Symptoms of Depression Predict the Trajectory of Pain Among Patients with Early Inflammatory Arthritis: A Path Analysis Approach to Assessing Change

ORIT SCHIEIR, BRETT D. THOMBS, MARIE HUDSON, SUZANNE TAILLEFER, RUSSELL STEELE, LAEORA BERKSON, CAROLE BERTRAND, FRANCOIS COUTURE, MARY-ANN FITZCHARLES, MICHEL GAGNÉ, BRUCE GARFIELD, ANDRZEJ GUTKOWSKI, HARB KANG, MORTON KAPUSTA, SOPHIE LIGIER, JEAN-PIERRE MATHIEU, HENRI MÉNARD, SUZANNE MERCILLE, MICHAEL STARR, MICHAEL STEIN, MICHEL ZUMMER, and MURRAY BARON

ABSTRACT. ***Objective.*** To assess the longitudinal relationships, including directionality, among chronic pain, symptoms of depression, and disease activity in patients with early inflammatory arthritis (EIA).

Methods. One hundred eighty patients with EIA completed an examination, including swollen joint count, and were administered the Center for Epidemiological Studies Depression Scale (CES-D) and the McGill Pain Questionnaire (MPQ) at 2 timepoints 6 months apart. Cross-lagged panel path analysis was used to simultaneously assess concurrent and longitudinal relationships among pain, symptoms of depression, and number of swollen joints.

Results. Pain, symptoms of depression, and number of swollen joints decreased over time ($p < 0.001$) and were prospectively linked to pain, symptoms of depression, and number of swollen joints, respectively, at 6 months. Symptoms of depression and pain were correlated with each other at baseline (0.47) and at 6-month followup assessments (0.28). Baseline symptoms of depression significantly predicted pain symptoms at 6 months (standardized regression coefficient = 0.28, $p = 0.001$), whereas pain and disease activity did not predict the course of any other variable after controlling for baseline values.

Conclusion. Symptoms of depression predicted the trajectory of pain from baseline to 6 months. In addition, there were reciprocal/bidirectional associations between pain and symptoms of depression over time. More research is needed to better understand the relationship between pain and depressive symptoms and how to best manage patients with EIA who have high levels of both. (First Release Dec 15 2008; J Rheumatol 2009;36:231–9; doi:10.3899/jrheum.080147)

Key Indexing Terms:
RHEUMATOID ARTHRITIS | PAIN | DEPRESSION
OUTCOMES ASSESSMENT | LONGITUDINAL STUDIES

Between 8% and 50% of patients with chronic pain have comorbid major depression[1]. Among patients with rheumatoid arthritis (RA), 13%–20% also have major depression as assessed by a structured clinical interview[2-4], and 23%–46% have symptoms of depression above cutoff thresholds based on self-report measures[5]. Rates are similarly high among patients with early-onset inflammatory arthritis[6-8]. Depression and chronic pain are each individually associated with poorer overall health status. Compared to either condition alone, patients with comorbid pain and depression experience greater healthcare costs, more disability, and higher morbidity and mortality[9-13].

From the Division of Rheumatology and Department of Psychiatry, Sir Mortimer B. Davis–Jewish General Hospital and McGill University; Department of Mathematics; Division of Rheumatology, McGill University; and Service de Rhumatologie, Hôpital Maisonneuve-Rosemont, Montreal, Quebec, Canada.

Support for the McGill Early Arthritis Registry has been received in the form of unrestricted educational grants from Merck, Pfizer and Aventis Pharmaceuticals. Drs. Thombs and Hudson are supported by New Investigator Awards from the Canadian Institutes of Health Research and Établissement de Jeunes Chercheurs awards from the Fonds de la Recherche en Santé Québec.

O. Schieir, BA, Division of Rheumatology; B.D. Thombs, PhD, Department of Psychiatry; M. Hudson, MD, MPH; S.S. Taillefer, PhD, Division of Rheumatology, Sir Mortimer B. Davis–Jewish General Hospital and McGill University; R.J. Steele, PhD, Department of Mathematics, McGill University; L. Berkson, MD, Division of Rheumatology, Sir Mortimer B. Davis–Jewish General Hospital and McGill University; C. Bertrand, MD, Service de Rhumatologie, Hôpital Maisonneuve-Rosemont; F. Couture, MD; M-A. Fitzcharles, MD; M. Gagné, MD; B. Garfield, MD; A. Gutkowski, MD; H. Kang, MD; M. Kapusta, MD, Division of Rheumatology, McGill University; S. Ligier, MD; J-P. Mathieu, MD, Service de Rhumatologie, Hôpital Maisonneuve-Rosemont; H. Ménard, MD, Division of Rheumatology, McGill University; S. Mercille, MD, Service de Rhumatologie, Hôpital Maisonneuve-Rosemont; M. Starr, MD; M. Stein, MD, Division of Rheumatology, McGill University; M. Zummer, MD, Service de Rhumatologie, Hôpital Maisonneuve-Rosemont; M. Baron, MD, Division of Rheumatology, Sir Mortimer B. Davis–Jewish General Hospital and McGill University.

Address reprint requests to Dr. B.D. Thombs, SMBD-Jewish General Hospital, 4333 Cote Ste Catherine Road, Montreal, Quebec H3T 1E4. E-mail: brett.thombs@mcgill.ca

Accepted for publication September 4, 2009.

A systematic review of the relationship between symptoms of depression and chronic pain identified studies that supported 3 different hypotheses: (1) that depressive symptoms precede and increase the risk of developing pain symptoms (the antecedent hypothesis); (2) that chronic pain develops first and increases the risk of depressive symptoms (consequence hypothesis); and (3) that there are common mutual causal or bidirectional pathways between pain and symptoms of depression (the stress-diathesis hypothesis)[14]. The temporal and causal directions between symptoms of depression and pain and the degree to which successfully treating one is affected by the presence of the other, however, are not well understood[15,16], since most existing research has used models that do not simultaneously incorporate concurrent relationships between symptoms of depression and pain with longitudinal trajectories.

