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Factors Affecting Depression Among People With Chronic Musculoskeletal Pain: A Structural Equation Model

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Objective: To adapt and test P. M. Lewinsohn, H. M. Hoberman, L. Teri, and M. Hautzinger's (1985) integrative model of depression for individuals with chronic musculoskeletal pain. ***Design:*** Structural equation modeling. ***Participants:*** Individuals with chronic pain ($N = 171$), recruited from 6 outpatient rehabilitation facilities in Canada. ***Outcome Measures:*** Two measures of the latent variable, depression (the Center for Epidemiologic Studies—Depression Scale and the Zung Self-Rating Depression Scale), along with multiple measures of each of 5 latent predictors (pain, interferences, stress, coping, and social and family support) and 2 measured predictors (preinjury psychopathology and catastrophizing). ***Results:*** The normed fit index, comparative fit index, and parsimony ratio indicated an adequate fit for the model, suggesting that stress, perceived severity of pain, activity interferences, and catastrophizing contributed to increased depression (vulnerabilities), whereas pain coping skills and social and family support contributed to decreased depression (immunities). ***Conclusions:*** Empirical support was found for the proposed model of depression for people with chronic musculoskeletal pain, and the model appears to provide useful information for clinical rehabilitation interventions.

Keywords: structural equation modeling, chronic pain, depression, rehabilitation

According to the Agency for Health Care Policy and Research (1999), depressive disorders, including major depression and dysthymia, are the most common types of mental illnesses, with one in five individuals (20%) affected at some point in life. The economic and personal costs of depression to individuals, families, and society as a whole are substantial. In the United States alone, the Agency for Health Care Policy and Research report estimated that the economic costs of depression exceeded $44 billion per year, in addition to significant personal costs, including higher mortality and impairments in multiple areas of functioning.

For people with disabilities, the incidence of depression is reported to be higher than for the general population. R. J. Turner and McLean (1989) indicated that people with physical disabilities are three to four times more likely than people without disabilities to have had an episode of major depression. Furthermore, people with chronic pain have been reported to experience an even higher rate of depression, with a point prevalence rate as high as 30% to 54% (Banks & Kerns, 1996). Among people with chronic low back pain, Polatin, Kinney, Gatchel, Lillo, and Mayer (1993) reported a 45% point prevalence rate and a 64% lifetime rate. Monsein and Cliff (1995) identified lower pain tolerance and reduced activity tolerance as significant negative consequences of depression that, if left untreated, could hinder active participation in rehabilitation programming and negatively influence rehabilitation outcomes. In the large-scale Canadian Community Health Survey, Currie and Wang (2004) found that the prevalence of major depression increased with the severity of chronic back pain and that chronic back pain in combination with depression resulted in greater disability than either pain or depression alone.

Integrative Model of Depression (IMD)

Lewinsohn, Hoberman, Teri, and Hautzinger (1985) developed the IMD on the basis of salient research findings on unipolar depression and by incorporating both cognitive models (i.e., cognitive dispositional factors) and reinforcement models (i.e., situational factors). They postulated that depression begins with the occurrence of an evoking event or antecedent. An antecedent is defined as any event (i.e., stressor) that increases the probability of the future occurrence of depression, including macrostressors (e.g., losing one's job), microstressors (e.g., being criticized), and chronic difficulties (e.g., longer term marital, social, and work problems). The evoking event results in a disruption of "scripted" or automatic behavior patterns and emotional responses. Disruptions of everyday routines and the emotional upsets that these disruptions produce can lead to a reduction in positive reinforcement and elevated rates of aversive experiences.

Initial negative emotional responses, along with the inability to reverse the impact of the stress, can result in increased self-awareness, reduced positive reinforcement, and increased negative experiences and can also foster an increment in self-focused attention (Lewinsohn et al., 1985). Self-focused attention heightens awareness of thoughts, values, feelings, and standards in terms of one's evaluation of self in relation to the evoking event. Cognitive

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consequences include negative self-evaluations, low rates of self-reinforcement, pessimism about the future, internal and global attribution for failure experiences, cognitive distortions, and preoccupation with negative experiences from the past. Behavioral consequences include withdrawal, social difficulties, reduced efforts and persistence, reduced performance, and magnification of affective reactions. The heightened state of self-awareness and dysphoria leads to cognitive and behavioral changes that are highly correlated with depression.

Central to the IMD is the concept of predisposing characteristics represented by individual differences and environmental variables, defined as vulnerabilities, which systematically increase the probability for the occurrence of depression, and immunities, which decrease the probability (Lewinsohn et al., 1985). Examples of vulnerability factors include female gender, age between 20 and 40 years, history of depression, low coping skills, sensitivity to aversive events, low socioeconomic status, high level of self-consciousness, low threshold for the evocation of the depressogenic self-schemas, low self-esteem, interpersonal dependency, and having children below the age of 7. Examples of immunities include positive coping skills, an ability to focus on external events, and good social and personal support. The application of concepts such as major evoking events (e.g., debilitating pain), life stressors, cognitive distortions (e.g., irrational beliefs, negative expectancies, catastrophizing), vulnerabilities (e.g., preinjury psychopathology, poor coping skills, poor social and family support), and immunities (e.g., good coping skills and social and family support), in the context of disability and rehabilitation, is central to the development of the causal model of depression for individuals with chronic musculoskeletal pain proposed in the current study.

A Model of Depression for People With Chronic Musculoskeletal Pain

The primary purpose of the present study is to formulate and test a model of depression specific to individuals with chronic musculoskeletal pain, on the basis of the IMD and a review of the pain and depression literature. The biopsychosocial model is consistent with cognitive–behavioral interventions commonly used in multidisciplinary pain rehabilitation programs, and the model developed could facilitate the understanding of needs and successful rehabilitation outcomes (Banks & Kerns, 1996; Monsein & Cliff, 1995). In addition, the model is consistent with the identification and remediation of factors contributing to work injuries and disabilities in disability management programs, which have emerged as a proactive alternative to the more reactive traditional individual approach to work injuries (Berkowitz & Berkowitz, 1991; Chan, Lui, Rosenthal, Pruett, & Ferrin, 2002; Habeck & Kirchner, 1999; Lui, Chan, Kwok, & Thorson, 1999). In particular, the purpose of the study is threefold: (a) to translate theoretical expectations into a structural equation model, (b) to examine the strength of relations among constructs that influence depression, and (c) to evaluate the general compatibility (i.e., goodness of fit) of the model with the data.

