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Laughter Frequency, Pain Perception, and Affect in Fibromyalgia Patients

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MA, University of Mary Hardin-Baylor, 2004

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Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Health Psychology

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Abstract

Fibromyalgia syndrome (FMS), a common chronic pain condition, is often incompletely treated by conventional medical therapies. It can cause disability, psychological distress, work-related absenteeism, increased use of healthcare resources, and result in the inability to carry out the tasks of daily living. The purpose of this quantitative, correlational study was to investigate the potential influence of laughter on affect and pain in individuals with FMS. Laughter produces beneficial effects on acute pain and on chronic pain in general and has been found to improve temporary affective states, but there have been no studies testing the effects of laughter on the pain and affect of fibromyalgia patients. Informing this study were the gate control and neuromatrix theories of pain, as well as the dynamic model of affect theory. The research questions addressed whether laughter frequency is associated with affect and or with perceived chronic pain levels in these individuals. Forty-one adult fibromyalgia patients documented all laughter episodes daily and assessed their pain and affective states 3 times per day for 14 days. Hierarchical regressions revealed that increased overall laughter frequency was significantly associated with decreases in overall pain and increases in overall positive affect but was not associated with measures of negative affect. Also, morning laughter frequency was predictive of increased afternoon and evening positive affect ratings, as well as with decreased afternoon pain ratings, but was not significantly associated with evening pain ratings. The knowledge gained from these results may have positive social change implications at the individual level, within those individuals' larger social networks, and within the research and medical communities.

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Dedication

I dedicate this dissertation to my dad, Mervin West. Years ago (early 1990s), he experienced a heart attack and underwent a quadruple bypass operation. While recovering, he then suffered a cardiac arrest (which he was able to survive thanks to the speedy response of paramedics). He grew quite depressed during his subsequent time in the hospital and refused further lifesaving surgery. He remained hospitalized, and his cardiologist prescribed laughter therapy to lift his spirits. Each day, the medical staff provided him with funny videos to watch. Before long, he seemed to be feeling more positive and consented to the surgery. He continued his laughter therapy at home as he was recovering. Though he was not a big believer in talk therapy, something as simple as laughing more may have made all the difference in his recovery.

My dad died from other health complications in 2007, so he, unfortunately, did not live long enough to see me complete this research. I would like to think he would be pleased to see that research is finding what he (and his doctor) already knew—that sometimes laughter really is the best medicine. RIP, Dad.

Acknowledgments

Firstly, I give thanks and credit to my sister, Heidi (who has fibromyalgia), for serving as the inspiration for this topic. And to my husband, Andrew, who has supported me in all ways throughout this process. Many thanks, as well, to Elizabeth Mesic, and the National Fibromyalgia Association (NFA) for helping me get to the finish line. Because Elizabeth agreed to post my flyer to the NFA Facebook page, I was able to come very close to reaching my needed sample size.

Much appreciation goes to my chair, Dr. Ellen Levine, who has been a source of consistent support and guidance throughout this very long process. Thank you, also, to Dr. Debra Wilson, Dr. Hannah Lerman, and Dr. M. Bryant Howren for your invaluable feedback and for helping to ensure the quality of my work. Many thanks, also, to my mom, who helped hold me accountable to deadlines. Thanks, also, to my brother, Stuart, and my friends, Carolyn, Jake, Jillian, and Deepa, for listening and for always appearing to have great interest in what I was studying! Special thanks to Jake for developing my flyer and for helping me with computer formatting. Thanks, also, to my friend, Steph, who has literally walked this walk with me. Finally, to the participants—thank you so very much for disrupting your lives for 2 weeks in order to provide this important contribution to research. So much was asked of you, and despite your pain and the other demands on your time, you saw it through to completion. You have my most sincere appreciation.

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Chapter 1: Introduction to the Study

Fibromyalgia syndrome (FMS) is a medical condition characterized by chronic musculoskeletal pain in multiple body regions and a set of other frequently occurring signs and symptoms. FMS is one of the most commonly observed pain conditions in medical settings and is thought to impact between 2% and 6% of people worldwide. This estimate includes roughly 10 million people in the United States alone (Lawrence et al., 2008; National Fibromyalgia Association [NFA], 2009).