Hypotheses related to the relationship between pain and depressive symptoms are not specific to RA, but several studies have examined directional relationships between pain and depressive symptoms among patients with RA. Although a number of cross-sectional studies of patients with RA have explored the relationship between pain and depressive symptoms[17-27], their cross-sectional designs do not allow conclusions about directionality. Similarly, longitudinal studies have designated either pain or depressive symptoms as the outcome variable[28,29] in order to test a given directionality hypothesis, but have not considered alternative hypotheses. One longitudinal study with 2 timepoints 24 months apart examined predictors of both pain and depressive symptoms within the same study of patients with RA[30], and reported significant autoregressive effects for pain and symptoms of depression at Time 2 after controlling for Time 1 demographic variables, disease variables, functional impairment, and sleep problems. In addition, Time 1 pain and an interaction term consisting of Time 1 pain and Time 1 sleep problems independently predicted Time 2 depressive symptoms. This study[30], however, used a series of multiple regression models rather than simultaneous analysis of the relationship between pain and depressive symptom variables over time.

Traditional multiple regression approaches assume that there is a single clearly defined outcome variable and that predictor variables are stable over time and associated with change in the outcome variable after controlling for its baseline value (e.g., pain as the outcome variable regressed on baseline symptoms of depression, which are assumed to be stable, controlling for baseline pain). These models are less adequate for testing hypotheses related to 2 variables, such as pain and depression, whose relationship likely evolves over time and where either variable may potentially function as a predictor variable and contribute to change in the trajectory of the other variable[31,32]. As shown in Figure 1, a prospective relationship between Time 1 depressive symptoms and Time 2 pain could potentially occur because (1) depression at Time 1 affects the trajectory or change in pain between Time 1 and Time 2 (Pathway A), consistent with the antecedent hypothesis; or (2) there are reciprocal relations between depressive symptoms and pain at Time 1 (Pathway B) and Time 2 (Pathway D) that are maintained over time (Pathways C). A combination of these scenarios is also possible. Multiple regression models would attribute each of these scenarios to depression influencing the trajectory of pain (Pathway A), even if the alternative hypothesis of a reciprocal or concurrent relationship that is stable over time (Pathways C to D) was more accurate[33]. The same critique could be applied to an analysis of a possible prospective link from pain to depressive symptoms (consequence hypothesis).

Cross-lagged panel path analysis models present an attractive alternative for examining the interrelationships between 2 or more variables over time[31-34]. These models allow the assessment of multiple independent and dependent variables over time in a single model and, compared to multiple regression models with a single dependent variable, a stronger test of whether one variable may influence the trajectory of the other by allowing the researcher to test competing hypotheses simultaneously. Thus, in terms of Figure 1, the cross-lagged panel path analysis model is specified to have 2 independent variables (e.g., pain and depression) and 2 dependent variables (e.g., pain and depression) with simultaneous tests of all possible pathways within and between variables (Pathways A, B, C, and D).

The various forms of path analysis models were first developed for use in the social sciences and are now used more frequently in the health sciences as well. Several studies have used path analysis models to assess longitudinal relationships among variables over time or in mediation models among patients with musculoskeletal diseases[27,35-37]. Covic, *et al*[38], for instance, used path analysis to test a series of cross-sectional models of the relationship between pain and symptoms of depression. They also used longitudinal path analysis models to assess the relationship between physical disability, helplessness, and passive coping on subsequent reports of pain and depression, but did not model the trajectories of pain and depression over time in any single model. Only one study[39] has used cross-lagged panel path analysis to address the issue of directionality between pain and depressive symptoms in RA. Brown[39] found that among patients diagnosed with RA up to 7 years (mean 3.3 yrs) prior to enrollment in the study, neither baseline symptoms of depression nor baseline pain predicted the other 12 months later. Pain at 2 years did significantly predict the trajectory of depressive symptoms between 2- and 3-year assessments, although the effect was relatively weak, providing partial support for the consequence hypothesis. It is important to determine, however, the degree to which longitudinal patterns of pain and depression from patients with established RA and relatively stable symptoms are evident and similar at very early stages of disease development.

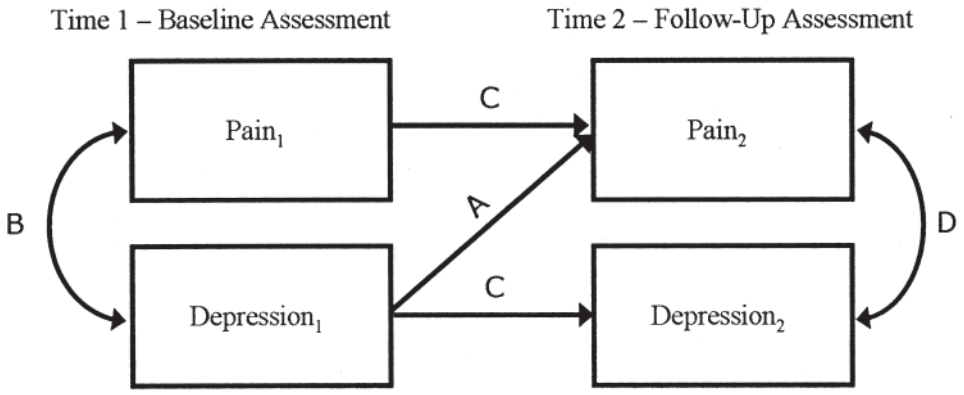

Figure 1. Curved bidirectional arrows represent associations between variables; straight arrows represent causal paths.

Early inflammatory arthritis (EIA) centers have been developed in recognition that early treatment of RA patients with disease modifying antirheumatic drugs (DMARD) interferes with the disease process, slowing or preventing irreversible joint damage and disability[40-42]. Indeed, the greatest improvements in pain, disability, and health-related quality of life (HRQOL) occur in patients treated within 1 year of symptom onset[43-46]. Relatively few studies have investigated the relationship between pain and symptoms of depression among patients with EIA. Most of these studies have been cross-sectional[7,8,47] or longitudinal studies that arbitrarily identified pain or symptoms of depression as a single outcome variable[48-52]. Two longitudinal studies examined pain and depression outcomes in patients defined as having EIA, but each modeled pain and depression outcomes separately[53,54]. Smedstad, *et al*[53] studied 216 patients with disease duration up to 4 years and reported significant autoregressive effects of pain and depression at 1 and 2 years' followup and significant concurrent relationships between pain and depression at baseline and 1 and 2 years. They did not, however, find any evidence for prospective effects of pain on depression or vice versa. Odegard, *et al*[54] also studied EIA patients with disease duration up to 4 years (n = 238) using repeated measures models with followups at 1, 2, 5, and 10 years, but did not find evidence for prospective relationships between pain and depression. The regression-based models used in each of these studies, however, were limited to assessing the trajectories of pain and depression over time in separate models. In addition, the mean disease duration in both studies was 2.2 years, whereas the goal of EIA centers is to treat patients as early as possible, ideally in the first months after symptom onset[45,46].