The proposed model includes five latent variables (pain perception, activity interferences, stress, pain coping ability, and social and family support) and the measured variables (preinjury psychopathology and catastrophizing) that are identified as important in influencing the development of depression. The model made the following *a priori* specifications.

1. Preinjury psychopathology would influence perception of pain, which, in turn, would influence daily activity levels (G. K. Brown, 1990; Matheson, 1995). Reduction in daily activities would lead individuals to catastrophize the effects of pain, resulting in a higher probability of depression (R. Beck, Robbins, Taylor, & Baker, 2001; Behel, Rybarczyk, Elliott, Nicholas, & Nyenhuis, 2002; G. W. Brown & Harris, 1989; Lewinsohn et al., 1985). Pain would also have a direct effect on depression (Banks & Kerns, 1996; Lewinsohn, Allen, Seeley, & Gotlib, 1999; Polatin et al., 1993). Reduction in daily activities would directly influence depressive state (Matheson, 1995; Turk, 2002). Preinjury psychopathology would also have a direct influence on stress level and depression (G. K. Brown, 1990; Matheson, 1995).

2. Stress would influence the level of family and social support (Downey & Coyne, 1990; Gotlib & Hammen, 1992; Turk, 2002). Low family and social support would be related to depression (Kerns, Rosenberg, & Otis, 2002; Nicassio & Radojevic, 1993). Stress would also have a direct effect on depression (Elliott, Witty, Herrick, & Hoffman, 1991; R. J. Turner & McLean, 1989).

3. Coping with pain would influence perception of pain and, in turn, would affect daily activity levels (Rosenstiel & Keefe, 1983). In addition, coping would also have a direct effect on daily activity levels (Keefe, Brown, Wallston, & Caldwell, 1989). Finally, coping would influence social and family support (Hwang, Myers, & Takeuchi, 2000). Therefore, pain coping skills would indirectly affect depression (Jensen & Karoly, 1991; Kopp, Skrabski, & Szedmak, 2000; J. A. Turner & Clancy, 1986).

Method

Participants

Participants were 171 rehabilitation clients recruited from six outpatient facilities that provided pain rehabilitation intervention for workers' compensation cases in Canada, primarily in the province of Alberta. Criteria for selection included age of 21 years or older along with a medical diagnosis of nonmalignant, work-related pain for at least 3 months, according to the criteria for chronicity specified by the International Association for the Study of Pain Subcommittee on Taxonomy (1986). The majority of the clients were recruited from Millard Health Centre in Edmonton, Alberta, in 2002. One hundred ninety-seven research packets were distributed to clients at Millard Health, where the first author was doing her predoctoral psychology internship at the time, and 145 clients returned the packets, with a return rate of 73.6%. In addition, five psychologists were contacted to help advertise for this research project in their respective outpatient rehabilitation agencies. Twenty-six clients then contacted the first author to express their interest in the research project, and all 26 clients returned the research packets.

Participants included 87 (50.9%) men and 84 (49.1%) women, with a mean age of 42.5 years (SD = 9.9, range = 19 to 67), and 62.6% were married or living with a partner. Participants were primarily Canadians of European descent (71.3%), with predominantly a high school or vocational–technical school education (91.2%). A majority identified their socioeconomic status as lower middle (39.8%) to middle (45.6%) class. The mean time since injury onset was 26.1 months (SD = 51.8), and major types of injuries included back (64.3%), upper extremity and lower extremity (31.0%), and mild head trauma with orthopedic pain (1.2%). Occupations of the participants were in the major categories of construction, transportation, manufacturing, janitorial, health care, mechanical, and

services, representing jobs requiring a wide range of physical demand characteristics.

Instruments

Multiple indicators and instruments were used to measure the latent constructs depicted in the model of depression that is hypothesized in the present study. The latent constructs included were depression, pain perception, activity interferences, stress, coping, and social and family support, in addition to two measured constructs, preinjury psychopathology and catastrophizing. Internal consistency reliability estimates for the sample used in the present study were computed for the various measures via Cronbach's alpha and are reported in the following sections, along with other information about each measure.

Depression. The Center for Epidemiologic Studies—Depression Scale (CES–D; Radloff, 1977) and the Zung Self-Rating Depression Scale (Zung, 1965) were used as measures of the latent dependent variable, depression. The CES–D was developed by Radloff (1977) to operationalize depressive symptomatology in the general population and consists of 20 items (e.g., "I felt that I could not shake off the blues even with help from my family or friends"). Each item is rated on a 4-point scale on "feelings/behavior during the past week," ranging from 0 (*rarely or none of the time*) to 3 (*most or all of the time*), and responses are summed over the 20 items to produce a CES–D total score, which can thus range from 0 to 60. Radloff reported internal consistency estimates ranging from .84 to .90 in several applications, and R. J. Turner and McLean (1989) found an estimate of .88 using a sample with physical disabilities. Cole, Rabin, Smith, and Kaufman (2004) reviewed research on the CES–D documenting internal consistency reliability, convergent validity, discriminant validity, and sensitivity. In addition, Elliott and Umlauf (1995) reviewed empirical support for the use of the CES–D with individuals with physical disabilities and concluded that "the CES–D appears to have considerable clinical and theoretical value for use in the rehabilitation setting" (p. 338). Using the sample in the current study, we found an internal consistency reliability estimate of .90.

The Zung was developed by Zung (1965) to operationalize the severity of both the psychological and the physiological symptoms of depression and consists of 20 items (e.g., "I feel down-hearted and blue"). Each item is rated on a 4-point scale ranging from 1 (*some of the time*) to 4 (*all of the time*), and responses are summed across the 20 items to produce a Zung total score, which can thus range from 20 to 80. Zung (1965) reported a split-half reliability estimate of .92, and Schaffer et al. (1985) found that Zung scores showed a stronger relation to diagnostic criteria for depression than two other widely used self-report measures, the Beck Depression Inventory (A. T. Beck, Ward, Mendelson, Mock, & Erbaugh, 1961) and the Minnesota Multiphasic Personality Inventory Depression scale (Hathaway & McKinley, 1940). In addition, Tate, Frochheimer, and Maynard (1993) found support for the validity and sensitivity of the Zung in measuring depression with individuals with spinal cord injuries. An internal consistency estimate of .88 was found with the sample in the present study.