The pain associated with FMS may move from site to site in the body and varies in its intensity (American College of Rheumatology [ACR], 2010; NFA, 2009). Individuals with FMS may show evidence of pain processing dysregulation and may also experience other symptoms such as fatigue, sleep disorders, or psychological distress (NFA, 2009). Also commonly observed with FMS are memory problems, cognitive dysfunction, and co-occurring disorders such as migraines or irritable bowel disorder. As of yet, researchers have not uncovered a particular cause for FMS, and there is no known cure. As such, medical treatments typically provide incomplete relief (ACR, 2010; NFA, 2009).

If symptoms escalate, this can result in disabling conditions and a decreased ability to carry out the tasks of daily living (ACR, 2010). This symptom escalation also leads to increased use of healthcare resources (and the associated economic burden), increased absenteeism from occupational activities, and increased psychosocial distress (Howard et al., 2010; Kleinman et al., 2009; Lachaine, Beauchemin, & Landry, 2010; Merskey, 2008; Sicras-Mainar et al., 2009; Spaeth, 2009).

Because of the limited relief from medical interventions alone, goals of managing fibromyalgia typically include managing pain, assisting with illness adjustment, increasing feelings of well-being, and enhancing productivity (Peterson, 2007; Turk, Swanson, & Tunks, 2008). To help with meeting those goals, patients are typically encouraged to adopt healthy lifestyle behaviors and pursue alternative additive therapies (such as yoga or acupuncture) to complement their medical interventions and to perhaps assist them with gaining increased relief from symptoms (ACR, 2010; NFA, 2009).

It is important, therefore, to have safe, effective alternative interventions available to enhance treatment outcomes. The primary goal of this research was to investigate one such potential option—laughter. Laughter, unlike other alternative treatments, does not require any specific equipment, there is no cost associated with it, it does not require agility or athleticism, it does not require large amounts of time (Bennett & Lengacher, 2006; Mora-Ripoll, 2010), and there are minimal side effects (Kong, Shin, Lee, & Yun, 2014). Specifically of interest in this study was to learn whether increased laughter frequency is associated with improvements in affect and or with reductions in pain severity in patients with FMS.

Background of the Study

Affect

Fibromyalgia patients have been shown to experience frequent episodes of negative affect and reduced incidence of positive affective states. They also appear to have difficulty regulating their emotions. Compared to patients with osteoarthritis (OA; also a chronic pain disorder), individuals with FMS evidence increased positive affect

dysregulation (Bartley, Rhudy, & Williams, 2009; Zautra, Fasman et al., 2005). FMS patients also experience greater difficulty with holding on to a positive affective state when in pain (Finan, Zautra, & Davis, 2009). As pain worsens, negative emotions tend to become predominant. However, the incidence of positive affect appears to moderate the effects of negative affect as well as perceived pain levels (Zautra, Smith, Affleck, & Tennen, 2001). This suggests that interventions that "focus on improving positive affective resources" may be especially beneficial with FMS patients (Zautra, Fasman et al., 2005, p. 147).

There is little research about the use of laughter to influence affect in chronic pain/FMS patients. However, humor therapy has been shown to improve affect/mood and quality of life perceptions in older adults with depression or Alzheimer's disease (Walter et al., 2007). Forced laughter (laughing in the absence of a humorous stimulus) has also been shown to significantly improve affect ratings in undergraduate students (Foley, Matheis, & Schaefer, 2002; Neuhoff & Schaefer, 2002).

Alexithymia

Alexithymia has been defined as a state of having reduced emotional awareness, such as having difficulty with identifying and describing emotional states (Sifneos, 1973), and is frequently observed in patients with FMS (Evren, Evren, & Guler, 2006). For instance, Evren et al. (2006) found that 39.2% of their FMS sample and Steinweg, Dallas and Rea (2011) found that 44% of their FMS participants had alexithymia. Alexithymia has also been shown to be positively correlated with increased pain intensity and with negative affect (Tooyserkani, Besharat, & Koochi, 2011) and has been shown to

be associated with pain interference (how much the pain impacts the tasks of daily living) and pain catastrophizing (Makino et al., 2013). Because alexithymia appears to be so prevalent among this population, excluding participants with alexithymia from study participation could make it difficult to obtain enough participants to carry out the study. However, because of its potential influence on pain ratings and affect, participants in this study were screened for the presence of alexithymia through the use of the Toronto Alexithymia Scale-20 (TAS-20; Bagby, Ayearst, Morariu, Watters, & Taylor, 2013; Bagby, Parker, & Taylor, 1993; Bagby, Taylor, & Parker, 1994), and those measures were held constant in the statistical analyses.

