DIFFERENCES BETWEEN FIBROMYALGIA SYNDROME & OSTEOARTHRITIS: A MODERATED MEDIATION APPROACH

A Thesis
Presented to the
Faculty of
San Diego State University

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts
in
Psychology

by
Dhwani J. Kothari
Summer 2013
SAN DIEGO STATE UNIVERSITY

The Undersigned Faculty Committee Approves the
Thesis of Dhwani J. Kothari:

Differences between Fibromyalgia Syndrome & Osteoarthritis: A Moderated
Mediation Approach

Terry A. Cronan, Chair
Department of Psychology

Allison A. Vaught
Department of Psychology

Shulami Ritblatt
Department of Child and Family Development

23 April 2013
Approval Date
Copyright © 2013
by
Dhwani J. Kothari
All Rights Reserved
Without health life is not life; it is only a state of languor and suffering – an image of death.
- Siddhārtha Gautama Buddha
ABSTRACT OF THE THESIS

Differences between Fibromyalgia Syndrome & Osteoarthritis: A Moderated Mediation Approach
by
Dhwani J. Kothari
Master of Arts in Psychology
San Diego State University, 2013

Fibromyalgia syndrome (FMS) and osteoarthritis (OA) are two painful chronic conditions. Cronan and Bigatti compared women with FMS and OA and found that women with FMS had significantly worse health status. The present study is an extension of the Cronan and Bigatti study. In order to identify the mechanism responsible for differences in health status between FMS and OA, a moderated mediation approach was used. The effects of knowledge about the illness (explanatory variable), self-efficacy (mediator), and depression (moderator) on health status were examined.

Knowledge about the illness is often essential for patients with chronic conditions because it can improve patients’ ability to manage their conditions successfully. Intervention studies that have incorporated a knowledge or education component have produced mixed results in the FMS population, but have improved functional outcomes in OA. Additionally, self-management is related to self-efficacy. Higher levels of self-efficacy were related to better health outcomes in both FMS and OA patients. Findings have also demonstrated that self-efficacy is influenced by depression in both populations. In FMS patients, the relationship between knowledge and health status may be influenced by self-efficacy and depression through moderated mediation.

Participants were 238 members of a health maintenance organization who were assigned to control conditions in two different intervention studies. Only control group participants were studied in order to avoid confounding with intervention effects. There were 169 people diagnosed with FMS and 69 with OA. Data from the 1-year time point were used for all measures, and all scores were standardized. The moderated mediation analysis was performed according to the analytic strategies provided by Muller, Judd, and Yzerbyt. Each step of the moderated mediation model was performed three times: (1) once with the FMS data, (2) once with the OA data, and (3) once with the addition of a group variable to examine whether people with FMS and OA differed at each step of the moderated mediation model. Overall, the moderated mediation model did not hold in any of the three instances. However, the results provided implications for the development of interventions. In FMS, it is important to consider a hierarchical approach to treatment, which involves addressing depression symptoms, self-efficacy, and factors associated with increasing age. Interestingly, depression was found to moderate the effects of self-efficacy in FMS, implying that depression should be the first level of the treatment hierarchy. In OA, depression, self-efficacy, and aging were also significant and are important to address in treatment programs. Lastly, the third moderated mediation model demonstrated no group differences between FMS and OA in any of the steps of the analysis. As in the first two models, the significant
relationships between depression, self-efficacy, and increasing age and health status suggest that these factors may be important predictors of health outcomes in chronic pain populations. The findings imply that the strengths of the interrelationships among knowledge, self-efficacy, and depression and health status were not consistent between FMS and OA. Although FMS and OA are both chronic pain conditions, separate interventions should be developed.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>CHAPTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CHAPTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTRODUCTION</td>
</tr>
<tr>
<td>Fibromyalgia</td>
</tr>
<tr>
<td>Osteoarthritis</td>
</tr>
<tr>
<td>Knowledge</td>
</tr>
<tr>
<td>Self-Efficacy and Depression</td>
</tr>
<tr>
<td>HYPOTHESES</td>
</tr>
<tr>
<td>Step One</td>
</tr>
<tr>
<td>Step Two</td>
</tr>
<tr>
<td>Step Three</td>
</tr>
<tr>
<td>METHOD</td>
</tr>
<tr>
<td>Participants</td>
</tr>
<tr>
<td>Measurements</td>
</tr>
<tr>
<td>Demographic Variables</td>
</tr>
<tr>
<td>Knowledge</td>
</tr>
<tr>
<td>Self-Efficacy</td>
</tr>
<tr>
<td>Depression</td>
</tr>
<tr>
<td>Health Status</td>
</tr>
<tr>
<td>Procedure</td>
</tr>
<tr>
<td>STATISTICAL ANALYSES</td>
</tr>
<tr>
<td>RESULTS</td>
</tr>
<tr>
<td>Descriptive Statistics</td>
</tr>
<tr>
<td>Demographic Variables</td>
</tr>
</tbody>
</table>
Differences between Groups on Measures .............................................................15
Moderated Mediation .............................................................................................18
Fibromyalgia .............................................................................................................18
Osteoarthritis ...........................................................................................................20
Fibromyalgia and Osteoarthritis ..............................................................................21

\* DISCUSSION ........................................................................................................24
Fibromyalgia .............................................................................................................24
Osteoarthritis ...........................................................................................................26
Fibromyalgia and Osteoarthritis ..............................................................................27
Implications and Limitations ..................................................................................28

REFERENCES ............................................................................................................30
MODERATED MEDIATION MODEL ......................................................................35
LIST OF TABLES

Table 1. Relationships between Demographic Variables and Outcome Variables ..........16
Table 2. Contrast Codes for Levels of Education.................................................................16
Table 3. Codes for Levels of Income..........................................................................................17
Table 4. Means and Standard Deviations for Each Measure at the 1-Year Time Point ........17
Table 5. Definitions of Beta Coefficients in Equations of Moderated Mediation
   Analysis (Without Group Variable).......................................................................................19
Table 6. Definitions of Beta Coefficients in Equations of Moderated Mediation
   Analysis (With Group Variable).............................................................................................22
LIST OF FIGURES

Figure 1. The moderated mediation model demonstrating the interrelationships of knowledge, self-efficacy, and depression in predicting health status for people with FMS and OA. The measures that were used for each variable are displayed. ..........................................................36
ACKNOWLEDGEMENTS

I have been very fortunate to have received the love and support of many friends and family members throughout my time in the Master’s program at San Diego State University. My Master’s thesis, in particular, would not have been possible without their encouragement and never ending faith in my academic abilities.

First, I want to acknowledge my wonderful family: my parents (Jigish and Geeta Kothari), brother (Dhaiwat Kothari), and sister-in-law (Bhumi Kothari). They continued to believe in me and bolstered my motivation these past two years. I love them all dearly and cannot thank them enough for molding me into the person I am today.

I would also like to thank my wonderful friends, Lisa Graves and Renee Payne. The Master’s program became less stressful, more exciting, and more feasible with their support. I felt confident in my progress because of their constant encouragement.

I really appreciate the time and energy that Dr. Allison Vaughn and Dr. Shulamit Ritblatt have dedicated to my Master’s thesis. They have given me such helpful feedback and I am extremely grateful.

Most importantly, I want to thank my lab family for being my support team. Charles Van Liew (my adopted brother), Danielle Casteel, Jennalee Wooldridge, Maya Santoro, Nancy Cronan, and Soujanya Gade: they have all been so helpful, caring, and reassuring these past two years. Lab has felt like home because of all of them! Lastly, I want to acknowledge my “grad school mother,” Dr. Terry Cronan. There are no words to express my gratitude. I am so fortunate to have received the opportunity of working with her. She had more faith in me than I had in myself. I aspire to be her, because she is amazing!
CHAPTER 1

INTRODUCTION

Rheumatic diseases encompass a range of conditions known to cause swelling, inflammation, and pain in the joints or muscles (American College of Rheumatology [ACR], 2006). The ACR reported that 50 million adults in the United States (U. S.) suffer from some type of arthritis (Centers for Disease Control and Prevention [CDC], 2010). In 2010, arthritis-related health care costs were estimated at $81 billion, and total costs, including medical care and loss of productivity, were estimated at $128 billion (CDC, 2010). Understanding the factors associated with health status may help in developing more effective interventions for those affected by rheumatic conditions.