Pain. The Visual Analogue Scale (VAS; Price, McGrath, Rafii, & Buckingham, 1983) and the Medical Outcomes Study Pain Severity scale (MOS-PS; Sherbourne, 1992) were used to measure the latent predictor variable perception of pain. The VAS has been used as a method of operationalizing subjective perceptions of pain in clinical settings (Ahles, Ruckdeschel, & Blanchard, 1984; Carlsson, 1983; Price et al., 1983; Scott & Huskisson, 1976), and it asks respondents to record their perceptions on a 100-mm horizontal line. The respondent is asked to draw a perpendicular line intersecting the horizontal line, indicating the average perceived intensity of pain experienced for the past week. The left end of the line is anchored with the label *no pain at all* (0), and the right end of the line is anchored with the label *intense/worst pain* (100). The number of millimeters from the left extreme to the point where the perpendicular line intersects the horizontal line is recorded as the VAS score, which can range from 0 to 100, with higher scores indicating greater intensity of pain perceived. Test–retest reliability estimates over different intervals have ranged from .60 to .97 (Ahles et al., 1984; Price et al., 1983; Scott & Huskisson, 1976).

The MOS-PS (Sherbourne, 1992) provides a five-item scale to operationalize the perception and impact of pain on the individual: (a) one item asking how often pain or discomfort has been experienced over the past 4 weeks, on a 5-point scale from 1 (*once or twice*) to 5 (*every day or almost every day*); (b) one item asking how long pain has usually lasted when experienced, on a 5-point scale from 1 (*a few minutes*) to 5 (*more than two days*); (c) two items to measure intensity of pain, one on average of the past 4 weeks and one at its worst over the past 4 weeks, each on a 21-point scale from 0 (*no pain*) to 20 (*pain as bad as you can imagine*); and (d) one item asking about the number of days over the past 4 weeks that pain has interfered with "things you usually do" (the last item is an open-ended item). As Sherbourne specified in the scoring rules, scores on each of the five items were converted to z scores and were averaged to produce the MOS-PS score, which could thus range from -3 to 3. Sherbourne reported an internal consistency estimate of .86 for MOS-PS scores, and an estimate of .74 was found for the sample in the present study.

Interferences. The MOS Daily Activities measure (MOS-DA; Sherbourne, Stewart, & Wells, 1992), the MOS Pain Effects measure (MOS-PE; Sherbourne, 1992), and the West Haven–Yale Multidimensional Pain Inventory–Interference subscale (WHYMPI-I; Kerns, Turk, & Rudy, 1985) were used to measure the latent predictor variable interferences with activities as a result of pain. The MOS-DA scale was developed by Sherbourne et al. (1992) to operationalize the effects of illness on an individual's activities. Dichotomous yes–no responses ("yes" assigned the value of 1 and "no" assigned the value of 0) are provided on each of the seven items (e.g., "Took *frequent rests* when doing work or other activities"), and the number of "yes" responses provides the MOS-DA total scores, which can range from 0 to 7. Sherbourne et al. reported an internal consistency estimate of .86 for this score, and an estimate of .83 was found for the sample in the present study.

The MOS-PE was developed by Sherbourne (1992) to operationalize the interference effects of pain. Six items (e.g., "During the past four weeks, how much did pain interfere with your ability to walk or move about?") are rated on a 5-point scale from 1 (*not at all*) to 5 (*extremely*), and responses to the six items are summed to produce the MOS-PE score, which can thus range from 6 to 30. Sherbourne et al. reported an internal consistency reliability estimate of .91 for this score, and an estimate of .91 was found with the sample in the present study.

The WHYMPI was developed by Kerns et al. (1985) to operationalize the degree of interference in various life domains resulting from chronic pain, with five subscales. Only the Interference subscale was used; it consists of nine items (e.g., "In general, how much does your pain problem interfere with your day-to-day activities?"). Each item is rated on a 7-point scale ranging from 0 (*none*) to 6 (*extreme*), and scores are summed across items to produce a WHYMPI-I total score, which can range from 0 to 54. Kerns et al. (1985) reported an internal consistency reliability estimate of .90 for this score, with a test–retest reliability estimate over a 2-week interval of .86, and an internal consistency estimate of .89 was found for the sample in the present study.

Stress. Life stress is measured by the Recent Life Changes Questionnaire (RLCQ; Miller & Rahe, 1997). Miller and Rahe (1997) adapted and modernized the Social Readjustment Rating Scale (SRRS) developed by Holmes and Rahe (1967) by retaining 30 of the original 43 SRRS items, adding 44 specific life change events, and recomputing new life change units (LCUs) to quantify the intensity and length of time necessary to accommodate each stressful life event in the RLCQ. The RLCQ is composed of 74 life events in five major domains of stress: (a) Health, with 7 items (e.g., "An injury or illness which kept you in bed a week or more, or sent you to the hospital"); (b) Work, with 16 items (e.g., "Change to a new type of work"); (c) Home and Family, with 27 items (e.g., "Major change in living conditions"); (d) Personal and Social, with 18 items (e.g., "Change in personal habits"); and (e) Financial, with 7 items (e.g., "Major

change in finances—decreased income"). Responses of "yes" or "no" for each event are used to indicate whether that event occurred in the past 12 months, and a number of LCUs is assigned to "yes" responses, varying for each event and indicating the severity of such specific life events (e.g., 500 LCUs are arbitrarily assigned to a "yes" response on the marriage). Specific LCUs are predetermined by previous research in which the higher the number of the LCU, the more stressful the life events are. LCUs for each "yes" response are then summed to produce scores for each subscale. Internal consistency reliability estimates of .55, .75, .64, .47, and .52 were found for the five domains, respectively, with the sample in the present study.