Depression

Depression, a disorder of mood, is associated with higher levels of negative affect (Anas & Akhouri, 2013). It is also associated with increased ratings of pain severity in those with chronic pain conditions (Aguglia, Salvi, Maina, Rossetto, & Aguglia, 2011; Baker, Buchanan, & Corson, 2008). Compared to an estimated 7% in the general population having depression (American Psychiatric Association, 2013), FMS patients tend to evidence much higher rates—ranging from 14.6% to 46% in literature reviewed for this study (see Aguglia et al., 2011; dos Santos, Quintans, Fraga, Macieira, & Bonjardim, 2012; Hassett, Cone, Patella, & Sigal, 2000; Ozcetin et al., 2007; Uguz et al., 2010; Wolfe & Michaud, 2009). Based on these findings, it was expected that this sample might also evidence increased ratings of depression. As such, participants were assessed for symptoms of depression through the use of the Beck Depression Inventory—Second

Edition (BDI-II; Beck, Steer, & Brown, 1996), and those measures were also held constant in the statistical analyses.

Laughter and Pain

In various studies, laughter has been shown to have positive influences—both physiologically and psychologically (Mora-Ripoll, 2011). One area of study that shows promise is through the implementation of laughter in order to alter an individual's pain experience (Bennett, 2003). For instance, laughter has been shown to increase acute pain tolerance (Stuber et al., 2009; Zweyer, Velker, & Ruch, 2004) and is also associated with elevations in acute pain thresholds (Dunbar et al., 2011; Mahony, Burroughs, & Hieatt, 2001). Though the research involving laughter and chronic pain is limited, focused laughter therapy has been found to be beneficial with a small sample of patients with rheumatoid arthritis (RA; Herschenhorn, 1994). Following Herschenhorn's study, participants reported improvements in the intensity of the pain experiences and reported the pain as being less bothersome. In another study, older adult chronic pain patients participated in 8 weeks of humor therapy (Tse et al., 2010). At the conclusion of the study, participants reported significantly reduced pain and significantly improved ratings of subjective well-being (Tse et al., 2010). The studies discussed above, as well as others, will be detailed further in the following chapter.

Problem Statement

FMS is a chronic, potentially disabling syndrome with no specifically identified cause and no cure, and medical interventions only offer partial relief from symptoms (ACR, 2010; NFA, 2009). FMS patients also tend to experience increased incidence of

negative affect and reduced positive affect and tend to experience difficulty with affect regulation (Bartley et al., 2009; Zautra et al., 2005). The problem is that individuals with FMS need safe, alternative treatment options to target symptoms that may not be addressed by traditional medical treatments. Laughter has been shown to increase acute pain tolerance (Stuber et al., 2009; Zweyer et al., 2004), increase pain thresholds (Dunbar et al., 2011; Mahony et al., 2001), produce decreases in pain severity of chronic pain (Herschenhorn, 1994; Tse et al., 2010), and improve temporary mood states (Foley et al., 2002; Neuhoff & Schaefer, 2002; Walter et al., 2007). However, it is not known whether laughter is related to reductions in perceived pain severity levels and improvements in affect in individuals with FMS.

Although there have been several studies about the role of affect dysregulation in patients with FMS, the specific role laughter may play in the affective states of these patients has not been investigated. Of the few studies found detailing the influence of laughter on affect and or mood, most are older studies. For instance, Young (1937) found that more frequent laughter was associated with higher ratings of cheerfulness in undergraduate students. Elicited laughter (from watching funny videos) has been associated with significant mood improvements in undergraduate students (Sakuragi, Sugiyama, & Takeuchi, 2002); forced (simulated) laughter has also been associated with significant improvement in temporary mood states in undergraduates (Foley et al., 2002); and in a more recent investigation, laughter therapy has been shown to significantly improve affect in cancer patients undergoing radiation therapy (Kim et al., 2015). It is important to discover if the findings discussed can be observed as well with a sample of

FMS patients. What sets this study apart from other laughter studies that have been conducted is that, instead of eliciting or forcing laughter, actual laughter incidence was recorded as participants went about their daily lives. In this way, it was possible to observe whether naturally occurring laughter is associated with pain and affect.

Purpose of the Study

The purpose of this study was to investigate the potential role laughter frequency plays in modulating perceived pain and affect in individuals with FMS. If laughter frequency is related to a reduction in perceived pain and or an improvement in affect, it can then be implemented as an additional tool in more effectively managing FMS symptoms.