Fibromyalgia syndrome (FMS) and osteoarthritis (OA) are two painful rheumatic diseases (National Institute of Arthritis and Musculoskeletal and Skin Diseases, 2012). FMS is characterized by widespread musculoskeletal pain, tender points, fatigue, sleep disturbance, stiffness, cognitive impairment, and depression (Bennett et al., 1991; Goldenberg, Burckhardt, & Crofford, 2004). Symptoms of OA include joint stiffness, pain, dysfunction, reduced mobility, and loss of flexibility (Kean, Kean, & Buchanan, 2004; Theis, Murphy, Hootman, Helmick, & Yelin, 2007). An important distinction between the two chronic pain conditions is that the etiology of FMS is unknown. Cronan and Bigatti (2003) compared women with FMS and OA. They found that the two groups differed in quality of well-being, self-efficacy, helplessness, and depression. Although the average age of women in the sample with FMS ($M = 53.89$, $SD = 11.47$) was considerably lower than those with OA ($M = 69.23$, $SD = 5.72$), the FMS women had significantly worse health status. Importantly, all of the participants in this study had health care insurance; thus, women who do not have access to medical care may have even lower health status. Additionally, women with FMS were more depressed than those with OA. Other researchers found that individuals with FMS were more depressed than others in the chronic pain population (Hudson, Hudson, Pliner, Goldenberg, & Pope, 1985) and the general population (Viitanen, Kautiainen, & Isomaki, 1985).
People who are diagnosed with FMS may have more difficulty in managing their symptoms because information about its etiology and management is not clear.

The present study used a moderated mediation analysis to examine the health status of people with FMS and OA as related to their level of knowledge about their illness (explanatory variable), self-efficacy (mediator), and depression (moderator; see Figure 1 in the Appendix). This model was intended to facilitate understanding of the factors that contribute to differences in health outcomes between people with FMS and OA.

**Fibromyalgia**

FMS affects approximately 5 million people in the U.S., most of them women (Lawrence et al., 2008). In a study comparing the characteristics and health care costs of patients with FMS to an age- and sex-matched comparison group, FMS patients had more medical and psychiatric comorbidities and used health care services more often (Berger, Dukes, Martin, Edelsberg, & Oster, 2007). The mean health care costs over 12 months for the FMS patients were about three times higher than for the comparison group ($9,573 versus $3,291, respectively).

Research on FMS has identified psychological factors, behavioral components, genetic predisposition, neuroendocrine and autonomic dysregulation, and proprioceptive abnormalities as potential correlates of the condition (Dadabhoy & Clauw, 2006); however, the etiology of FMS is still uncertain. Recent studies have shown some efficacy for pharmacological treatments, but these treatments have been plagued with drug intolerability and adverse-event-incited discontinuation (Häuser, Bernardy, Üçeyler, & Sommer, 2009; Marcus, 2009). Research on non-pharmacological FMS interventions has demonstrated benefits, but the effects quickly diminish after participants complete the intervention. Thus, it appears at present that the most promising interventions for people with FMS are behavioral interventions that provide FMS patients with long-term techniques that increase health status. To date, no such interventions exist.

**Osteoarthritis**

OA is a joint disease that involves the degradation of joints, leading to cartilage destruction and pain in the affected joints (Cronan & Bigatti, 2003; Hinton, Moody, Davis, & Thomas, 2002). OA is the most common type of arthritis, with knees, hips, and hands being
the most frequently affected joints (Lawrence et al., 2008). The risk of developing OA increases with age through “wear and tear,” as more than 50% of those 65 years and older have OA (Arthritis Foundation, 2012). Other factors related to OA include obesity, joint injury, muscle weakness, and the presence of additional arthritic conditions, such as rheumatoid arthritis (Fries, 2010). Data from the Medical Expenditure Panel Survey demonstrated that OA increased total health care costs in the U. S. by $185.5 billion yearly (Kotlarz, Gunnarsson, Fang, & Rizzo, 2009).

Treatment of OA is aimed at improving function and quality of life through pharmacological and other methods. Common medications prescribed for pain management in OA patients are acetaminophen, non-steroidal anti-inflammatory drugs, cyclooxygenase inhibitors, irritants, and others (Hinton et al., 2002). Non-pharmacological interventions include patient education, exercise, and rehabilitation. Joint replacement surgery is one solution that is effective in reducing or eliminating the effects of OA for some people. The most promising behavioral interventions for people with OA appear to be those directed toward pain management.

**Knowledge**

People with chronic illnesses often ask to be actively involved in handling their condition, thereby accepting responsibility for day-to-day disease management (Barlow, Wright, Sheasby, Turner, & Hainsworth, 2002). Self-management can be conceptualized as strategies and tasks an individual must follow in order to reduce the impact of a specific disease on one’s physical health status (Clark et al., 1991). Clark and colleagues (1991) suggested that successful self-management of chronic illnesses requires knowledge of the condition and its treatment. If patients do not have sufficient knowledge about their condition, they may have less control over their symptom management. Therefore, determining the role of knowledge in chronic pain populations, specifically in FMS and OA, may help to explain differences in their health status.

Behaviorally-based intervention studies for people with FMS have produced mixed results, and no long-term effects have been demonstrated. For instance, Gowans, deHueck, Voss, and Richardson (1999) examined the impact of exercise and education on individuals with FMS and compared them to a waitlist control group. Subjects’ knowledge of FMS
management increased in the intervention group; however, follow-up results at 3 months and 6 months demonstrated that their knowledge decreased to baseline levels. Vlaeyen and colleagues (1996) studied cognitive-educational treatment in FMS. They compared three groups: a combined cognitive and educational intervention (ECO), an attention control with education plus discussion (EDI), and a waitlist control (WLC). Contrary to the researchers’ hypothesis, patients in the EDI condition performed significantly better in terms of pain coping and pain control, but demonstrated no increase in knowledge. This finding was unexpected because the primary aim of the EDI condition was to provide information, and it did not involve teaching coping or self-control techniques. In another study, Burckhardt, Mannerkorpi, Hedenberg, and Bjelle (1994) assessed the effects of education and physical training in women with FMS. Participants who received education and physical therapy, or education only, reported that the course provided them with new ways to cope and increased their understanding of FMS, which was supported through positive changes in self-efficacy. Importantly, health status was found to improve at follow-up for women who received an education component.

In summary, the role of knowledge in FMS patients is not clear. No researchers have examined the relationship between knowledge and health status in this population. If increasing knowledge is related to improved health status, then behavioral interventions could focus on increasing patients’ knowledge of their condition; the mechanism responsible for the relationship has been reported to be self-management (Clark et al., 1991). As individuals with FMS begin to take more responsibility in treatment of their chronic pain, the use of health care services may decrease.

In contrast to the case with FMS, most clinicians and patients have sufficient knowledge of OA and understand how to manage the symptoms. Hill and Bird (2007) assessed patient knowledge and misconceptions of OA through a validated, self-report knowledge questionnaire. Most of the patients understood how OA affected joints, and the importance of exercise and weight control. Further, self-care education reduced health care use and costs for patients with OA of the knee (Mazzuca, Brandt, Katz, Hanna, & Melfi, 1999). Hopman-Rock and Westhoff (2000) examined the effects of a health education and exercise program for people with OA of the hip or knee, and found that participants gained a better understanding of the causes related to their pain symptoms. Interestingly, Axford,
Heron, Ross, and Victor (2008) suggested that the level of patient education should be taken into consideration during the treatment of OA patients. Participants who experienced more pain had less OA knowledge, which led to depression and an inability to cope with the disease.

In summary, researchers have demonstrated that people with OA generally have some knowledge regarding their illness and understand how to manage their symptoms. Further, research has shown that incorporating a knowledge or education component in interventions improves functional outcomes. Therefore, increasing levels of knowledge are likely to result in better health status in the OA population.