No published longitudinal studies in EIA have examined directional hypotheses between pain and depression while controlling for disease activity using cross-lagged panel path analysis. Thus, our objective was to examine the longitudinal relationship between pain and symptoms of depression, controlling for disease activity, using cross-lagged panel path analysis in patients with EIA treated by a rheumatologist within 1 year of symptom onset.

MATERIALS AND METHODS

Patient sample. The study sample consisted of patients enrolled in the McGill Early Arthritis Registry (McEAR) between January 2004 and December 2007 who completed baseline and 6-month followup registry visits. Patients in the registry are referred by 21 rheumatologists from greater Montreal, Quebec, Canada, and, to be included in the registry, must have 1 or more swollen joints for at least 6 weeks, but less than 1 year duration, be 16 years of age or older, and be fluent in French or English. Exclusion criteria include clinical evidence of remote joint damage suggestive of a previous RA episode, any rheumatic diagnosis other than RA or undifferentiated inflammatory arthritis (UIA), severe functional limitation from a disease other than arthritis, and any disorder that compromises the ability to give informed consent. Patients in the registry provide an extensive clinical history, undergo examination, and complete a series of self-report questionnaires related to their psychosocial and clinical health status at baseline, every 6 months for the first 2 years of followup, and annually thereafter. In our study, data from the baseline and 6-month assessments were used. The smaller number of patients with longer followup data did not allow for longitudinal analysis of additional assessment points. All patients in the McEAR provide informed consent, and the research ethics boards of McGill University, the Sir Mortimer B. Davis-Jewish General Hospital, and all referring hospitals approved the data collection protocol.

Measures. Pain: The Short-Form McGill Pain Questionnaire (MPQ)[55,56] was used in our study. It contains 11 items related to the sensory dimension of pain and 4 related to the affective dimension. Each descriptor is ranked on a 4-point intensity scale (0–3; none to severe), and total scores range from 0 to 45. The MPQ has been used extensively and has excellent psychometric properties[57].

Symptoms of depression: The Center for Epidemiologic Studies Depression Scale (CES-D)[58] is a 20-item self-report scale that asks patients to rate frequency of depressive symptoms in the past week from 0 (rarely or none of the time) to 3 (most or all of the time). The cutoff for depression used in psychiatric samples and in the general population is 16, although a higher cutoff of 19 has been recommended for patients with RA[59,60]. Cutoffs are referenced for illustrative purposes, but the CES-D total score was used in all multivariate analyses as an index of severity of self-reported symptoms of depression.

Disease activity: Disease activity was assessed using a swollen joint count based on the American College of Rheumatology (ACR) joint count of 66 swollen joints, scored 0 if there is no swelling or 1 if swelling is present[61,62]. Joint counts were performed by 1 of 2 trained McEAR research

nurses who traveled to the referring rheumatology office to perform the joint counts and obtain a blood sample on the same day of the rheumatologist assessment. The same joint examiner conducted baseline and followup assessments. Although other measures such as the Disease Activity Score 28-joint count[63] exist to assess disease activity in RA, these include subjective factors such as tender joint count and patient global assessment of disease activity that may be affected by the patient's concurrent perceptions of pain and/ or symptoms of depression. In addition, swollen joint counts have been shown to be just as sensitive to change and predictive of radiographic damage as commonly used acute-phase reactants such as erythrocyte sedimentation rate or C-reactive protein[62]. Therefore, for the purposes of our study, the number of swollen joints was used as an objective measure of disease activity.

Statistical analyses. Bivariate comparisons: Clinical variables were compared between baseline and followup assessments using paired sample t-tests for continuous variables (pain, depressive symptom severity) and McNemar's chi-squared tests for the proportion of patients above cutoff levels on the CES-D. The distribution of the swollen joint count was skewed, therefore differences in the number of swollen joints at baseline and 6-month followup were compared using the Wilcoxon signed-rank test. All comparative analyses were conducted using SPSS version 15.0 (SPSS, Chicago, IL, USA), and all statistical tests were 2-sided with a $p < 0.05$ significance level.

Multivariate analysis: Cross-lagged panel path analysis models developed with EQS 6.1[64] were used to simultaneously assess the cross-sectional and prospective relationships between levels of pain, symptoms of depression, and the number of swollen joints. These path models can be used to simultaneously estimate correlation coefficients between concurrently measured variables (e.g., pain and depressive symptoms at Time 1) and standardized regression coefficients over time between variables (e.g., depressive symptoms at Time 2 regressed on pain at Time 1) and within variables (e.g., depressive symptoms at Time 2 regressed on depressive symptoms at Time 1).

An initial model (Model 1) was specified so that pain, symptoms of depression, and number of swollen joints were allowed to correlate with each other at both baseline and 6-month assessments. In addition, each outcome variable (pain, depressive symptoms, number of swollen joints at 6 mo) was regressed on its baseline value. Subsequent to Model 1, a series of 3 models with different cross-lagged associations between the 3 variables of interest were tested. Model 2 specified cross-links from baseline symptoms of depression to both 6-month pain and swollen joints (testing the antecedent hypothesis). Model 3 specified cross-links from baseline pain to both 6-month symptoms of depression and swollen joints (testing the consequence hypothesis). Model 4 specified cross-links from baseline number of swollen joints to both 6-month pain and symptoms of depression. In each model, the "crossing" paths represent a potential association between the baseline variable tested and the trajectory of the other variables from baseline to the 6-month followup.