Nature of the Study

In this correlational study, participants first completed demographic questionnaires and were then screened for alexithymia through the use of the TAS-20 (Bagby et al., 2013; Bagby et al., 1993; Bagby et al., 1994), and for symptoms of depression through the use of the BDI-II (Beck et al., 1996). Those measures were then held constant in the statistical analyses following the study. Participants documented all daily instances of laughter for a 14-day period. Participants also rated their pain levels and affective states 3 times per day. Daily measures employed in this study include the adapted Daily Laughter Record (DLR; Martin & Kuiper, 1999), the Pain Intensity-Numeric Rating Scale (PI-NRS; Farrar, Young, LaMoreaux, Werth, & Poole, 2001), and the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). All assessment tools will be discussed further in the third chapter.

Research Questions and Hypotheses

Research Question 1

Will laughter frequency influence the affect of FMS patients after controlling for depression and alexithymia?

$H_0$1: Laughter frequency will not influence the affect of FMS patients after controlling for depression and alexithymia.

H_a1: Laughter frequency will influence the affect of FMS patients after controlling for depression and alexithymia.

Research Question 2

Will laughter frequency influence the perceived chronic pain levels of FMS patients after controlling for depression and alexithymia?

$H_0$2: Laughter frequency will not influence difference in perceived chronic pain levels of FMS patients after controlling for depression and alexithymia.

H_a2: Laughter frequency will influence difference in perceived chronic pain levels of FMS patients after controlling for depression and alexithymia.

Theoretical Base

Two related theories of pain guided this research. The first theory is the gate control theory of pain. This was the first theory of pain in which other variables beyond stimulus-response were considered in the pain experience—most notably psychological influences. This theory was developed largely to understand the experience of chronic pain in the absence of painful sensory stimuli (Melzack, 1993, 1999b, 2008; Melzack & Wall, 1965). More recently, a neuromatrix theory of pain was proposed. This theory

evolved from the gate control theory and builds on its principles to address more comprehensively the pain experience (Melzack, 1999a, 2001). The central concept of the neuromatrix theory of pain is that there exists a complicated neuronal network that consists of communication between multiple brain centers, including "the thalamus and cortex as well as between the cortex and limbic system" (Melzack, 1999b, p. 881). Relevant to this study is the neuromatrix theory's tenet that part of this network includes an affective experience (for instance, the limbic system plays a role in modulating the experience of pain).

In this study, I have drawn from and tested the dynamic model of affect, in which Zautra et al. (2001) suggested that "the relationship between negative and positive emotions changes as a function of ongoing events" (p. 787). According to the principles of this model, it is predicted that if individuals experience episodes of positive affect while experiencing pain, the positive emotions will serve to moderate pain-related negative emotions. This theory, as well as the pain theories above, will be discussed in greater detail in Chapter 2.

Definition of Terms

Affect: Often used interchangeably with *mood* and *emotion.* For the purposes of this study, it means the subjective experience of a temporary, changeable emotional state. This is in contrast to a more stable, enduring mood state (American Psychiatric Association, 2000).

Chronic pain: Pain that persists past the time when the injury or tissue damage should have healed, or when it persists despite minimal evidence of physiological

pathology (Loeser, Butler, Chapman, & Turk, 2001). To be considered chronic, the pain must have lasted at least 3 months (Merskey & Bogduk, 1994).

Laughter: Frequently used interchangeably in the literature with *mirthful laughter* and *humor*—which should be distinguished from *sense of humor.* Humor is something that may evoke laughter. It acts as a stimulus. Laughter is the psychophysiological reaction to something perceived as humorous or in response to some other stimulus (Mahony, Burroughs, & Lippman, 2002).

Negative affect: An aversive emotional state characterized by subjective distress (Watson et al., 1988).

Pain: A subjectively aversive state related to physiological damage sustained. It has both sensory and affective components (Merskey & Bogduk, 1994).

Positive affect: A subjectively pleasant emotional state (Watson et al., 1988).

Sense of humor: A trait that varies among individuals. What one individual finds humorous may differ from others. Having a sense of humor may or may not lead to actual laughter (Svebak, 1974; Svebak, Kristoffersen, & Aasarød, 2006).

Assumptions

In this study, it was assumed that participants were accurately diagnosed by their physicians as having FMS. In addition, it was assumed that participants were capable of understanding and completing all questionnaires and assessments and that their responses were truthful. Lastly, it was assumed that the participants complied with all study protocols.

Limitations and Delimitations

Because this study did not take place in the laboratory with the ability to control for confounds, there is the potential for other extraneous variables to have influenced study outcomes. There are also several inherent considerations that may limit the generalizability of this study's outcomes. Firstly, women tend to comprise 75% to 90% of those diagnosed with FMS (NFA, 2009). This sample, likewise, was disproportionately composed of women (95.12%), thereby limiting generalizability of results to men with FMS.