**Self-Efficacy and Depression**

Bandura (1977) defined self-efficacy as a person’s confidence in his or her ability to perform a particular behavior and achieve a specific outcome. Self-efficacy in an arthritis population is a person’s belief that he or she can manage the arthritic pain and the stressors produced by the arthritis (McKnight, Afram, Kashdan, Kasle, & Zautra, 2010). In general, an individual’s knowledge of his or her chronic illness should relate to successful self-management of the condition (Clark et al., 1991). However, if the level of self-efficacy is low, a person may not be confident in his or her ability to use knowledge effectively. Thus self-efficacy may mediate the relationship between knowledge and health status.

Furthermore, Bandura (1998) considered self-efficacy to be influenced by a person’s affect. A person’s affect (or mood) can be determined by events which are related or unrelated to a specific task (Russell & McAuley, 1986). In a mood manipulation study, Kavanagh and Bower (1985) found higher self-efficacy scores for a positive mood/state and lower self-efficacy scores for a negative mood/state, indicating that self-efficacy is influenced by affect.

The present study examined depression as a moderator of the mediation by self-efficacy (see Appendix Figure 1).

Self-efficacy has been shown to predict better functional status through improved health behaviors in chronic pain populations (Marks, Allegrante, & Lorig, 2005). Arnstein, Caudill, Mandle, Norris, and Beasley (1999) studied the mediation of pain-related disability by self-efficacy and the mediation of depression by disability in chronic pain patients. Findings demonstrated that self-efficacy mediated the relationship between pain intensity and
pain-related disability, and that self-efficacy alone accounted for 6% of the variance in depression. Also, pain-related disability mediated the relationship between pain intensity and depression. Arnstein and colleagues (1999) suggested that the chronic pain patients may have felt disabled by their pain because of their low self-efficacy beliefs. Further, the disability may be related to depression. These results support the possibility of a relationship between self-efficacy and depression in predicting health status among chronic pain populations.

More specifically, the role of self-efficacy has been examined in FMS patients. Buckelew and colleagues (1994) investigated self-efficacy and pain behavior among FMS subjects and found that patients with high self-efficacy demonstrated fewer pain behaviors. Additionally, self-efficacy accounted for 10 to 14% of the variance in pain behavior. Surprisingly, depression was not related to pain behavior in the Buckelew et al. (1994) study, even though 47% of the subjects met the cutoff for clinical depression. Sánchez, Martínez, Miró, and Medina (2011) studied predictors of pain perception and self-efficacy for pain control in patients with FMS, and found that depression was a significant predictor of self-efficacy expectations in pain management. Patients with lower expectations about controlling their symptoms reported greater intensity and severity of pain. These findings suggest a relationship between depression and self-efficacy in FMS, with depression moderating the effects of self-efficacy.

Self-efficacy has also served as a mediator in FMS studies. Two studies in particular demonstrated that self-efficacy mediated the effects of pain and disability on depression, through the development of helplessness (Nicassio, Schuman, Radojevic, & Weisman, 1999; Palomino, Nicassio, Greenberg, & Medina, 2007). Recently, Miró, Martínez, Sánchez, Prados, and Medina (2011) examined the mediating roles of self-efficacy and sleep quality in FMS subjects. Self-efficacy mediated the relationship between pain and emotional distress. The authors suggested the importance of the meaning attributed to pain, rather than of the pain itself. Thus, self-efficacy may indirectly affect health status through perceived pain. Depression may impact both self-efficacy and health status.

In the OA population, self-efficacy has contributed to functional outcomes. Specifically, in women with knee OA, there was a significant correlation between physical performance and self-report of function; however, when participants with low and high functional self-efficacy were examined separately, there was a significant relationship
between physical performance and self-reported function only for women with higher functional self-efficacy (Harrison, 2004). Sharma and colleagues (2003) examined people with OA of the knee to identify factors related to poor physical function outcome over 3 years. Self-efficacy predicted less disability at the 3-year follow-up, as indicated by both the participants' self-reports and their observed functioning. In a systematic review of coping strategies and self-efficacy in OA, higher levels of baseline self-efficacy were significantly related to reduced disability and improved mood (Benyon, Hill, Zadurian, & Mallen, 2010). Maly, Costigan, and Olney (2006) examined the determinants of self-efficacy for physical tasks in people with knee OA. Subjects with higher levels of depression had lower self-efficacy. The researchers suggested that depression should be considered when addressing functional outcomes in OA. As in FMS studies, self-efficacy has been studied as a mediator in OA patients. McKnight and colleagues (2010) found that coping self-efficacy mediated the relationship between catastrophizing and physical functioning.

Higher levels of self-efficacy have been beneficial in FMS and OA patients in terms of health outcomes; however, findings have also demonstrated that self-efficacy is influenced by depression in both populations (Sánchez et al., 2011; Maly et al., 2006). A person’s confidence in his or her ability to manage the pain-related symptoms can change, depending on his or her affect (Bandura, 1998). Therefore, the role of self-efficacy in predicting health status may be moderated by depression. The relationship between knowledge and health status in FMS and OA patients may not be the same. It is possible that there may not be a direct relationship in FMS patients, who may be influenced by self-efficacy and depression through moderated mediation.
CHAPTER 2

HYPOTHESES

Step One
The primary hypothesis for this thesis was: the level of knowledge about patients' chronic pain condition will significantly predict health status, controlling for depression. The strength of the relationship will be stronger for people with OA than for those with FMS.

Step Two
It was predicted that there would be a significant interaction, where the relationship between knowledge and self-efficacy would depend on the level of depression. This interaction effect was predicted to be stronger in the FMS group than the OA group.

Step Three
It was predicted that self-efficacy would affect health status, controlling for the level of knowledge and depression. It was further predicted that this relationship would be stronger for people with FMS than for those with OA.
CHAPTER 3

METHOD

PARTICIPANTS

Participants included 238 members of a health maintenance organization (HMO) who were assigned to control conditions in two different intervention studies. Participants with FMS were required to have a physician’s diagnosis of FMS and meet the ACR criteria for FMS. The OA participants were required to have a confirmed diagnosis of OA. There were 169 (160 women, 9 men) people with FMS and 69 (47 women, 22 men) with OA. The FMS group was considerably younger ($M_{age} = 54.07, SD = 11.47$) than the OA group ($M_{age} = 70.03, SD = 5.22$). The majority of the FMS patients was Caucasian (85.2%), had completed some level of college (75.0%), and had family incomes ranging from $10,000 to $50,000 (64.0%). Among the OA patients, 89.9% identified as Caucasian, 39.7% had completed some level of college, 30.9% had a Master’s or doctorate degree, and most had family incomes ranging from $10,000 to $30,000 (61.3%).

MEASUREMENTS

Participants completed the following self-report measurements. Information collected from these measurements was used in the statistical analyses.

Demographic Variables

A medical history questionnaire was administered to FMS and OA participants during the first assessment visit. Through this questionnaire, information about age, gender, education level, income level, and ethnicity was obtained from each participant.

Knowledge

A 20-item, true/false, self-report questionnaire assessed the level of knowledge among FMS participants. This measure was based on the Arthritis Foundation’s Fibromyalgia Self-Help Course (Arthritis Foundation, 1995). Items in this questionnaire included, “Fibromyalgia means pain in muscles, ligaments, and tendons” (Answer: True),
and “Inflammation is not a part of fibromyalgia” (Answer: True). Higher scores on the Knowledge Test indicate better knowledge of the FMS condition.

For OA participants, the Arthritis (OA) Knowledge Test was used. This questionnaire also consisted of 20 items that were presented in a true/false response format. Examples of the items include, “Osteoarthritis most often affects weight-bearing joints” (Answer: True) and “The pain, stress, depression cycle is impossible to break” (Answer: False). High scores on the OA Knowledge Test indicate better knowledge of the OA condition.