Coping. Six of seven subscales on the Coping Strategies Questionnaire (CSQ; Rosenstiel & Keefe, 1983) were used as measures of the latent predictor, coping. The CSQ was developed by Rosenstiel and Keefe (1983) to operationalize pain coping mechanisms used by people with chronic pain. The CSQ is composed of 42 items, with 6 in each of the seven subscales. The following six subscales, providing measures of positive as opposed to negative coping, were used as separate measures of coping (the seventh subscale was used as a measure of catastrophizing and is described in the *Catastrophizing* section): (a) Diverting Attention (e.g., "I try to think of something pleasant"), (b) Reinterpreting Pain Sensation (e.g., "I try to feel distant from the pain, almost as if the pain was in somebody else's body"), (c) Coping Self Statement (e.g., "I tell myself to be brave and carry on despite the pain"), (d) Ignoring Sensations (e.g., "I don't think about the pain"), (e) Praying and Hoping (e.g., "I pray to God it won't last long"), and (f) Pain Behaviors (e.g., "I leave the house and do something, such as going to the movies or shopping"). The items are rated on a 7-point scale from 0 (*never do that*) to 6 (*always do that*), and scores on each subscale can thus range from 0 to 36. Previous research has found internal consistency estimates for the CSQ subscales to range from .57 to .89 (Gil, Abrams, Phillips, & Keefe, 1989; Keefe et al., 1987), and estimates found for the sample in the present study ranged from .75 to .87.

Social and family support. The MOS Family (MOS-F; Sherbourne & Kamberg, 1992) measure and the Social Support Index (SSI; McCubbin, Patterson, & Glynn, 1996) were used to measure the latent predictor social and family support. The MOS-F was developed by Sherbourne and Kamberg (1992) to operationalize the quality of interactions and support among family members. The MOS-F is composed of three subscales, with each used in the present study as a separate measure of social and family support. The Satisfaction With Family Life subscale is composed of three items (e.g., "The amount of togetherness and cohesion you have"), with each item rated on a 5-point scale from 1 (*poor*) to 5 (*excellent*), and scores are summed to produce a MOS-Family Support/Family Life score that can thus range from 3 to 15. The Happiness With Family Life subscale is composed of one item (i.e., "Overall, how happy are you with your family life?"), rated on a 6-point scale from 1 (*very unhappy*) to 6 (*extremely happy*), which produces a MOS-Family Support/Family Happiness score. Finally, the Marital Functioning subscale is composed of six items (e.g., "We said anything we wanted to each other"), with each item rated on a 5-point scale from 1 (*definitely false*) to 5 (*definitely true*), and scores are summed to produce an MOS-Family Support/Family Functioning score that can thus range from 6 to 30. Sherbourne and Kamberg reported internal consistency reliability estimates for the two multi-item measures, Satisfaction With Family Life and Marital Functioning, of .93 and .83, respectively, and the estimates for the sample in the present study were .92 and .75, respectively.

The SSI was developed by McCubbin et al. (1996) to operationalize the degree of social support available to individuals in the community. The SSI is composed of 17 items (e.g., "If I had an emergency, even people I do not know in this community would be willing to help"), with each item rated on a 5-point scale from 0 (*strongly disagree*) to 4 (*strongly agree*), and scores are summed to produce an SSI total score that can thus range from 0 to 68. McCubbin et al. reported an internal consistency reliability estimate of .82, with a test–retest reliability estimate of .83, and an internal consistency estimate of .90 was found for the sample in the present study.

Preinjury psychopathology. The Preinjury Psychopathology Scale was developed by the authors as a brief measure of preinjury psychopathology. This scale consisted of three dichotomous items to measure whether participants had a previous history of anxiety, depression, and substance abuse (e.g., "Prior to your current injury, have you ever received treatment for depression disorders?"). Responses of "yes" or "no" were requested for each item, with the number of "yes" responses used as a Preinjury Psychopathology Scale score that could thus range from 0 to 3. The internal consistency reliability estimate found for the sample in the present study was .59.

Catastrophizing. The Catastrophizing subscale of the CSQ, which has been described as a single measure of negative beliefs rather than coping (Rosenstiel & Keefe, 1983), was used in the present study as a measure of negative coping. As with the other CSQ subscales, the Catastrophizing subscale is composed of six items (e.g., "It's terrible, and I feel it's never going to get any better"), rated on the same 7-point scale from 0 (*never do that*) to 6 (*always do that*), and the scores are summed to produce a CSQ-Catastrophizing score that can range from 0 to 36. Rosenstiel and Keefe reported an internal consistency estimate of .81, and an estimate of .87 was found for the sample in the present study.

Procedure

After we secured the approval of each of the participating facilities, participants were recruited either by the first author or by psychologists on staff in each of the respective facilities, with a script provided to facilitate consistency in recruitment and distribution of instrument packets to participants. Packets included a brief cover letter explaining the study, an informed consent form, and a 14-page questionnaire divided into sections for each of the measures. Participation was estimated to require 45–60 min, and participants were given the option of completing the survey on site or taking it home to complete within 3 to 4 days, with a stamped return envelope provided.

Results

Descriptive Statistics

Means and standard deviations for the 24 measured variables used in this study are shown in Table 1. The mean scores of 24.69 and 59.08 on the two measures of depression, the CES–D and the Zung, were above the scores of 16 and 50 on those two measures, respectively, that are considered indicative of depression. Furthermore, 60.2% of the sample had scores of 16 or above on the CES–D, and 64.3% had scores above 50 on the Zung, which suggests that a substantial proportion of the sample might have been experiencing depression. In addition, 28.1% of the participants reported a history of depression, and 35.1% reported a history of one or more of the three types of psychopathology listed: depression, anxiety, and substance abuse. The depression scores are consistent with other research that has reported a high prevalence of depression among individuals with chronic pain (e.g., Banks & Kerns, 1996; Polatin et al., 1993). A majority of the participants reported a relatively high severity of pain, with mean scores on the VAS of 53.09, just above the midpoint between the extremes of 0 (*no pain at all*) and 100 (*intense/worst pain*). On the MOS-PS measure, 66.7% of the sample reported experiencing pain "every day or almost every day" in the previous 4 weeks. Of these 171 participants, 73% met the International Association for the Study of Pain Subcommittee on Taxonomy's (1986) definition of

Table 1
Possible Score Ranges and Sample Means and Standard Deviations for Variables in This Study