In addition, the study participants were all volunteers recruited from social media, bulletin board postings, support group meetings, and through a therapist's practice. There may be intrinsic differences between those FMS patients who do and do not volunteer to participate in studies, making it difficult to generalize to the larger group of FMS patients. It could be that those FMS patients who did not volunteer to participate may have had such symptom exacerbations that they felt unable to fully participate in a study such as this. It could be that they were in too much pain or that they were feeling too fatigued or depressed to put forth the extra effort needed to fulfill the requirements of the study. Some may have also perceived the requirements of the study to be too taxing or a hassle to fit into their days. Personality factors may also influence who chooses to volunteer for studies (Lönnqvist et al., 2007; Saliba & Ostojic, 2014). Lönnqvist et al. (2007) conducted two studies—one with officers in the military, and one with siblings from large families. In both studies, the researchers found that those volunteering to participate tended to have significantly lower ratings of neuroticism and significantly

higher ratings of conscientiousness compared to those who did not volunteer to participate (Lönnqvist et al., 2007). Additionally, in the sibling study, those who agreed to participate had significantly higher ratings of extraversion and agreeableness compared to those who did not volunteer (Lönnqvist et al., 2007). In addition, Saliba and Ostojic (2014) compared the Myers-Briggs Type Indicator (Myers, McCaulley, Quenk, & Hammer, 1998), ratings of their study participants to a representative population sample in the United States. They found that individuals who chose to participate in their study tended to be overrepresented by those with the trait of "Intuition" (N; "a grasp of possibilities") and underrepresented by those with the trait "Sensing" (S; "a reliance on facts"; Saliba & Ostojic, 2014, p. 241). Saliba and Ostojic suggested further study is warranted in order to assess whether such differences in personality traits impact study outcomes and the ability to generalize from such outcomes. Lastly, since only FMS patients were included, results will not easily generalize to other chronic pain conditions or to other types of medical disorders.

Significance of the Study

This is likely the first study to address laughter as it specifically relates to affect and perceived pain levels in FMS patients. Though fibromyalgia is not typically associated with increased mortality risk (Wolfe, Hassett, Walitt, & Michaud, 2011), it is a medical disease that (to date) has no cure. It can and does result in disability and results in significant costs in terms of health care resources, lost productivity and time on the job, and personal relationships. Since the results found in this investigation demonstrate that increased laughter frequency is associated with reduced pain severity ratings and

improved positive affect ratings, this could have positive social change implications at the individual level, within the FMS patients' larger social networks, as well as within the research and medical communities.

Summary

Fibromyalgia is a chronic, potentially disabling syndrome that is often incompletely treated. In the research literature, laughter has been shown to effectively improve affect and increase pain tolerance and pain thresholds in various settings and with varying populations who have other ailments, but research has not been conducted on naturally occurring spontaneous laughter and its relationships with affect and pain perception in FMS.

Chapter 2 includes a comprehensive discussion of the available literature regarding FMS, affect and FMS, and laughter and its physiological and psychological effects. Also detailed in Chapter 2 are the theories of pain and affect that formed the foundation for this study.

Chapter 2: Literature Review

In this study, I investigated the relationships between laughter, pain perception, and affect in individuals with FMS. In this chapter, the relevant extant literature pertaining to each topic is reviewed. First, I discuss FMS in greater detail—including signs and symptoms, diagnostic criteria, potential etiologic factors, common treatments administered, the costs associated with it, its association with psychiatric diagnoses, and coping strategies commonly used. Following the FMS overview is a discussion of laughter's influences on various markers of health and pain. I then discuss pain theories, as well as how they relate to the experience of chronic pain. A section on affect, emotion regulation, and alexithymia findings in the FMS population follows. Finally, I discuss the dynamic affect model proposed by Zautra et al. (2001) as it pertains to persons who have chronic pain conditions.

In order to examine the current research, a comprehensive search was performed using several electronic databases. Thoreau was the primary electronic database employed for the literature search because it searches multiple databases and retrieves the largest body of search results. Other databases used include Academic Search Premier, PsycINFO, and Medline. Search terms included *fibromyalgia*, *pain*, *laughter*, *chronic pain*, *alexithymia,* and *affect*, as well as combined search terms such as *pain and affect*, *laughter and pain*, *laughter and health*, *emotion regulation and fibromyalgia,* and *fibromyalgia and affect*. References were also gathered through reference lists from related journal articles as well as through searching prominent researchers' names in the databases. There was also an extensive search for articles that cited other articles central

to the study. Peer-reviewed journal articles were the primary source of information for this review, but there were also germane source websites used for important demographic and statistical information, as well as for the general overviews of fibromyalgia.