**Self-Efficacy**

The Arthritis Self-Efficacy Scale (ASES; Lorig, Chastain, Ung, Shoor, & Holman, 1989) measured perceived self-efficacy in FMS and OA participants. The ASES was modified for the FMS population by replacing the word “arthritis” with “fibromyalgia” or “condition” where necessary. For example, the question “How certain are you that you can deal with the frustration of arthritis?” changed to “How certain are you that you can deal with the frustration of fibromyalgia?” This measure consisted of 20 items that assessed self-efficacy for pain, daily functioning, and other symptoms. Participants rated their confidence in their ability to perform certain activities or tasks on a scale of 0 (“Very Uncertain”) to 100 (“Very Certain”). An example of an item is: “How certain are you that you can make large reductions in pain by methods other than taking extra medication?” Higher scores on the ASES indicate greater self-efficacy. Test-retest (.71 ≤ α ≤ .85) and internal (.76 ≤ α ≤ .89) reliability have been demonstrated (Lorig et al., 1989).

**Depression**

The Center for Epidemiologic Studies-Depression Scale (CES-D) assessed depression symptomatology in all of the FMS and half of the OA participants. The CES-D is a self-administered measure that consists of 20 items, which are rated on a 4-point Likert scale ranging from 0 (“Rarely or None of the Time”) to 3 (“Most or All of the Time”). Examples of items include, “I did not feel like eating; my appetite was poor” and “I felt that people disliked me.” Scores range from 0 to 60, with 19 and above indicating depressed mood for chronic pain populations (Turk & Okifuji, 1994). A score of 19 was used as a cut-off for both FMS and OA participants (Radloff, 1977). The CES-D is reliable (α = .88), internally
consistent (.80 ≤ α ≤ .90), has moderate test-retest reliability (r = .40), and high concurrent and construct validity (Radloff, 1977).

The other half of the OA participants completed the Geriatric Depression Scale (long form; GDS; Yesavage et al., 1983). The GDS is a 30-item, self-report questionnaire that measures depression symptomatology in older adults. Participants were asked to respond with either “yes” or “no” to each statement. A total score is calculated, which indicates the level of depression. A score of 0-9 is “normal,” 10-19 is “mildly depressed,” and 20-30 is “severely depressed.” The GDS has been found to be internally consistent, reliable, valid, and correlated with the Research Diagnostic Criteria for depression (Yesavage et al., 1983).

Health Status

The Fibromyalgia Impact Questionnaire (FIQ) measured health status in participants with FMS (Burckhardt, Clark, & Bennett, 1991). The first subscale, physical functioning, is measured with 10 items (parts a through j). Participants were asked to rate their ability to perform large muscle tasks, such as walking several blocks, using a 4-point Likert scale, ranging from 0 (“Always able to do”) to 3 (“Never able to do”). The second subscale measured the number of days in the past week that the participant felt good, and the third subscale concerns the number of days in the past week that the participant was unable to do work because of FMS-related symptoms. Subscales 4 through 10 are visual analog scales which are marked in 10 increments. These assessed difficulty at work, pain, tiredness, morning tiredness, stiffness, tension, and depression. Scores on the FIQ range from 0 to 100, with higher scores indicating greater impairment in functioning. Test-retest reliability (0.56 ≤ α ≤ 0.95) and content and construct validity have been demonstrated (Burckhardt et al., 1991).

The Arthritis Impact Measurement Scale (AIMS) assessed health status in participants with OA. There are 45 items that make up nine subscales: mobility, physical activity, dexterity, household activities, activities of daily living, anxiety, depression, social activity, and pain. A total health score was calculated by adding the values from the mobility, physical activity, dexterity, household activity, depression, and pain subscales. Items from these six subscales were presented in a yes/no response format or in a Likert scale. Examples of items include, “If I do all the right things, I can successfully manage my arthritis” and “It
seems as though fate and other factors beyond my control affect my arthritis.” Higher health scores on the AIMS imply lower health status. Construct validity for this scale has been previously demonstrated (0.61 to 0.84; Meenan, Gertman, Mason, & Dunalf, 1982).

Concurrent validity in the FIQ has been shown with the AIMS (Iversen, 2003). The FIQ physical function scale correlated with the lower extremity physical function scale of the AIMS ($r = 0.65$). Also, the items on the FIQ significantly correlated with the items on the AIMS (range: .28 to .83).

**PROCEDURE**

The participants were part of studies that measured the effects of social support and education training on health status, health care use, and quality of well-being (Oliver, Cronan, Walen, & Tomita, 2001; Groessl, Kaplan, & Cronan, 2003). To recruit the FMS participants, newspaper advertisements, mass mailings to HMO members, physician referrals, and flyers in physicians’ offices were used. For FMS participants to be eligible, they needed a physician’s diagnosis of FMS, which was confirmed by a trained research assistant using the ACR diagnostic criteria (Wolfe et al., 1990). The ACR criteria included: reporting pain in 11 of 18 tender points from a manual tender point examination with digital palpation, and report of widespread pain that consisted of axial pain, left and right side pain, and upper and lower body pain.

The OA participants were recruited by sending out 3,000 letters inviting people who had OA to participate. Eligible participants had to be at least 60 years of age with a diagnosis of OA. The diagnoses were confirmed with medical chart reviews of radiographic evidence.

For the purpose of this study, only data from participants in control conditions was used to avoid possible confounds with intervention effects. Specifically, data from the 1-year time point was used in the statistical analyses for both groups.
A moderated mediation analysis using SPSS and STATA was performed to test the effects of knowledge about the chronic pain condition, self-efficacy, and depression on health status. First, all scores from measures at the 1-year time point were standardized (z-scores). The moderated mediation model was executed according to the analytic strategies provided by Muller, Judd, and Yzerbyt (2005). Specifically, Muller et al. (2005) specified the following three equations to measure the effects of moderated mediation:

1. \[ Y = \beta_{10} + \beta_{11}(X) + \beta_{12}(Mo) + \beta_{13}XMo + \epsilon_i \]
2. \[ Me = \beta_{20} + \beta_{21}(X) + \beta_{22}(Mo) + \beta_{23}XMo + \epsilon_i \]
3. \[ Y = \beta_{30} + \beta_{31}(X) + \beta_{32}(Mo) + \beta_{33}(Me) + \beta_{34}XMe + \beta_{35}XMo + \beta_{36}MoMe + \epsilon_i \]

In these equations, self-efficacy represents the mediator (Me) and depression denotes the moderator (Mo). According to Baron and Kenny’s (1986) work on moderated mediation, three separate conditions are examined in this model: (1) the moderator (depression) can affect the pathway between the explanatory variable (knowledge) and the mediator (self-efficacy), (2) the moderator (depression) can affect the pathway between the mediator (self-efficacy) and the response variable (health status), or (3) the moderator (depression) can affect both pathways simultaneously. In the present study, the effect of depression as a moderator was examined in relation to the association between knowledge and self-efficacy (i.e., condition 1; see Appendix Figure 1).

Further, Muller et al. (2005) stated that in order for the prototypical moderated mediation to be significant, three additional conditions must be met. First, the explanatory variable (knowledge) must affect the response variable (health status), controlling for the moderator (depression). In equation 1, \( \beta_{11} \) must be significantly different from zero, and \( \beta_{13} \) will not be significantly different from zero. Second, there must be a significant interaction (\( \beta_{23} \)), where the relationship between the explanatory variable (knowledge) and the mediator (self-efficacy) varies as a function of the moderator (depression). The effect of knowledge on self-efficacy should depend on the level of depression. Third, the mediator (self-efficacy)
must affect the response variable (health status), controlling for the explanatory variable (knowledge) and the moderator (depression).

The three conditions of the prototypical moderated mediation, depicted by Muller and colleagues (2005), were implemented for FMS subjects and OA subjects separately. Each of the three steps to test the conditions was performed once with the FMS data and once with the OA data. This was executed to determine whether the moderated mediation model applies for FMS patients, OA patients, or both. In order to test whether people with FMS and OA differed at each step of the moderated mediation analysis, the three steps were repeated for a third time with the addition of a group variable to represent their condition (i.e., FMS, OA). Statistically significant differences in the group variable at each step of the model were examined.
CHAPTER 5

RESULTS

DESCRIPTIVE STATISTICS

Descriptive statistical analyses were performed to examine the relationships between demographic variables and outcome variables, and to identify differences between the FMS and OA group on each construct (i.e., the level of knowledge, self-efficacy, depression, and health status).