Variable	Possible range	*M*	*SD*
Depression			
CES–D total	0–60	24.69	12.45
Zung total	25–100	59.08	13.81
Pain			
Visual Analogue Scale	0–100	53.09	20.20
MOS Pain Severity total	−3–3	−0.002	0.74
Interferences			
MOS Daily Activities total	0–7	5.20	1.90
MOS Pain Effects total	6–30	22.68	5.10
WHYMPI Interference total	0–54	38.43	10.08
Stress			
RLCQ Health life change units	0–225	130.90	66.54
RLCQ Work life change units	0–645	128.23	116.70
RLCQ Home and Family life change units	0–1,648	183.04	149.76
RLCQ Personal and Social life change units	0–715	180.70	116.02
RLCQ Financial life change units	0–368	85.29	64.17
Coping			
CSQ Diverting Attention total	0–36	10.05	8.43
CSQ Reinterpreting Pain Sensations total	0–36	16.02	7.29
CSQ Coping Self Statements total	0–36	20.33	7.50
CSQ Ignoring Sensations total	0–36	13.82	7.36
CSQ Praying and Hoping total	0–36	15.72	8.87
CSQ Pain Behaviors total	0–36	18.41	6.44
Social and family support total			
MOS Family Support/Family Life total	3–15	9.93	3.81
MOS Family Support/Family Happiness total	1–6	3.33	1.27
MOS Family Support/Family Functioning total	6–30	18.31	3.50
Social Support Index total	0–68	39.21	6.11
Preinjury Psychopathology Scale	0–3	0.57	0.86
CSQ Catastrophizing total	0–36	13.47	7.86

Note. CES–D = Center for Epidemiological Studies—Depression scale; Zung = Zung Self-Rating Depression Scale; MOS = Medical Outcomes Study scales; WHYMPI = West Haven–Yale Multidimensional Pain Inventory; RLCQ = Recent Life Changes Questionnaire; CSQ = Coping Strategies Questionnaire.

chronic pain (i.e., 6 months or more), whereas 26% satisfied the definition of acute pain (6 months or less). A series of *t* tests was performed to test for potential significant differences on the various clinical scores between the acute and the chronic pain samples. Results indicated that all except the variable chronicity ($p < .001$) were nonsignificant; therefore, the two groups were combined for subsequent analyses.

Structural Equation Model

The relations between the indicator variables (psychological measures) and their underlying latent constructs in the hypothesized model predicting depression, which were delineated previously, are schematically portrayed in Figure 1. The hypothesized model was tested with the maximum likelihood method in the AMOS 4.0 statistical software (Arbuckle & Wothke, 1999). Several goodness-of-fit indexes are commonly used to evaluate how well the structural equation model fits the data. The chi-square statistic is one of the most commonly used goodness-of-fit indexes. In this study, the chi-square statistic, $\chi^2(240, N = 171) = 667.50$, $p < .001$, was significant, which suggests that the fit of the data to the hypothesized model was less than adequate. However, structural equation modeling is grounded in large sample theory, and finding well-fitted hypothesized models, in which the chi-square value approximates the degrees of freedom, has proven to be unrealistic (Ullman, 2001). Therefore, the normed fit index (NFI) and the comparative fit index (CFI), which are less sensitive to large sample size, were computed. The NFI was developed by Bonett and Bentler (1983) and can be classified as an incremental or comparative index of fit (Hu & Bentler, 1995), as it is based on a comparison of the hypothesized model against some standard, such as a baseline model (typically the independence or null model). However, the NFI has a tendency to underestimate fit in small samples. Bentler (1990) revised the NFI to take sample size into account and proposed the CFI, which is a more appropriate measure of fit for small samples than the NFI. Values for both NFI and CFI also range from 0 to 1. In general, a value greater than .90 is considered representative of a well-fitting model. In recent years, with additional experiences of using the CFI, Hu and Bentler (1995) have proposed a more stringent cutoff of values greater than .95 as indicative of a well-fitting model. In this study, the NFI and the CFI were computed to be .93 and .95, respectively; therefore, they indicated an adequate fit to the model. In addition, the issue of model parsimony was examined via the first fit index (parsimony ratio), proposed by James, Mulaik, and Brett (1982), which is computed relative to the NFI and the CFI and takes into account the complexity of the model. A parsimony NFI (PNFI) of .74 and a parsimony CFI (PCFI) of .76 fall within the expected range of values of .50 and above.

We performed *post hoc* model modifications to determine whether a better fitting model could be developed. According to Martens (2005), *post hoc* modifications should be based on both empirical and theoretical criteria. In this study, we examined the critical ratio value for eliminating paths, along with the modification index (MI) for adding paths in the model. Four structural paths were found to have a critical ratio less than $\pm$ 1.96 (*ns*). This empirical guidance can also be supported by conceptual and theoretical reasons suggesting that those paths could be eliminated from the model: (a) preinjury psychopathology to depression, (b) preinjury psychopathology to pain, (c) pain to depression, and (d) coping with pain to pain. In addition, the MI suggested that adding the path from interferences to stress would reduce the chi-square statistic by 26.98. The remaining MI values suggested no other paths to add to the model.

Respecified Model

On the basis of the *post hoc* model modifications tested, we revised the hypothesized model by eliminating four paths (coping to pain, preinjury psychopathology to pain, pain to depression, and preinjury psychopathology to depression) and adding one path (interferences to stress). The results also showed an adequate fit of the model to the data, $\chi^2(243, N = 171) = 639.22$, $p < .001$ (NFI = .93, CFI = .96, PNFI = .76, PCFI = .78). Although the improvement in model fit for the respecified model appears to be

