression history may be an important control variable in future research on pain and current major depression. Consider that many people with current major depression may have experienced a history of depression. Without knowing their history, researchers could potentially misattribute pain-related patterns rooted in depression history to their current state. Conversely, if formerly depressed individuals are not distinguished in a healthy control group, they may add error variance to the data. Lastly, findings suggest that practitioners and clinicians consider including depression history as an intake variable in pain-related assessments. Knowing a patient’s history of depression, not only their current depression status, may provide important clues as to why he or she might be more emotionally responsive to daily pain and, potentially worse off as chronic pain intensifies over time.

Acknowledgements

This research was supported by grant funding from the Arthritis Foundation, as well as the National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS).

Appendix A.

Below are the full HLM equations used to model the average daily diary measures using pleasant mood as an example.

Level-1

\[ \text{pleasant mood}_{ij} = b_{0j} + r \]

Level-2

\[ b_{0j} = G_{00} + G_{01}\text{DepHx} + G_{02}\text{CurDep} + G_{03}\text{DepHx/CurDep} + G_{04}\text{Neur} + G_{05}\text{Pain} + G_{06}\text{Age} + u \]

The level-1 equation computed the average (i.e., intercept) of pleasant mood for each person, or \( b_{0j} \). The level-2 equation predicted variability in the level-1 \( b_{0j} \) as a function of depression history (no history \( = -1 \); history \( = 1 \)), current depressive symptoms (diary depression aggregate group-centered), the cross-product interaction term between depression history and current depressive symptoms, as well as neuroticism, average

Please cite this article as: Tamlin S. Conner et al., Coping with rheumatoid arthritis pain in daily life: Within-person ..., Pain (2006), doi:10.1016/j.pain.2006.06.033.
daily pain, and age (all grand mean centered) as additional controls. The cross-product interaction term was dropped from the equation if not significant. We were especially interested in the significance tests of $G_{11}$ (and $G_{13}$) as partial regression coefficients for the unique associations between depression history (and current depressive symptoms) and average pleasant mood.

Below are the full equations used to model the slopes, again, using pleasant mood as an example.

Level-1

\[ \text{pleasant mood}_{ij} = b_0j + b_1j \text{Pain} + r \]

Level-2

\[ b_0j = G_{00} + G_{01} \text{DepHx} + G_{02} \text{CurDep} + G_{03} \text{DepHx/CurDep} + G_{04} \text{Neur} + G_{05} \text{Age} + u \]

\[ b_1j = G_{10} + G_{11} \text{DepHx} + G_{12} \text{CurDep} + G_{13} \text{DepHx/CurDep} + G_{14} \text{Neur} + G_{15} \text{Age} + u \]

The level-1 equation computed the day-to-day relation between daily reports of pain (person-centered) and daily pleasant mood for each person, or $b_0j$. The level-2 equations were similar to those used in the intercept analyses, except that average pain was not included as a control and an additional equation was necessary to model the level-1 intercepts, $b_0j$, for statistical completeness. Here, we were interested in the significance tests of $G_{11}$ (and $G_{13}$) as partial regression coefficients for the unique association between depression history (and current depressive symptoms) and the within-person relation between pain and pleasant mood. For example, a positive $G_{11}$ coefficient indicates that participants with a history of depression have a stronger daily association between pain and pleasant mood, relative to participants without a history of depression.

In all analyses, a standard linear set up was used when modeling the continuous measures (e.g., pain, mood, etc.), whereas a non-linear model – specifying a Bernoulli sampling with logit-link function – was used when modeling the seven binary coping measures (unit specific model; Raudenbush and Bryk, 2002).

References