Demographic Variables

Linear regression or analysis of variance (ANOVA) was performed to determine whether each demographic variable (i.e., age, gender, education, and income) was significantly related to health status or self-efficacy (i.e., the outcome variables) in the FMS and OA groups (see Table 1). Findings indicated that the level of education ($F(5, 161) = 2.76, p = .020$) and income ($F(7, 155) = 2.15, p = .042$) were both significantly related to health status in the FMS group. In the OA group, age was significantly related to health status ($F(1, 67) = 4.92, p = .030$). Further, income was significantly related to self-efficacy in the FMS sample ($F(7, 156) = 3.84, p = .001$). None of the demographic variables were significantly related to self-efficacy in the OA sample. Based on these findings, age, education, and income were entered as covariates into the moderated mediation analysis for the FMS and OA groups. Since both education and income were on a nominal scale of measurement, orthogonal contrast codes were created for the education variable and income was transformed into a continuous variable (see Tables 2 and 3).

Differences between Groups on Measures

The means and standard deviations for each measure at the 1-year time point are presented in Table 4. Separate, independent samples t-tests were performed to compare scores between FMS and OA participants on each measure. Findings indicated that there were no significant differences between FMS and OA participants in terms of their level of knowledge about their illness ($t(235) = -.56, p = .574$). FMS and OA participants were
### Table 1. Relationships between Demographic Variables and Outcome Variables

<table>
<thead>
<tr>
<th>Demographic Variables</th>
<th>Outcome Variables</th>
<th>Health Status</th>
<th>Self-Efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>FMS: $F(1, 166) = 2.39, p = .124$</td>
<td>FMS: $F(1, 167) = 1.76, p = .186$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OA: $F(1, 67) = 4.92, p = .030$</td>
<td>OA: $F(1, 67) = 1.35, p = .250$</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>FMS: $F(1, 166) = .10, p = .752$</td>
<td>FMS: $F(1, 167) = .45, p = .503$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OA: $F(1, 67) = 3.76, p = .057$</td>
<td>OA: $F(1, 67) = 3.80, p = .055$</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>FMS: $F(5, 161) = 2.76, p = .020$</td>
<td>FMS: $F(5, 162) = 2.25, p = .052$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OA: $F(5, 62) = .45, p = .810$</td>
<td>OA: $F(5, 62) = 1.59, p = .175$</td>
<td></td>
</tr>
<tr>
<td>Income</td>
<td>FMS: $F(7, 155) = 2.15, p = .042$</td>
<td>FMS: $F(7, 156) = 3.84, p = .001$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OA: $F(7, 54) = 2.15, p = .054$</td>
<td>OA: $F(7, 54) = 1.66, p = .139$</td>
<td></td>
</tr>
</tbody>
</table>

### Table 2. Contrast Codes for Levels of Education

<table>
<thead>
<tr>
<th>Education Group</th>
<th>Contrast Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade school/High school</td>
<td>-0.5</td>
</tr>
<tr>
<td>Some college/Bachelor’s/Other certificate</td>
<td>0</td>
</tr>
<tr>
<td>Master’s degree/Doctorate degree</td>
<td>-0.5 0.5</td>
</tr>
</tbody>
</table>
Table 3. Codes for Levels of Income

<table>
<thead>
<tr>
<th>Income Group</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below $10,000</td>
<td>1</td>
</tr>
<tr>
<td>$10,000-$20,000</td>
<td>2</td>
</tr>
<tr>
<td>$20,001-$30,000</td>
<td>3</td>
</tr>
<tr>
<td>$30,001-$40,000</td>
<td>4</td>
</tr>
<tr>
<td>$40,001-$50,000</td>
<td>5</td>
</tr>
<tr>
<td>$50,001-$60,000</td>
<td>6</td>
</tr>
<tr>
<td>$60,001-$70,000</td>
<td>7</td>
</tr>
<tr>
<td>Above $70,000</td>
<td>8</td>
</tr>
</tbody>
</table>

Table 4. Means and Standard Deviations for Each Measure at the 1-Year Time Point

<table>
<thead>
<tr>
<th>Measures</th>
<th>Group</th>
<th>FMS</th>
<th>OA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge (Knowledge Test)</td>
<td></td>
<td>$M = 16.56$</td>
<td>$M = 16.75$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$SD = 2.23$</td>
<td>$SD = 2.54$</td>
</tr>
<tr>
<td>Self-Efficacy (ASES)</td>
<td></td>
<td>$M = 61.00$</td>
<td>$M = 79.01$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$SD = 16.42$</td>
<td>$SD = 14.88$</td>
</tr>
<tr>
<td>Depression (CES-D and GDS)</td>
<td></td>
<td>$M = 25.83$</td>
<td>$M = 13.02$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$SD = 16.78$</td>
<td>$SD = 12.59$</td>
</tr>
<tr>
<td>Health Status (FIQ and AIMS)</td>
<td></td>
<td>$M = 58.31$</td>
<td>$M = 21.66$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$SD = 17.32$</td>
<td>$SD = 8.09$</td>
</tr>
</tbody>
</table>

Note. The means for depression and health status are expressed as percentages.
significantly different in their levels of self-efficacy, as measured by the ASES ($t(236) = -7.88, p < .001$); people with FMS had lower levels of self-efficacy ($M = 61.00, SD = 16.42$) than those with OA ($M = 79.01, SD = 14.88$). In order to compare depression and health status between FMS and OA participants, each score was first converted to a percentage (i.e., each score was divided by the maximum score specified by the measure and then multiplied by 100). A higher percentage value indicated higher levels of depression or greater impairment in functioning (i.e., lower health status). The independent samples $t$-test for depression ($t(236) = 5.71, p < .001$) demonstrated that people with FMS were significantly more depressed ($M = 25.83, SD = 16.78$) than those with OA ($M = 13.02, SD = 12.59$). Additionally, FMS participants exhibited lower health statuses ($M = 58.31, SD = 17.32$) than OA participants ($M = 21.66, SD = 8.09; t(235) = 16.82, p < .001$).

**Moderated Mediation**

The moderated mediation analysis was conducted three times (with the inclusion of covariates); it was performed with the FMS data, with the OA data, and with the addition of a group variable to examine differences between FMS and OA at each step of the moderated mediation model.

**Fibromyalgia**

The following three equations were used to measure moderated mediation in the FMS sample (the definition of each beta coefficient can be found in Table 5):

1. \[ Y = \beta_{10} + \beta_{11}(X) + \beta_{12}(Mo) + \beta_{13}XM + \beta_{14}(Age) + \beta_{15}(Educ_1) + \beta_{16}(Educ_2) + \beta_{17}(Inc) + \varepsilon_i \]

2. \[ Me = \beta_{20} + \beta_{21}(X) + \beta_{22}(Mo) + \beta_{23}XM + \beta_{24}(Age) + \beta_{25}(Educ_1) + \beta_{26}(Educ_2) + \beta_{27}(Inc) + \varepsilon_i \]

3. \[ Y = \beta_{30} + \beta_{31}(X) + \beta_{32}(Mo) + \beta_{33}(Me) + \beta_{34}XM + \beta_{35}XM + \beta_{36}MoMe + \beta_{37}(Age) + \beta_{38}(Educ_1) + \beta_{39}(Educ_2) + \beta_{310}(Inc) + \varepsilon_i \]

In the first condition of the prototypical moderated mediation, the explanatory variable (knowledge) must affect the response variable (health status), controlling for the moderator (depression; Muller et al., 2005). This condition did not hold in the FMS sample; the level of knowledge was not significantly related to health status, controlling for depression, age, education, and income ($\beta_{11} = .064, t(155) = -1.12, p = .265$). However, depression, as a moderator, significantly affected health status ($\beta_{12} = .671, t(155) = 10.82, p <
### Table 5. Definitions of Beta Coefficients in Equations of Moderated Mediation Analysis (Without Group Variable)