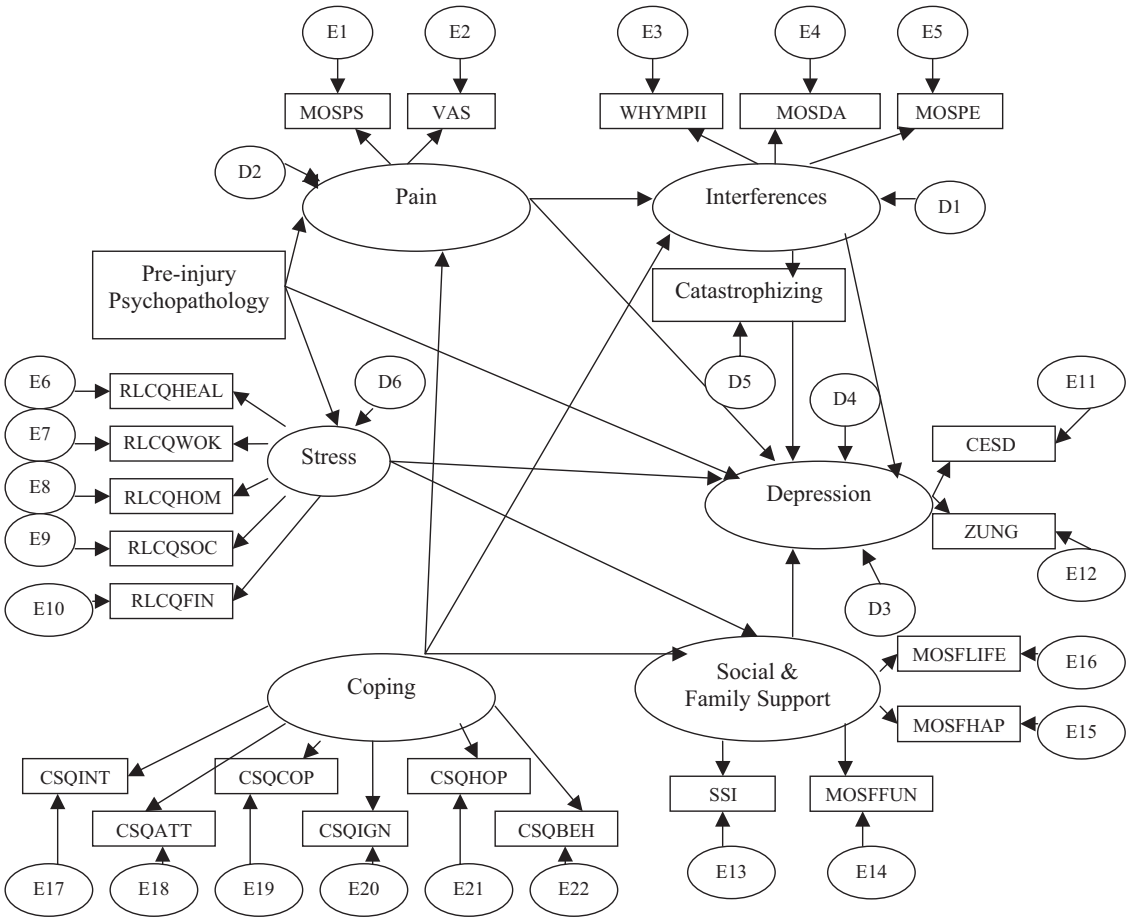

Figure 1. Hypothesized model of depression: Measurement and structural components. MOSPS = Medical Outcomes Study (MOS) Pain Severity; VAS = Visual Analogue Scale; WHYMPII = West Haven–Yale Multidimensional Pain Scale Interference; MOSDA = MOS Daily Activities; MOSPE = MOS Pain Effects; RLCQHEAL = Recent Life Changes Questionnaire (RLCQ) Health; RLCQWOK = RLCQ Work; RLCQHOM = RLCQ Home and Family Life; RLCQSOC = RLCQ Personal and Social; RLCQFIN = RLCQ Financial; CESD = Center for Epidemiologic Studies—Depression Scale; ZUNG = Zung Self-Rating Depression Scale; CSQINT = Coping Strategies Questionnaire (CSQ) Reinterpreting Pain Sensations; CSQATT = CSQ Diverting Attention; CSQCOP = CSQ Coping Self Statements; CSQIGN = CSQ Ignoring Sensations; CSQHOP = CSQ Praying and Hoping; CSQBEH = CSQ Increasing Behavioral Activities; SSI = Social Support Index; MOSFFUN = MOS Family Support/Family Functioning; MOSFHAP = MOS Family Support/Family Happiness; MOSFLIFE = MOS Family Support/Family Life; D = disturbances (error term for latent variables); E = Errors (error term for measured variables).

small on the basis of the CFI and parsimony ratio, the model difference was statistically significant, $\Delta\chi^2(3, N = 171) = 28.28$. Moreover, compared with the original model, the parameter estimates for the structural paths in the respecified model were all statistically significant. A schematic representation of the respecified model is displayed in Figure 2.

The unstandardized as well as the standardized maximum likelihood estimates are presented in Table 2. All parameter estimates were statistically significant and appear substantively meaningful. An examination of the modification indexes of the respecified model revealed no significant reduction of the chi-square statistic that could be obtained by adding new paths.

According to the model, depression was directly predicted by four variables: interferences, catastrophizing, stress, and social and family support. The structural path coefficients for these four variables were .43, .22, .18, and −.43, respectively, indicating that high interferences in daily activities, catastrophizing, high stress level, and poor social and family support all had a direct effect on depression. Preinjury psychopathology was positively related to stress (.39). The relation between preinjury psychopathology and depression was found to be mediated by stress (standardized indirect effect = .17). Pain perception was found to be strongly predictive of a higher level of interference in daily activities (.77). The relation between pain and depression was mediated by interferences (standardized indirect effect = .58), with people who had higher perceived interruption to life functions also having higher depression scores. Coping skills for pain symptoms were related to interferences in daily

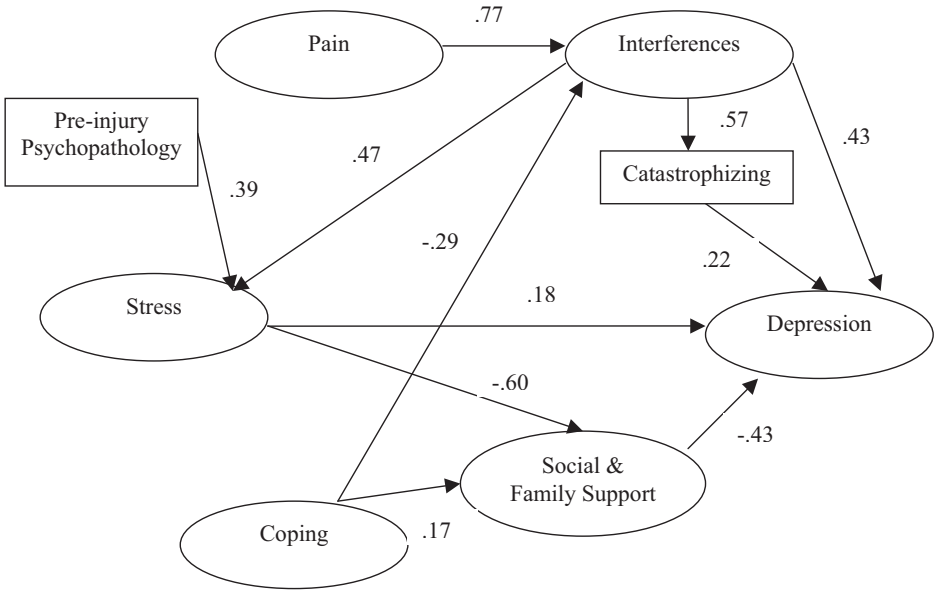

Figure 2. Respecified model of depression: Structural path coefficients.