To be plausible explanations of possible causal relationships, models must fit well. That is, they must explain the bulk of the variance between model variables. This was tested by applying a series of fit indices, including the comparative fit index (CFI), which indicates how much variance is explained when going from a null model where no variables are allowed to correlate with each other to the estimated model[65]; the Tucker-Lewis Index (TLI)[66], which is similar to the CFI but is more resistant to sample size; and the root mean-square error of approximation (RMSEA), which indicates how much variance is not accounted for when comparing a saturated model (where are all variables are specified to correlate with each other) to the estimated model per degree of freedom[67]. Standard guidelines suggest that models with TLI and CFI between 0.80 and 0.90 fit moderately well, with > 0.90 indicating a well-fitting model[67,68]. RMSEA values < 0.05 are considered to be representative of good fitting models, and values between 0.05 and 0.08 of moderate fit. Chi-squared tests of fit are also presented. However, since they are highly sensitive to sample size and can lead to the rejection of well-fitting models, practical fit indices (CFI, TLI, and RMSEA) were emphasized[69,70].

In addition, improvement in model fit was assessed to determine if adding links between variables improved the overall model significantly (e.g., comparing Models 2, 3, or 4 to Model 1). If adding links between variables did not improve overall model fit, then these links were not retained. Assessment of model fit and change in fit between nested models were evaluated using the Satorra-Bentler robust chi-squared (SB chi-squared) and the Scaled Difference chi-squared test (SDCS)[71] as a conservative approach given the non-normality of the data.

RESULTS

Sample characteristics. A total of 320 McEAR patients completed baseline assessments; 52 (16.3%) completed baseline assessments less than 6 months previous and were not eligible for the study, and 77 (of the 268 eligible patients; 28.7%) did not complete their scheduled 6-month followup assessment (withdrew from study or missed visit). Of the 191 patients who completed their second visit, 11 (5.8%) patients had incomplete data and were not included our study. Thus, 180 (67.2%) patients with complete baseline and followup assessments were included. The 88 patients excluded from our analysis were not significantly different from the patients included in the study with respect to demographic variables (age, sex, and education) or study outcomes (pain, symptoms of depression, and number of swollen joints).

Approximately two-thirds (n = 125, 69.4%) of the sample was female; 126 patients (70.0%) were married or living as married; 107 (59.4%) had postsecondary education; and 91 (50.6%) were working. The mean age was 57.1 years [standard deviation (SD) 14.2]. Mean disease duration was 7.0 months (SD 3.5); 123 (68.3%) patients had already been treated with at least 1 DMARD [hydroxychloroquine 78 (43.3%), methotrexate 69 (38.3%), sulfasalazine 30 (16.7%), leflunomide 1 (0.6%)]; 84 (46.7%) had been treated with prednisone; 42 patients (23.3%) met the full ACR criteria for RA; and slightly more than half (n = 95, 52.8%) of patients in our study were rheumatoid factor-positive. The sample was similar to published data from other EIA samples of at least 100 patients in terms of age (range of mean age 49 to 60 yrs)[47,51,53,54,72] and percentage female (63% to 74%)[47,51,53,54,72]. The sample in our study appeared to have a higher level of education than the only other study of at least 100 patients that provided education data (60% less than 9 yrs), although data from that study may not be representative[51].

At baseline, the median number of swollen joints was 6.0 [interquartile range (IQR) 2.0–10.0], mean MPQ score was 8.0 (SD 8.6), and mean CES-D score was 13.5 (SD 9.3); 73 patients (40.6%) scored at least 16 on the CES-D, and 48 (26.7%) scored 19 or higher. At the 6-month followup, patients reported significantly lower scores on all 3 measures (median number swollen joints = 2.0, IQR 0.0 to 5.0, $p < 0.001$; mean MPQ = 5.5, SD 6.7, $p = < 0.001$; mean CES-D = 11.0, SD 9.0, $p < 0.001$). The number of patients scor-

ing ≥ 16 on the CES-D was 51 (28.3%; p = 0.003), and the number of patients scoring 19 or above was 38 (21.1%; p = 0.164).

Cross-lagged panel path analysis models. The initial model, Model 1, in which baseline scores of pain, depressive symptoms, and number of swollen joints were specified to predict 6-month scores with no cross-predictions across variables, fit reasonably well [SB chi-squared (6) = 15.4, p = 0.018, CFI = 0.95, TLI = 0.93, RMSEA = 0.09; Figure 2]. All prospective paths from baseline to 6-month scores were significant (p < 0.001). Bivariate correlations between pain, depressive symptoms, and swollen joints ranged from 0.28 to 0.47 at baseline and from 0.17 to 0.28 at 6 months (p < 0.05). Model 2 added cross-links from baseline symptoms of depression to pain and swollen joints at 6 months (Figure 3). Baseline depressive symptoms significantly predicted pain at 6 months (standardized regression coefficient = 0.28, p = 0.002), but not swollen joints (standardized regression coefficient = 0.02, p = 0.823), so the model was respecified after removing the link between baseline depressive symptoms and swollen joints at 6 months. Depressive symptoms at baseline continued to predict 6-month pain (standardized regression coefficient = 0.28, p = 0.001), and the model fit significantly better than Model 1 as determined by the scaled difference in chi-squared test [SDCS(1) = 11.02, p < 0.001]. Model 3 included the prospective links of Model 1 plus cross-links from pain at baseline to depressive symptoms and swollen joints at 6 months, but neither was significant (pain to depression, standardized regression coefficient = 0.09, p = 0.278; pain to swollen joints, standardized regression coefficient = 0.03, p = 0.652), and the model did not fit significantly better than the baseline Model 1. Model 4 added cross-links between swollen joints at baseline and the other 2 outcome variables at 6 months, but neither link was significant (swollen joints to depression, standardized regression coefficient = 0.09, p = 0.148; swollen joints to pain, standardized regression coefficient = 0.08, p = 0.399).

DISCUSSION

Ours is the first study to use cross-lagged panel path analyses methods to assess the relationship between pain and symptoms of depression over time in patients with EIA who were treated by a rheumatologist within 1 year of symptom onset. The main findings of our study were (1) that pain, symptoms of depression, and the number of swollen joints all improved significantly from the baseline visit to the 6-month followup; (2) that the most robust predictors of pain, symptoms of depression, and swollen joints at 6 months were baseline values of these variables; and (3) that symptoms of depression predicted change in pain symptoms, but pain and swollen joints did not predict change in other variables, supporting the antecedent hypothesis. Since pain decreased between baseline and 6-month assessments, high levels of depressive symptoms were associated with less improvement in pain. There were also strong correlations between depression and pain at baseline and 6-month followup, which suggests important bidirectional causal processes that evolve over time.