<table>
<thead>
<tr>
<th>Beta Coefficients</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta_{10}$, $\beta_{20}$, $\beta_{30}$</td>
<td>Y-intercept</td>
</tr>
<tr>
<td>$\beta_{11}$, $\beta_{21}$, $\beta_{31}$</td>
<td>Explanatory variable: Knowledge</td>
</tr>
<tr>
<td>$\beta_{12}$, $\beta_{22}$, $\beta_{32}$</td>
<td>Moderator: Depression</td>
</tr>
<tr>
<td>$\beta_{13}$, $\beta_{23}$, $\beta_{33}$</td>
<td>Knowledge X Depression interaction</td>
</tr>
<tr>
<td>$\beta_{33}$</td>
<td>Mediator: Self-efficacy</td>
</tr>
<tr>
<td>$\beta_{34}$</td>
<td>Knowledge X Self-efficacy interaction</td>
</tr>
<tr>
<td>$\beta_{36}$</td>
<td>Depression X Self-efficacy interaction</td>
</tr>
<tr>
<td>$\beta_{14}$, $\beta_{24}$, $\beta_{37}$</td>
<td>Covariate: Age</td>
</tr>
<tr>
<td>$\beta_{15}$, $\beta_{25}$, $\beta_{38}$</td>
<td>Covariate: Education</td>
</tr>
<tr>
<td></td>
<td>(Less or more than some level of college vs. Some level of college)</td>
</tr>
<tr>
<td>$\beta_{16}$, $\beta_{26}$, $\beta_{39}$</td>
<td>Covariate: Education (Grade school/High school vs. Master’s/Doctorate degree)</td>
</tr>
<tr>
<td>$\beta_{17}$, $\beta_{27}$, $\beta_{310}$</td>
<td>Covariate: Income</td>
</tr>
</tbody>
</table>

.001). Specifically, a 1-standard deviation increase in depression levels was related to a .671-standard deviation increase on the FIQ (i.e., lower health status). A total of 37.03% of the variance in health status was uniquely accounted for by depression.

In the second step of the prototypical moderated mediation, there must be a significant interaction ($\beta_{23}$) where the relationship between the explanatory variable (knowledge) and the mediator (self-efficacy) varies as a function of the moderator (depression; Muller et al., 2005). This interaction was not significant in the FMS sample ($\beta_{23} = .043, t(156) = .77, p = .443$). However, depression was significantly related to self-efficacy, across levels of knowledge, age, education, and income ($\beta_{22} = -.530, t(156) = -7.96, p < .001$). A 1-standard deviation increase in depression was related to a .530-standard deviation decrease in self-efficacy. Additionally, 23.48% of the variance in self-efficacy was uniquely accounted for by depression.
In the second step of the analysis, income was found to be significantly related to self-efficacy ($\beta_27 = .084, t(156) = 2.64, p = .009$), and it uniquely accounted for 2.58% of the variance in self-efficacy. Specifically, people with higher incomes reported higher levels of self-efficacy.

The third condition of the prototypical moderated mediation requires the mediator (self-efficacy) to affect the response variable (health status), controlling for the explanatory variable (knowledge) and the moderator (depression). In the FMS sample, this relationship was significant ($\beta_{33} = -.240, t(152) = -3.33, p = .001$). A 1-standard deviation increase in self-efficacy was related to a .240-standard deviation decrease on the FIQ (i.e., higher health status). Self-efficacy uniquely accounted for 3.18% of the variance in health status. Further, depression was also significantly related to health status, controlling for the level of knowledge, self-efficacy, age, education, and income ($\beta_{32} = .585, t(152) = 7.99, p < .001$). Specifically, a 1-standard deviation increase in depression levels was related to a .585-standard deviation increase on the FIQ (i.e., lower health status). Depression uniquely accounted for 18.28% of the variance in health status. There was also a significant interaction between self-efficacy and depression ($\beta_{36} = .124, t(152) = 2.20, p = .029$) which accounted for 1.39% of the variance in health status. The effect of self-efficacy on health status was stronger for people who were less depressed. For people who were more depressed, the effect of self-efficacy on health status became weaker and antagonistic.

Lastly, age was significantly related to health status in the third step of the model ($\beta_{37} = -.011, t(152) = -2.20, p = .029$), and it accounted for 1.39% of the variance in health status. A 1-year increase in age was associated with a .011-standard deviation decrease on the FIQ (i.e., higher health status).

**Osteoarthritis**

The following three equations were used to measure moderated mediation in the OA sample (the definition of each beta coefficient can be found in Table 5):

1. \[ Y = \beta_{10} + \beta_{11}(X) + \beta_{12}(Mo) + \beta_{13}XMo + \beta_{14}(Age) + \beta_{15}(Edu_{C1}) + \beta_{16}(Edu_{C2}) + \beta_{17}(Inc) + \epsilon_i \]
2. \[ Me = \beta_{20} + \beta_{21}(X) + \beta_{22}(Mo) + \beta_{23}XMo + \beta_{24}(Age) + \beta_{25}(Edu_{C1}) + \beta_{26}(Edu_{C2}) + \beta_{27}(Inc) + \epsilon_i \]
3. \[ Y = \beta_{30} + \beta_{31}(X) + \beta_{32}(Mo) + \beta_{33}(Me) + \beta_{34}XMe + \beta_{35}XMo + \beta_{36}MoMe + \beta_{37}(Age) + \beta_{38}(Edu_{C1}) + \beta_{39}(Edu_{C2}) + \beta_{310}(Inc) + \epsilon_i \]
In the OA sample, the first step of the prototypical moderated mediation was not significant. The level of knowledge was not significantly related to health status, controlling for depression ($\beta_{11} = .016$, $t(52) = .13$, $p = .895$). However, depression, as a moderator, significantly affected health status, across levels of knowledge, age, education, and income ($\beta_{12} = .424$, $t(52) = 3.17$, $p = .003$). Specifically, a 1-standard deviation increase in depression levels was related to a .424-standard deviation increase on the AIMS (i.e., lower health status). A total of 13.36% of the variance in health status was uniquely accounted for by depression.

Additionally, in the first step of the analysis, age was significantly related to health status ($\beta_{14} = .061$, $t(52) = 2.54$, $p = .014$). A 1-year increase in age was related to a .061-standard deviation increase on the AIMS (i.e., lower health status). Age uniquely accounted for 8.58% of the variance in health status.

The second condition of the prototypical moderated mediation did not hold in the OA sample. The relationship between knowledge and self-efficacy did not vary as a function of depression ($\beta_{23} = -.014$, $t(52) = -.11$, $p = .911$). Depression, however, was significantly related to self-efficacy, controlling for the level of knowledge, age, education, and income ($\beta_{22} = -.478$, $t(52) = -3.51$, $p = .001$). A 1-standard deviation increase in depression was related to a .478-standard deviation decrease in self-efficacy. Further, 16.59% of the proportion of variance in self-efficacy was uniquely accounted for by depression.

The third condition of the moderated mediation was significant in the OA sample. Self-efficacy was significantly related to health status, controlling for knowledge, depression, age, education, and income ($\beta_{33} = -.540$, $t(49) = -4.74$, $p < .001$). A 1-standard deviation increase in self-efficacy was related to a .540-standard deviation decrease on the AIMS (i.e., higher health status). Self-efficacy uniquely accounted for 18.45% of the variance in health status. Interestingly, depression was not related to health status in the OA sample ($p = .237$), which is in contrast to the FMS group.