activities (−.29), with better pain coping skills associated with less interference in activities. Coping was related to social and family support (.17), and the relation between coping and depression was mediated by social and family support (standardized indirect effect = −.30), with better coping skills related to better psychological adjustment.

Finally, Table 3 presents the squared multiple correlation coefficients for the endogenous variables in the model. The squared multiple correlation value represents the proportion of variance that is explained by the predictors of the variable in question. Of most interest in this study is depression. As may be seen in Table 3, depression was predicted by interferences, catastrophizing, stress, and social and family support, and 91% of the variance in depression was accounted for by those four predictors. Interferences were predicted by pain perception and coping with pain, and 67% of the variance in interferences was accounted for by those two predictors. Stress was predicted by preinjury psychopathology and interferences, and 37% of the variance in stress was accounted for by those predictors. Catastrophizing was predicted by interferences, and 33% of the variance in catastrophizing was accounted for by reduction in daily activities. Social and family support was predicted by stress and coping with pain, and 42% of the variance in social and family support was accounted for by those predictors.

Discussion

In the present study, preinjury psychopathology was not found to have significant influences on pain perception. Pain perception was found to have a strong influence on interference with daily life and work functions. The finding of a strong mediating effect of major disruption in scripted behavior between pain and depression is consistent with the literature (G. K. Brown, 1990; Monsein & Cliff, 1995; Sherbourne, 1992) and is also consistent with the IMD

Table 2
Maximum Likelihood Estimates of Respecified Model

Path	Unstandardized estimate	Standardized estimate	*SE*	Critical ratio
Pain → interferences	1.299	0.765	0.223	5.826
Coping with pain → interferences	−0.041	−0.294	0.010	−4.155
Preinjury psychopathology → stress	20.268	0.386	4.164	4.867
Interferences → stress	22.520	0.466	4.323	5.210
Coping with pain → support	0.021	0.171	0.010	2.201
Stress → support	−0.011	−0.605	0.002	−5.405
Interferences → catastrophizing	4.766	0.572	0.623	7.652
Interferences → depression	4.726	0.431	0.764	6.187
Support → depression	−5.379	−0.426	1.002	−5.368
Stress → depression	0.042	0.184	0.018	2.345
Catastrophizing → depression	0.293	0.221	0.072	4.052

Note. All critical ratios had significant results/paths.

Table 3
Squared Multiple Correlations (SMCs) for the Endogenous Variables in the Respecified Model

Predictor to endogenous variable	SMC
Interferences	0.672
Stress	0.366
Catastrophizing	0.327
Social and family support	0.423
Depression	0.907

Note. Catastrophizing is a measured variable. Interferences, stress, social and family support, and depression are latent variables.

model. The relation between interferences and depression was found to be mediated by catastrophizing, which is also consistent with findings reported in the literature (e.g., R. Beck et al., 2001; Behel et al., 2002; Gil, Williams, Keefe, & Beckham, 1990). According to Lewinsohn et al. (1985), negative cognitive consequences of interferences in daily activities include high expectancies for negative outcomes, self-blame, and irrational beliefs. The current findings support the mediating effect of catastrophizing between interferences and depression. Preinjury psychopathology was found to have a strong influence on the level of stress experienced by people with chronic pain, which is consistent with expectation, as psychopathology can disrupt many aspects of life, including sleeping and eating patterns, social involvement and functioning, and employment.

The relationship between preinjury psychopathology and depression was found to be mediated by level of stress. However, a direct link between preinjury psychopathology and depression was not found in the present study, perhaps in part because the preinjury psychopathology measure included anxiety and substance abuse, not just depression. Thus, the lack of direct relation between preinjury psychopathology and depression does not necessarily mean that there is no relation between preinjury depression and current levels of depression. Also, the preinjury psychopathology measure is one of the crudest measures among all of the measures used in this study. Finally, a direct link between pain and depression was not supported by the results.

Stress was found to exert a direct effect on depression, and the effect of stress on depression was found to be mediated by social and family support. The results are consistent with the literature, which suggests that people with strong family and social support are better equipped to deal with adversities in life and are less prone to become depressed (Kerns et al., 2002; Nicassio & Radojevic, 1993).

Positive pain coping strategies were not found to have a strong influence on pain perception. However, coping was found to have a strong influence on activity and social and family support levels. Therefore, pain coping strategies can be viewed as an important immunity factor, and skills in the use of pain coping strategies can reduce interference in daily and work activities. Skills in pain coping strategies can also help clients with chronic pain to maintain positive relationships with family and friends. Both minimizing reduction in activity level and maintaining strong social and family support will lessen the occurrence of depression. It is interesting that training in stress reduction, coping skills, and social skills is often a part of psychological interventions, whereas interferences in everyday activities seem to be more in the realm of medical interventions (e.g., surgery, physical therapy, and occupational therapy), yet medical rehabilitation outcomes are strongly influenced by psychological rehabilitation outcomes.

In conclusion, the structural equation modeling analyses indicate an adequate fit between the proposed model and the data. Clinically, the structural relations among the predictor variables and the dependent variable in the causal model appear to be consistent with the conceptual model posited by Lewinsohn et al. (1985). First, depression-evoking events, such as an injury or an experience with debilitating pain, serve as stressors and can trigger both behavioral and psychological reactions. Second, stressors disrupt automatic behaviors and reduce the availability of positive reinforcers, such as hindrance in routine personal, work, and leisure activities. In addition, individuals are likely to have immediate emotional responses as a result of the disruption. If individuals are not able to reverse the negative emotional responses, they are likely to further withdraw inward and to increase their awareness of their negative selves. Catastrophizing, therefore, can be an important determinant in the development of depression. Third, central to the IMD model are the vulnerability and immunity factors that, respectively, increase the risk and prevent the development of depression in times of stressful life events.