The findings from our study are consistent with other studies in EIA that report significant improvements in clini-

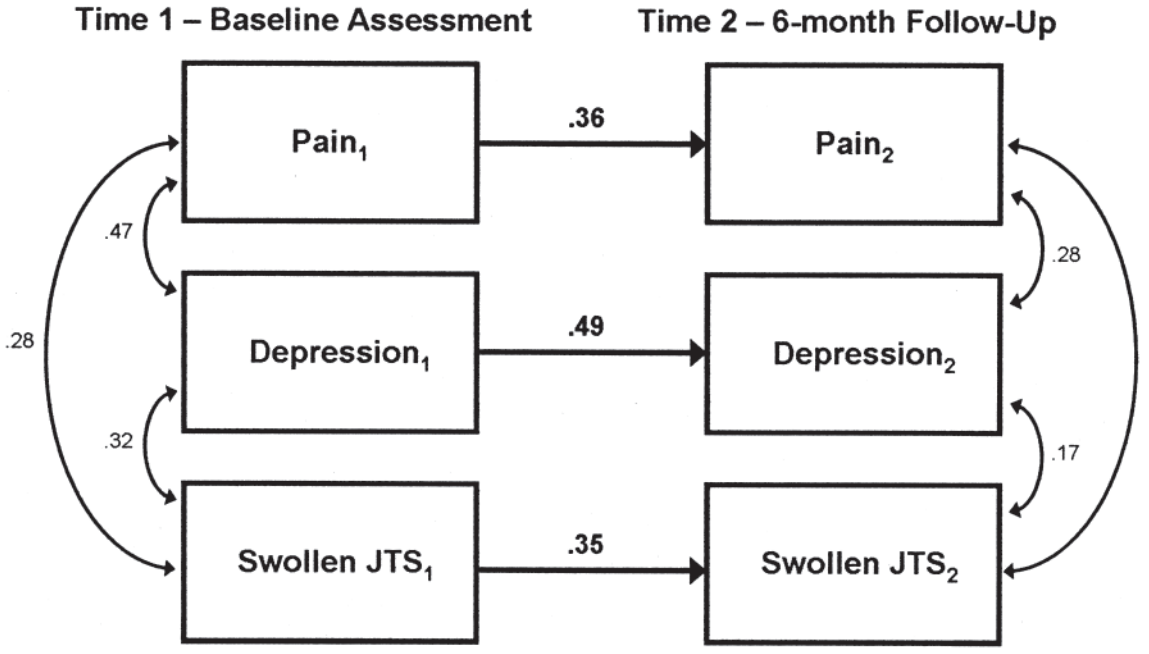

Figure 2. Curved arrows indicate significant correlations between variables (p < 0.05); straight arrows indicate significant relationships between variables over time with respective standardized regression coefficients (p < 0.05).

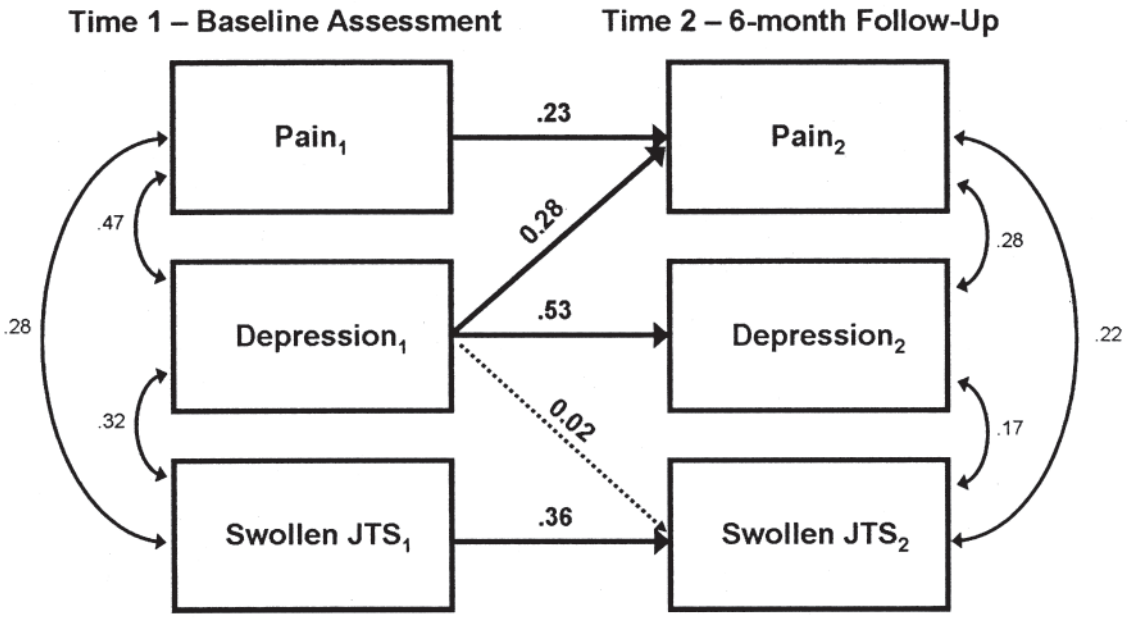

Figure 3. Curved arrows indicate significant correlations between variables ($p < 0.05$), straight arrows indicate significant relationships between variables over time with respective standardized regression coefficients ($p < 0.05$), and dotted arrow indicates relationships that are not significant.

cal status (pain and swollen joints) in the first year after diagnosis in response to early detection and treatment[72,73]. In terms of change in depressive symptoms, other studies of patients with EIA have yielded conflicting results. Some studies[49,50] have reported that depressive symptoms remain stable over time, whereas other studies[51,74] have reported that depressive symptoms improved, which is consistent with results from our study. Variability in results may be due to the use of different depressive symptom measures across studies as well as different followup assessment schedules. The general finding that high levels of depressive symptoms are common in a sample of patients with EIA, however, is consistent with previous findings that rates of depression appear to be similar for patients newly diagnosed and patients with chronic RA[52,75].