**Fibromyalgia and Osteoarthritis**

The following three equations were used to measure moderated mediation in the entire sample, which includes both FMS and OA participants (the definition of each beta coefficient can be found in Table 6):

\[\text{AIMS} = \beta_0 + \beta_1 \text{Knowledge} + \beta_2 \text{Depression} + \beta_3 \text{Self-efficacy} + \beta_4 \text{Knowledge} \times \text{Depression} + \beta_5 \text{Knowledge} \times \text{Self-efficacy} + \beta_6 \text{Depression} \times \text{Self-efficacy} + \beta_7 \text{Age} + \beta_8 \text{Education} + \beta_9 \text{Income} + \epsilon\]
Table 6. Definitions of Beta Coefficients in Equations of Moderated Mediation Analysis (With Group Variable)

<table>
<thead>
<tr>
<th>Beta Coefficients</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta_{10}, \beta_{20}, \beta_{30}$</td>
<td>$Y$-intercept</td>
</tr>
<tr>
<td>$\beta_{11}, \beta_{21}, \beta_{31}$</td>
<td><em>Explanatory variable</em>: Knowledge</td>
</tr>
<tr>
<td>$\beta_{12}, \beta_{22}, \beta_{32}$</td>
<td><em>Moderator</em>: Depression</td>
</tr>
<tr>
<td>$\beta_{13}, \beta_{23}, \beta_{34}$</td>
<td>Group (FMS or OA)</td>
</tr>
<tr>
<td>$\beta_{14}, \beta_{24}, \beta_{36}$</td>
<td>Knowledge X Depression interaction</td>
</tr>
<tr>
<td>$\beta_{15}$</td>
<td>Knowledge X Group interaction</td>
</tr>
<tr>
<td>$\beta_{25}$</td>
<td>Knowledge X Depression X Group interaction</td>
</tr>
<tr>
<td>$\beta_{33}$</td>
<td><em>Mediator</em>: Self-efficacy</td>
</tr>
<tr>
<td>$\beta_{35}$</td>
<td>Knowledge X Self-efficacy interaction</td>
</tr>
<tr>
<td>$\beta_{37}$</td>
<td>Depression X Self-efficacy interaction</td>
</tr>
<tr>
<td>$\beta_{16}, \beta_{26}, \beta_{39}$</td>
<td><em>Covariate</em>: Age</td>
</tr>
<tr>
<td>$\beta_{17}, \beta_{27}, \beta_{310}$</td>
<td><em>Covariate</em>: Education</td>
</tr>
<tr>
<td>(Less or more than some level of college vs. Some level of college)</td>
<td></td>
</tr>
<tr>
<td>$\beta_{18}, \beta_{28}, \beta_{311}$</td>
<td><em>Covariate</em>: Education</td>
</tr>
<tr>
<td>(Grade school or High school vs. Master’s or Doctorate degree)</td>
<td></td>
</tr>
<tr>
<td>$\beta_{19}, \beta_{29}, \beta_{312}$</td>
<td><em>Covariate</em>: Income</td>
</tr>
</tbody>
</table>

1. $Y = \beta_{10} + \beta_{11}(X) + \beta_{12}(Mo) + \beta_{13}(Group) + \beta_{14}XMo + \beta_{15}XGroup + \beta_{16}(Age) + \beta_{17}(Edu_{C1}) + \beta_{18}(Edu_{C2}) + \beta_{19}(Inc) + \varepsilon_i$
2. $Me = \beta_{20} + \beta_{21}(X) + \beta_{22}(Mo) + \beta_{23}(Group) + \beta_{24}XMo + \beta_{25}XMoXGroup + \beta_{26}(Age) + \beta_{27}(Edu_{C1}) + \beta_{28}(Edu_{C2}) + \beta_{29}(Inc) + \varepsilon_i$
3. $Y = \beta_{30} + \beta_{31}(X) + \beta_{32}(Mo) + \beta_{33}(Me) + \beta_{34}(Group) + \beta_{35}XMe + \beta_{36}XMo + \beta_{37}XMoMe + \beta_{38}MeXGroup + \beta_{39}(Age) + \beta_{310}(Edu_{C1}) + \beta_{311}(Edu_{C2}) + \beta_{312}(Inc) + \varepsilon_i$

A group variable was added to determine whether people with FMS and OA differed at each step of the moderated mediation analysis. Overall, the group variable, or any interaction term that contained the group variable, was not significant in any of the three steps.
In the first step, depression was significantly related to health status, controlling for knowledge, group, age, education, and income ($\beta_{12} = .620, t(213) = 10.62, p < .001$). A 1-standard deviation increase in depression levels was related to a .620-standard deviation increase on the FIQ or AIMS (i.e., lower health status). Further, 31.17% of the proportion of variance in health status was uniquely accounted for by depression. There was also a significant interaction between the level of knowledge and depression ($\beta_{13} = .113, t(213) = 2.27, p = .024$), which accounted for 1.42% of the variance in health status. According to Muller and colleagues (2005), $\beta_{13}$ should not be significant in the first step of the prototypical moderated mediation. Further, income was significantly related to health status ($\beta_{19} = -.063, t(213) = -2.24, p = .026$) and it accounted for 1.39% of the variance in health status. People with higher incomes reported higher health statuses.

In step two of the analysis, depression was significantly related to self-efficacy, controlling for knowledge, group, age, education, and income ($\beta_{22} = -.524, t(214) = -8.79, p < .001$). A 1-standard deviation increase in depression was related to a .524-standard deviation decrease in self-efficacy scores. Also, depression uniquely accounted for 22.34% of the variance in self-efficacy. Additionally, age ($\beta_{26} = -.013, t(214) = -2.26, p = .025$) and income ($\beta_{29} = .075, t(214) = 2.62, p = .009$) were found to be significantly related to self-efficacy. A 1-year increase in age predicted a .013-standard deviation decrease in self-efficacy, and higher incomes were related to higher levels of self-efficacy. Further, age uniquely accounted for 1.48% of the variance in self-efficacy and income accounted for 1.99% of the variance.

Lastly, in the third step, self-efficacy ($\beta_{33} = -.333, t(210) = -4.60, p < .001$) and depression ($\beta_{32} = .430, t(210) = 6.64, p < .001$) were both significantly related to health status, across levels of knowledge, group, age, education, and income. Higher levels of self-efficacy were related to higher levels of health status, and higher levels of depression were related to lower levels of health status. Self-efficacy accounted for 5.08% of the variance in health status and depression accounted for 10.59% of the variance.
CHAPTER 6

DISCUSSION

As demonstrated by Cronan and Bigatti (2003), although women with FMS were considerably younger than those with OA, women with FMS had significantly lower health status. The purpose of the present study was to extend the findings of Cronan and Bigatti (2003) by examining differences between the two chronic pain populations. Moderated mediation analyses were performed to identify the interrelationships of knowledge, self-efficacy, and depression in predicting health status.

FIBROMYALGIA

In the FMS sample, the first two steps of the moderated mediation analysis were not significant. The level of knowledge was not related to health status and the effect of knowledge on self-efficacy did not depend on depression. However, in both steps of the analysis, depression was significantly related to the outcome variables (i.e., health status and self-efficacy). Higher levels of depression were related to poorer health status and lower self-efficacy. It is likely that depression predicts functional outcomes in FMS because depression was more prevalent (i.e., about 62% to 86%) in the FMS population (Aguglia, Salvi, Maina, Rossetto, & Aguglia, 2011; Gracely, Ceko, & Bushnell, 2012) than OA (i.e., about 23% to 33%; Theis et al., 2007) and the two conditions (i.e., FMS and depression) shared similar pathophysiology. In the present study, depression uniquely accounted for about 37% of the variance in health status and 23% of the variance in self-efficacy, which are both large effects. Additionally, in the second step of the analysis, income was significantly related to self-efficacy, suggesting that people with FMS who have higher incomes feel more confident in their ability to manage their condition. This is consistent with other research that has shown positive correlations between income and health. Marmot and Wilkinson (2001) found that higher socioeconomic status was related to lower rates of morbidity and mortality.

The third step of the moderated mediation analysis was significant in the FMS sample. Self-efficacy was significantly related to health status; higher levels of self-efficacy
predicted better health status, accounting for 3% of the variance in health status. As in the first two steps, depression again was significantly related to the outcome variable; depression accounted for 18% of the variance in health status. Interestingly, there was also a significant interaction between self-efficacy and depression. Higher levels of self-efficacy were related to better health status for those who were less depressed. For FMS individuals who were more depressed, the relationship between self-efficacy and health status became weaker. This suggests that depression can hinder a person’s ability to manage his or her condition effectively and cause poorer health status. This interaction effect is consistent with Bandura’s (1998) theory, which stated that self-efficacy is influenced by affect (i.e., depression). Further, Sánchez and colleagues (2011) found a similar relationship in their study; they reported that depression predicted self-efficacy expectations in pain management. FMS patients with lower expectations (which may be attributed to higher levels of depression) experienced greater severity and intensity of pain (i.e., worse health outcomes). In the present study, depression moderated the effects of self-efficacy in FMS.