The respecified model derived in the present study also indicates that there were several immunity and vulnerability factors that could influence the development of depression. For instance, the model indicates that positive pain coping skills, positive thinking, and the availability of social and family support were among the potential immunity factors. Conversely, elevated stressful life events, being pain-focused, high catastrophizing, and limited social and family support appeared to increase the risk of depression. The structural equation model, therefore, appeared to demonstrate support for the IMD model, and it tended to be consistent with the practice of most pain rehabilitation programs, which adopt a cognitive–behavioral approach to intervention.

Implications for Clinical Practice

The results of the study provide information that may facilitate psychological services for individuals with chronic musculoskeletal pain. For researchers designing comprehensive psychosocial assessments, the model of depression serves to identify vulnerability and immunity factors that may be important to consider. For example, stress was a significant factor influencing interference in daily activities and may have both a direct and an indirect effect on depression. Using passive pain coping strategies, adopting negative cognitive schemas, and having limited social and family support all contributed to an increased risk of depression. Individuals who experience chronic pain as a result of injuries also often experience other hindrances and problems in their life, and a comprehensive assessment of those psychosocial contributing factors is important to consider in the initial assessment. It is also important to assess the perception of pain from the individual's perspective. The discrepancy between the objective and subjective data would allow the clinician to help the individual better understand the inconsistencies of his or her behavior, which would result in more realistic expectations of functional limitations and interferences resulting from the pain in daily activities. Pain is a major disrupting event in scripted and automatic behavior. Disruption in

scripted behavior (interferences) reduces the amount of reinforcement that an individual can derive from his or her environment. Reduction in activities induces an individual to turn inward, which results in a preoccupation with negative self-evaluation, negative outcome expectancies, and cognitive distortions. Catastrophizing (a negative coping strategy) was found to be a consequence of interferences and had a direct influence on depression. Conversely, positive coping strategies were found to reduce interferences in activities and to strengthen social and family support, resulting in less vulnerability for depression. The use of a coping measure, such as the CSQ, to assess the positive coping strategies and abilities and maladaptive negative coping behavior in pain rehabilitation could be helpful for devising a coping skills training plan for clients.

Social skills are also important for individuals with chronic pain. People with chronic pain, because of their pain, stress, and restricted activities, may be vulnerable to reduced social contacts. Therefore, clients may benefit from both coping skills and social skills training to help them maintain old friendships and develop new friends and social and family support, which are important to mental health.

Interferences are a major factor in depression. The resulting reductions in activities can be due to both psychological and physical factors. Therefore, to prevent clients from becoming depressed and thus compromising other medical and vocational rehabilitation goals, the use of a multidisciplinary team approach to treatment seems indicated. Finally, the results support the crucial role of psychological services in medical rehabilitation settings. Psychologists can play an important part in helping individuals to understand the concept of pain as well as depression and how their cognitions can help them to stay positive and motivated in working through the injury and pain. The use of more active cognitive and behavioral self-management approaches, such as distraction, relaxation, imagery, and self-talk, would likely reduce the focus on pain and increase functionality. Counseling in terms of interpersonal skills would facilitate appropriate interaction with family, friends, and coworkers. Finally, the appropriate and early identification of potential risk factors would likely enable individuals to more quickly return to their preinjury functioning and quality of life and help to minimize health care costs.

Limitations

Although the current study provides supportive evidence of Lewinsohn et al.'s (1985) model of depression for individuals with chronic musculoskeletal pain, it has several limitations. First, the self-selection nature of participation from workers may not represent a wide spectrum of workers of musculoskeletal pain with different psychological profiles; thus, the profile may not be generalizable to all workers with musculoskeletal pain. Future studies of a more representative sample would enhance the generalizability and robustness of the results. Second, the large deviation of the chronicity of pain in this sample potentially makes the results less generalizable to either acute or chronic cases because the existing sample contains both types. However, after we performed a statistical test of significance, all variables except chronicity were nonsignificant between the acute and the chronic samples. Speculation of the data indicated that a majority of the acute cases were marginal in being categorized into the chronic phase. In the future, selection of participants of a more distinct chronicity may provide a different profile between acute and chronic pain cases. Therefore, a replication of the study with a larger sample size across a more representative range of client types is warranted to enhance the generalizability of the results. Third, two of the variables, namely cognitive distortion and preinjury psychopathology, used a single indicator for measurement. With preinjury psychopathology, a multiple indicator and a follow-up inquiry about whether clients who had such previous psychological issues sought treatment would make this variable a better predictor. In relation to cognitive distortion, a wider construct of measuring distortion (e.g., helplessness) would provide a better indication of how this variable affects depression.

Future Research Direction

In the current study, we adapted and tested Lewinsohn et al.'s (1985) model of depression, which was developed on the basis of individuals with unipolar depression. This study has provided a model for understanding factors contributing to depression in a sample of individuals with chronic musculoskeletal pain, and the results support the model. Continuing research to facilitate an understanding of psychosocial and economic factors would serve to refine and validate the model developed in the present study. Replications with large, geographically dispersed samples seem indicated. Quintana and Maxwell (1999) indicated that statistical indexes generally perform adequately and yield meaningful and interpretable values with a sample size of 200 participants or more. According to these guidelines, the sample size of 171 in the current study is minimally acceptable. Replication with larger, more representative samples of pain patients in multiple clinical settings would serve to verify and refine the model. In the current study, cognitive distortion was measured by a single indicator (the Catastrophizing subscale of the CSQ). In hindsight, it may be better to measure the cognitive distortion construct as a latent variable with multiple indicators, such as catastrophizing and hopelessness. Finally, we could have improved the items measuring preinjury psychopathology by asking the participants whether they had been diagnosed and treated for depression, anxiety, and substance abuse. Continuing research will serve to refine the model toward providing an empirical basis for psychosocial assessment and treatment, facilitating improved functioning and quality of life.

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