Results from our study are also consistent with other studies that have reported evidence for bidirectional causal pathways linking pain and symptoms of depression in both chronic RA and EIA[30,38,53,75]. Pain is related to work disability and reduced social and recreational participation, all of which may contribute to the development of depressive symptoms[75]. In addition, numerous studies have identified environmental and psychosocial influences, in addition to the role of nociceptive signals, in the pathogenesis of pain[76,77]. Depression has been hypothesized to act directly on pain by sensitizing pain pathways[78]. Moreover, depression may indirectly contribute to pain by reducing positive coping behaviors, self-efficacy and perceived control, all of which are predictive of better health outcomes[8,29,79-82]. RA patients with depression are 3 times as likely to be nonadherent to medical treatments as nondepressed patients[83]. It is possible that poorer health behaviors early in the course of disease among patients with depression could influence the pervasiveness of depression and pain symptoms common in patients with established RA who do not receive early intervention. More research is needed, however, to better delineate the bidirectional nature of processes linking pain and symptoms of depression.

Several limitations should be considered when interpreting our findings. First, our study examined baseline and 6-month followup data and should be replicated in a sample with a longer followup period to determine whether these relationships persist. Second, only about 20% of RA cases were strictly defined according to ACR criteria. However, this is likely an underestimate because, although dosages are not reported in the registry, most patients were treated with at least 1 DMARD prior to the first assessment point when patients are classified as RA or UIA. Third, although all patients undergo a tender joint count at the same time as the swollen joint count, fibromyalgia is not formally assessed and we cannot rule out that fibromyalgia and not active RA may be involved in some cases. Fourth, although patients in our study were similar to other published EIA cohorts in terms of age and sex, sampling was not random, and it is possible that the sample may not be representative in terms of education, income, or other important sociodemographic variables. Finally, our study used a self-report measure of depressive symptoms and did not formally assess major depression. Thus, while it is tempting to suggest that the implementation of systematic depression screening and

treatment would improve EIA patient outcomes, this would be premature. Sharpe, *et al*[84,85] found that cognitive-behavioral therapy reduced depressive symptoms and healthcare utilization in a small sample of patients with recently diagnosed RA (n = 53). As noted by Sheehy, *et al*[75], however, key considerations, such as how to best facilitate early and effective screening of depression in EIA clinics, warrant further attention.

Our study was the first longitudinal study to examine directional relationships between pain and depressive symptoms in EIA using cross-lagged panel path analysis in patients diagnosed and treated by a rheumatologist within 1 year of symptom onset. Our results demonstrated that depressive symptoms significantly contributed to the trajectory of pain symptoms from baseline assessment to 6-month followup. In addition, there were reciprocal/bidirectional associations between pain and depression that continued across assessment points. Pain and depression are intricately related and more research is necessary to better understand this relationship.

ACKNOWLEDGMENT

We thank Dr. Jean-François Boivin of McGill University for his insightful comments on an earlier version of this manuscript.

REFERENCES

1. Smith GR. The epidemiology and treatment of depression when it coexists with somatoform disorders, somatization, or pain. Gen Hosp Psychiatry 1992;14:265-72.
2. Creed F. Psychological disorders in rheumatoid arthritis: a growing consensus? Ann Rheum Dis 1990;49:808-12.
3. Creed F, Murphy S, Jayson MV. Measurement of psychiatric disorder in rheumatoid arthritis. J Psychosom Res 1990;34:79-87.
4. Dickens C, Jackson J, Tomenson B, Hay E, Creed F. Association of depression and rheumatoid arthritis. Psychosomatics 2003;44:209-15.
5. Blalock SJ, DeVellis RF, Brown GK, Wallston KA. Validity of the Center for Epidemiological Studies Depression Scale in arthritis populations. Arthritis Rheum 1989;32:991-7.
6. Barlow JH, Cullen LA, Rowe IF. Comparison of knowledge and psychological well-being between patients with a short disease duration (< or = 1 year) and patients with more established rheumatoid arthritis (> or = 10 years duration). Patient Educ Couns 1999;38:195-203.
7. Chaney JM, Uretsky D, Mullins L, et al. Differential effects of age and illness duration on pain-depression and disability-depression relationships in rheumatoid arthritis. Int J Rehab Health 1996;2:101-12.
8. Treharne GJ, Kitas GD, Lyons AC, Booth DA. Well-being in rheumatoid arthritis: the effects of disease duration and psychosocial factors. J Health Psychol 2005;10:457-74.
9. Ang DC, Choi H, Kroenke K, Wolfe F. Comorbid depression is an independent risk factor for mortality in patients with rheumatoid arthritis. J Rheumatol 2005;32:1013-9.
10. Katz PP, Yelin EH. Life activities of persons with rheumatoid arthritis with and without depressive symptoms. Arthritis Care Res 1994;7:69-77.
11. Kirmayer LJ, Robbins JM, Dworkind M, Yaffe MJ. Somatization and the recognition of depression and anxiety in primary care. Am J Psychiatry 1993;150:734-41.
12. Parker JC, Smarr KL, Slaughter JR, et al. Management of depression in rheumatoid arthritis: a combined pharmacologic and cognitive-behavioral approach. Arthritis Rheum 2003;49:766-77.
13. Strine TW, Hootman JM, Okoro CA, et al. Frequent mental distress status among adults with arthritis age 45 years and older, 2001. Arthritis Rheum 2004;51:533-7.
14. Fishbain DA, Cutler R, Rosomoff HL, Rosomoff RS. Chronic pain-associated depression: antecedent or consequence of chronic pain? A review. Clin J Pain 1997;13:116-37.
15. Bair MJ, Robinson RL, Katon W, Kroenke K. Depression and pain comorbidity: a literature review. Arch Intern Med 2003;163:2433-45.
16. Hurwitz EL, Morgenstern H, Yu F. Cross-sectional and longitudinal associations of low-back pain and related disability with psychological distress among patients enrolled in the UCLA Low-Back Pain Study. J Clin Epidemiol 2003;56:463-71.
17. Abdel-Nasser AM, Abd El-Azim S, Taal E, El-Badawy SA, Rasker JJ, Valkenburg HA. Depression and depressive symptoms in rheumatoid arthritis patients: an analysis of their occurrence and determinants. Br J Rheumatol 1998;37:391-7.
18. Conner TS, Tennen H, Zautra AJ, Affleck G, Armeli S, Fifield J. Coping with rheumatoid arthritis pain in daily life: within-person analyses reveal hidden vulnerability for the formerly depressed. Pain 2006;126:198-209.
19. Covic T, Tyson G, Spencer D, Howe G. Depression in rheumatoid arthritis patients: demographic, clinical, and psychological predictors. J Psychosom Res 2006;60:469-76.
20. Dickens C, McGowan L, Clark-Carter D, Creed F. Depression in rheumatoid arthritis: a systematic review of the literature with meta-analysis. Psychosom Med 2002;64:52-60.
21. Fifield J, Tennen H, Reisine S, McQuillan J. Depression and the long-term risk of pain, fatigue, and disability in patients with rheumatoid arthritis. Arthritis Rheum 1998;41:1851-7.
22. Rupp I, Boshuizen HC, Roorda LD, Dinant HJ, Jacobi CE, van den Bos G. Poor and good health outcomes in rheumatoid arthritis: the role of comorbidity. J Rheumatol 2006;33:1488-95.
23. Serbo B, Jajic I. Relationship of the functional status, duration of the disease and pain intensity and some psychological variables in patients with rheumatoid arthritis. Clin Rheumatol 1991;10:419-22.
24. Soderlin MK, Hakala M, Nieminen P. Anxiety and depression in a community-based rheumatoid arthritis population. Scand J Rheumatol 2000;29:177-83.
25. Tsai PF. Predictors of distress and depression in elders with arthritic pain. J Adv Nurs 2005;51:158-65.
26. Brown SC, Glass JM, Park DC. The relationship of pain and depression to cognitive function in rheumatoid arthritis patients. Pain 2002;96:279-84.
27. Zautra AJ, Burleson MH, Smith CA, et al. Arthritis and perceptions of quality of life: an examination of positive and negative affect in rheumatoid arthritis patients. Health Psychol 1995;14:399-408.
28. Zautra AJ, Parrish BP, Van Puymbroeck CM, et al. Depression history, stress, and pain in rheumatoid arthritis patients. J Behav Med 2007;30:187-97.
29. Brown GK, Nicassio PM, Wallston KA. Pain coping strategies and depression in rheumatoid arthritis. J Consult Clin Psychol 1989;57:652-7.
30. Nicassio PM, Wallston KA. Longitudinal relationships among pain, sleep problems, and depression in rheumatoid arthritis. J Abnorm Psychol 1992;101:514-20.
31. Campbell D, Kenny DA. A primer on regression artifacts. New York: Guilford Press; 1999.
32. Hays RD, Marshall GN, Wang EY, Sherbourne CD. Four-year cross-lagged associations between physical and mental health in the Medical Outcomes Study. J Consult Clin Psychol 1994;62:441-9.
33. Hall JA, Milburn MA, Epstein AM. A causal model of health status