Lastly, in the third step of the analysis, there was a significant relationship between age and health status; an increase in age predicted better health status in FMS people. This is consistent with the findings reported by Cronan, Serber, Walen, and Jaffe (2002). Cronan and colleagues examined three different age groups of people with FMS; young (20-39 years), middle-aged (40-59 years) and older (60-85 years) adults. They found that older FMS adults experienced less symptomatology. It is possible that older adults consider their condition to be a normal part of aging (Cronan et al., 2002). Younger adults do not expect to face illnesses; they may have less experience in managing their health issues, and, as a consequence, report poorer health status.

Overall, the moderated mediation model did not hold in the FMS sample. According to Muller and colleagues (2005), in order to establish a moderated mediation relationship among variables, the three steps of the prototypical moderated mediation must be significant. Only one of the three steps was significant in the FMS group (i.e., the third step). However, the results provide important information for the development of future interventions. It may be beneficial to consider a hierarchical approach in the psychological treatment of FMS. Since depression appears to be a significant predictor of health outcomes, the first level of the hierarchy would be to address the effects of depression. The second level of the hierarchy
could pertain to self-efficacy; clinicians can teach FMS patients techniques to improve their confidence in their ability to manage their pain-related symptomatology. It is likely that because depression and self-efficacy are intertwined, decreasing levels of depression may directly affect self-efficacy. Further, because age is also a contributing factor, it would be helpful to understand what components specifically are related to the positive correlation between health and aging. These factors can also be applied to the treatment hierarchy.

**OSTEOARTHRITIS**

In the OA sample, the first two steps of the moderated mediation analysis were not significant. However, similar to the FMS group, depression was a significant predictor of both of the outcome variables (i.e., health status and self-efficacy) in the first two steps. Higher levels of depression were related to poorer health status and lower self-efficacy. This is not surprising as depression is highly prevalent in older populations and negatively contributes to pain and disability in OA (as cited in Rosemann et al., 2007). Further, Maly et al. (2006) suggested that depression should be considered when addressing functional outcomes in OA, especially because depression was found to affect self-efficacy in their study. In this study, depression uniquely accounted for about 13% of the variance in health status and 17% of the variance in self-efficacy. Depression appears to be a significant predictor of health outcomes in OA as well as in FMS.

Additionally, in the first step of the analysis, age was related to health status; an increase in age predicted worse health status in people with OA. This is contrary to findings from the FMS sample where an increase in age predicted better self-reported health status. Rosemann et al. (2007) found that increased age was related to lower levels of depression in OA. Other researchers reported that older adults with OA (> 55 years) considered their symptoms to be a normal part of aging and that younger adults with OA felt more distressed by their condition (Gignac et al., 2006). The mean age of OA adults in this study was 70 years. It is interesting that there was a negative relationship between age and health status in this study because in previous studies there was a positive relationship. However, arthritis, in general, is associated with lower quality of life (as cited in Lin et al., 2003). There are likely other factors that also increased with increasing age, such as comorbid conditions, which led to poor self-reported health status in the OA group.
The third step of the moderated mediation analysis was significant in the OA sample. Self-efficacy was significantly related to health status; an increase in self-efficacy resulted in better health status. Self-efficacy accounted for about 17% of the variance in health status. This is likely as the more people feel confident in their ability to manage their condition, the better they will consider their health. Although depression was a significant factor in the first two steps of the analysis, depression was not significant in the third step. This demonstrates that depression is related to health outcomes in both FMS and OA, but it is a stronger predictor of health status in the FMS population.

Overall, the moderated mediation model did not hold in the OA sample either; only the last of the three steps of the analyses was significant. However, the results suggest that self-efficacy and depression are important to address in behavioral interventions for people with OA. In order to further improve health status, it would be important to understand which factors specifically contribute to worse health outcomes in older adults (compared to younger adults) with OA and apply those to treatment programs as well.

**Fibromyalgia and Osteoarthritis**

The third moderated mediation analysis was performed to determine whether people with FMS and OA differed at each step of the analysis. Overall, the FMS and OA groups did not differ at any of the steps. Further, the first two steps of the analysis were not significant; however, depression affected the outcome variables (i.e., health status and self-efficacy) in these steps. Depression accounted for about 31% of the variance in health status and 22% of the variance in self-efficacy, which are both large effects. This demonstrates that depression is a major component of chronic pain conditions. In their review of pain and depression, Campbell, Clauw, and Keefe (2003) described biological and psychosocial mechanisms that underlie pain and depression. Because there is a strong link between pain and depression, Campbell et al. (2003) suggested that methods to diagnose depression should be standardized. If depression in chronic pain patients is detected early on, it can be integrated into treatment strategies to modify the long-term course of pain and disability. Findings from the present study support the relationship between pain and depression in chronic pain populations.
Additionally, income was also significantly related to the outcome variables, health status and self-efficacy, in the first two steps of the analysis. Higher incomes were related to better health outcomes in FMS and OA. This is consistent with previous research that has demonstrated positive correlations between income and health (Marmot & Wilkinson, 2001). In the second step of the analysis, age was found to relate to self-efficacy. Controlling for group (i.e., FMS, OA), an increase in age predicted a decrease in self-efficacy. Older adults may attribute the development of chronic illnesses to normal aging (Cronan et al., 2002; Gignac et al., 2006); however, if treatment options are not clear and multiple conditions are diagnosed, confidence in the management of symptomatology is likely to become weaker (i.e., low self-efficacy).

The third step of the analysis was significant. Self-efficacy and depression were both related to health status, controlling for group. Higher levels of self-efficacy were related to better health status and higher levels of depression were related to poor health status. Self-efficacy accounted for about 5% of the variance in health status and depression accounted for 11%. These findings are consistent with previous research. Arnstein and colleagues (1999) also found that self-efficacy and depression affected health outcomes in chronic pain patients.

Overall, the moderated mediation model did not hold when controlling for group. Only the third step of the analysis was significant. Based on the findings, it is important to incorporate methods to increase self-efficacy and decrease depression in interventions for chronic pain populations. It is possible that a bidirectional relationship exists between self-efficacy and depression. Additionally, since age was found to negatively affect self-efficacy, it will be important to understand which factors are associated with increasing age in older populations and how they can be addressed to improve pain management.

**IMPLICATIONS AND LIMITATIONS**

Findings from the present study provide implications for the development of interventions for the FMS and OA population. Importantly, the results demonstrated that the strengths of the interrelationships among knowledge, self-efficacy, and depression as predictors of health status were not consistent between FMS and OA. Therefore, even though FMS and OA are both chronic pain conditions, they are associated with different functional
outcomes. The assumption is that because the two conditions are both rheumatic diseases with similar symptomatology, it is appropriate to develop similar interventions. However, results from this study imply that there are different mechanisms involved in the pain experience of FMS and OA, which contributes to differences in health status.

Further, we also found that knowledge was a not a significant predictor in the moderated mediation analyses. It is possible that the relationships may have differed if baseline knowledge was measured. At the 1-year time point, there was a ceiling effect in knowledge in both the FMS and OA groups. One explanation for this is that these control participants may have sought additional outside information about their condition because they realized that they were serving as controls.

A third of the U. S. population suffers from chronic pain conditions (Johannes, Le, Johnston, & Dworkin, 2010). As demonstrated in the present study, chronic pain conditions, such as FMS and OA, are associated with poorer health outcomes. Health care providers or clinical researchers could apply this information to empirically-supported treatments for FMS and OA. As chronic pain patients take more responsibility for their symptom management, the use of health care services and costs may decline. Therefore, researchers should find effective methods to alleviate the negative psychological impact of chronic pain on individuals with FMS and OA; effective techniques could also assist in attenuating the financial burden on the health care system.
REFERENCES


APPENDIX

MODERATED MEDIATION MODEL
Figure 1. The moderated mediation model demonstrating the interrelationships of knowledge, self-efficacy, and depression in predicting health status for people with FMS and OA. The measures that were used for each variable are displayed.