and satisfaction with medical care. Med Care 1993;31:84-94.
34. Streiner D, Norman G. Health measurement scales: a practical guide to their development and use. New York: Oxford University Press; 2003:192.
35. Chaney JM, Mullins LL, Wagner JL, Hommel KA, Page MC, Doppler MJ. A longitudinal examination of causal attributions and depression symptomatology in rheumatoid arthritis. Rehab Psychol 2004;49:126-33.
36. Martens MP, Parker JC, Smarr KL, et al. Health status, cognitive coping, and depressive symptoms: Testing for a mediator effect. J Rheumatol 2005;32:1584-8.
37. Rhee SH, Parker JC, Smarr KL, et al. Stress management in rheumatoid arthritis: what is the underlying mechanism? Arthritis Care Res 2000;13:435-42.
38. Covic T, Adamson B, Spencer D, Howe G. A biopsychosocial model of pain and depression in rheumatoid arthritis: a 12-month longitudinal study. Rheumatology Oxford 2003;42:1287-94.
39. Brown GK. A causal analysis of chronic pain and depression. J Abnorm Psychol 1990;99:127-37.
40. Aletaha D, Eberl G, Nell VP, Machold KP, Smolen JS. Practical progress in realisation of early diagnosis and treatment of patients with suspected rheumatoid arthritis: results from two matched questionnaires within three years. Ann Rheum Dis 2002;61:630-4.
41. Aletaha D, Smolen JS. DMARD use in early rheumatoid arthritis. Lessons from observations in patients with established disease. Clin Exp Rheumatol 2003;21:S169-73.
42. Moreland LW, Bridges SL Jr. Early rheumatoid arthritis: a medical emergency? Am J Med 2001;111:498-500.
43. Kosinski M, Kujawski SC, Martin R, et al. Health-related quality of life in early rheumatoid arthritis: impact of disease and treatment response. Am J Managed Care 2002;8:231-40.
44. Welsing PM, van Gestel AM, Swinkels HL, Kiemeney LA, van Riel PL. The relationship between disease activity, joint destruction, and functional capacity over the course of rheumatoid arthritis. Arthritis Rheum 2001;44:2009-17.
45. Di Martino S, Paget S. On the importance of early arthritis centers. HSS J 2005;1:107-9.
46. O'Dell JR. Treating rheumatoid arthritis early: a window of opportunity? Arthritis Rheum 2002;46:283-5.
47. Ramjeet J, Koutantji M, Barrett EM, Scott DG. Coping and psychological adjustment in recent-onset inflammatory polyarthritis: the role of gender and age. Rheumatology Oxford 2005;44:1166-8.
48. Uhlig T, Smedstad LM, Vaglum P, Moum T, Gerard N, Kvien TK. The course of rheumatoid arthritis and predictors of psychological, physical and radiographic outcome after 5 years of follow-up. Rheumatology Oxford 2000;39:732-41.
49. Evers AW, Kraaimaat FW, Geenen R, Bijlsma JW. Determinants of psychological distress and its course in the first year after diagnosis in rheumatoid arthritis patients. J Behav Med 1997;20:489-504.
50. Evers AW, Kraaimaat FW, Geenen R, Jacobs JW, Bijlsma JW. Longterm predictors of anxiety and depressed mood in early rheumatoid arthritis: a 3 and 5 year followup. J Rheumatol 2002;29:2327-36.
51. Persson LO, Larsson BM, Nived K, Eberhardt K. The development of emotional distress in 158 patients with recently diagnosed rheumatoid arthritis: a prospective 5-year follow-up study. Scand J Rheumatol 2005;34:191-7.
52. Sharpe L, Sensky T, Allard S. The course of depression in recent onset rheumatoid arthritis: the predictive role of disability, illness perceptions, pain and coping. J Psychosom Res 2001;51:713-9.
53. Smedstad LM, Vaglum P, Moum T, Kvien TK. The relationship between psychological distress and traditional clinical variables: a 2 year prospective study of 216 patients with early rheumatoid arthritis. Br J Rheumatol 1997;36:1304-11.
54. Odegard S, Finset A, Mowinckel P, Kvien TK, Uhlig T. Pain and psychological health status over a 10-year period in patients with recent onset rheumatoid arthritis. Ann Rheum Dis 2007;66:1195-201.
55. Melzack R. The McGill Pain Questionnaire: major properties and scoring methods. Pain 1975;1:277-99.
56. Melzack R. The short-form McGill Pain Questionnaire. Pain 1987;30:191-7.
57. Jensen M, Karoly P. Self-report scales and procedures for assessing pain in adults. In: Turk D, Melzack R, editors. Handbook of pain assessment. New York: Guilford; 2001:15-34.
58. Radloff L. The CES-D scale: a self-report depression scale for research in the general population. Appl Psychol Meas 1977;1:385-401.
59. Martens MP, Parker JC, Smarr KL, Hewett JE, Slaughter JR, Walker SE. Assessment of depression in rheumatoid arthritis: a modified version of the Center for Epidemiologic Studies depression scale. Arthritis Rheum 2003;49:549-55.
60. McQuillan J, Fifield J, Sheehan TJ, et al. A comparison of self-reports of distress and affective disorder diagnoses in rheumatoid arthritis: a receiver operator characteristic analysis. Arthritis Rheum 2003;49:368-76.
61. Arnett FC, Edworthy SM, Bloch DA, et al. The American Rheumatism Association 1987 revised criteria for the classification of rheumatoid arthritis. Arthritis Rheum 1988;31:315-24.
62. Felson DT, Anderson JJ, Boers M, et al. The American College of Rheumatology preliminary core set of disease activity measures for rheumatoid arthritis clinical trials. The Committee on Outcome Measures in Rheumatoid Arthritis Clinical Trials. Arthritis Rheum 1993;36:729-40.
63. van der Heijde DM, van 't Hof M, van Riel PL, van de Putte LB. Development of a disease activity score based on judgment in clinical practice by rheumatologists. J Rheumatol 1993;20:579-81.
64. Bentler P, Wu EJC. EQS structural equations program, version 6.1. Encino, CA: Multivariate Software; 2003.
65. Bentler P. Comparative fit indexes in structural models. Psychol Bull 1990;107:238-46.
66. Tucker L, Lewis C. A reliability coefficient for maximum likelihood factor analysis. Psychometrika 1973;38:1-10.
67. Steiger J. Structural model evaluation and modification: An interval estimation approach. Multivar Behav Res 1990;25:173-80.
68. Browne M, Cudeck, R. Alternative ways of assessing model fit. In: Bollen K, Long, JS, editors. Testing structural equation models. Beverly Hills, CA: Sage; 1993:136-62.
69. Reise SP, Widaman KF, Pugh RH. Confirmatory factor analysis and item response theory: two approaches for exploring measurement invariance. Psychol Bull 1993;114:552-66.
70. Tomarken AJ, Waller NG. Potential problems with "well fitting" models. J Abnorm Psychol 2003;112:578-98.
71. Satorra A, Bentler PM. A scaled difference chi-square test statistic for moment structure analysis. Psychometrika 2001;66:507-14.
72. Lindqvist E, Saxne T, Geborek P, Eberhardt K. Ten year outcome in a cohort of patients with early rheumatoid arthritis: health status, disease process, and damage. Ann Rheum Dis 2002;61:1055-9.
73. Albers JM, Paimela L, Kurki P, et al. Treatment strategy, disease activity, and outcome in four cohorts of patients with early rheumatoid arthritis. Ann Rheum Dis 2001;60:453-8.
74. Crotty M, McFarlane AC, Brooks PM, Hopper JL, Bieri D, Taylor SJ. The psychosocial and clinical status of younger women with early rheumatoid arthritis: a longitudinal study with frequent measures. Br J Rheumatol 1994;33:754-60.
75. Sheehy C, Murphy E, Barry M. Depression in rheumatoid arthritis — underscoring the problem. Rheumatology Oxford 2006;45:1325-7.
76. DeLeo JA. Basic science of pain. J Bone Joint Surg Am

2006;2:58-62.
77. Dieppe PA, Lohmander LS. Pathogenesis and management of pain in osteoarthritis. Lancet 2005;365:965-73.
78. Blackburn-Munro G, Blackburn-Munro RE. Chronic pain, chronic stress and depression: coincidence or consequence? J Neuroendocrinol 2001;13:1009-23.
79. Brekke M, Hjortdahl P, Kvien TK. Self-efficacy and health status in rheumatoid arthritis: a two-year longitudinal observational study. Rheumatology Oxford 2001;40:387-92.
80. Brus H, van de Laar M, Taal E, Rasker J, Wiegman O. Determinants of compliance with medication in patients with rheumatoid arthritis: the importance of self-efficacy expectations. Patient Educ Couns 1999;36:57-64.
81. Groarke A, Curtis R, Coughlan R, Gsel A. The role of perceived and actual disease status in adjustment to rheumatoid arthritis. Rheumatology Oxford 2004;43:1142-9.
82. Schiaffino KM, Shawaryn MA, Blum D. Examining the impact of illness representations on psychological adjustment to chronic illnesses. Health Psychol 1998;17:262-8.
83. DiMatteo MR, Lepper HS, Croghan TW. Depression is a risk factor for noncompliance with medical treatment: meta-analysis of the effects of anxiety and depression on patient adherence. Arch Intern Med 2000;160:2101-7.
84. Sharpe L, Sensky T, Allard S, Timberlake N, Ryan B, Brewin C. A blind, randomised controlled trial of cognitive behaviour therapy for patients recently diagnosed with rheumatoid arthritis. Pain 2001;89:275-83.
85. Sharpe L, Sensky T, Timberlake N, Ryan B, Allard S. Long-term efficacy of a cognitive behavioural treatment from a randomized controlled trial for patients recently diagnosed with rheumatoid arthritis. Rheumatology Oxford 2003;42:435-41.