Overview of Fibromyalgia Syndrome

Signs, Symptoms, and Associated Conditions

As discussed briefly in the first chapter, FMS is a medical condition with the hallmark feature of persistent, widespread musculoskeletal pain and tenderness in all quadrants of the body (above and below the waist, and both left and right sides of the body; ACR, 2010). Individuals with FMS experience all over body pain and a generally reduced pain threshold, but they also have localized body regions that are particularly sensitive to pain stimuli—called tender points (Bennett, 2009).

Tender points should be distinguished from trigger points. Though these terms are often used interchangeably by patients and physicians, they are actually associated with similar but distinct medical symptoms. Tender points are simply used for diagnosing FMS. They are points that, when mechanically pressed, become painful. They do not appear to be the direct source of the pain experienced in FMS. Trigger points, on the other hand, are associated with myofascial pain disorder (MPS) and tend to be tender and painful without being pressed. The pain in MPS directly originates at the trigger points. That pain can be localized or can radiate to other body regions. Though there are other subtle differences between tender points and trigger points, there are two important distinctions between them. First, differences in the muscle fibers and electrical activity associated with trigger points (taut bands or nodules in the muscles) can be observed with

electromagnetic imaging or ultrasonography, whereas there are still no reliable imaging techniques or diagnostic tests available for the identification of FMS pain. Perhaps most important, in terms of therapeutic outcomes, pain appears to be instantly relieved in patients with MPS when treatments are used to target the trigger points (e.g., dry needling or physiotherapy). This is not the case with FMS. There are no treatments currently available that instantly relieve FMS patients' pain (Skorupska, Bednarek, & Samborski, 2013).

FMS is also characterized by dysfunctions in the sleep cycle. For instance, in Stage 4 of the sleep cycle, FMS patients tend to have periodic brain waves characteristic of an awake state instead of those characteristics of a deep sleep state (NFA, 2009). Patients with FMS may also experience fatigue, pain processing irregularities (individuals with FMS tend to experience hypersensitivity to pain stimuli), and psychological distress such as symptoms of depression and anxiety (ACR, 2010; Centers for Disease Control and Prevention [CDC], 2011; NFA, 2009). Other common symptoms include stiffness upon waking, tingling in the extremities, headaches (tension headaches or more severe migraines), cognitive dysfunction, dizziness, vision difficulties, dry eyes and mouth, and impaired memory. Other disorders and syndromes commonly associated with FMS include irritable bowel syndrome, lupus, restless legs syndrome, temporomandibular disorder, other comorbid rheumatic disorders, pelvic and bladder pain syndromes, arthritis, and gastric reflux disorder (ACR, 2010; CDC, 2011; NFA, 2009; Wolfe et al., 1990).

Symptoms associated with FMS are variable over time, may increase or decrease in intensity, and are sensitive to psychological stress, weather (cold or humid), physical overexertion, reduced sleep quality, and fatigue. The symptoms can become so debilitating at times that the individual may be unable to participate in work or social activities or to complete even the most basic daily tasks of living (ACR, 2010; CDC, 2011; NFA, 2009; Wolfe et al., 1990).

Prevalence and Demographics

Estimates of FMS in the adult (age 18 and older) U. S. population range from 2% to 4% (ACR, 2010; Wolfe, Ross, Anderson, Russell, & Hebert, 1995). This translates to between 5 and 10 million people estimated to have FMS in the United States (Lawrence et al., 2008; NFA, 2009). Worldwide, estimates of FMS range from 3% to 6%. The preponderance of patients with FMS are female (the incidence is at least 7 times greater in women than in men), but it is found in men and children as well. FMS is most commonly diagnosed during middle age. Rates of diagnosis increase with advancing age (8% of individuals meet the criteria for FMS by the age of 80; ACR, 2010; CDC, 2011; NFA, 2009). FMS is also observed in all racial groups (NFA, 2009).

FMS may also have a heritable component, as it has been observed among siblings and among mothers and their children (NFA, 2009). For example, Arnold et al. (2004) gathered information from first-degree family members (total $N = 533$; 146 were directly interviewed and provided the researchers with information on 455 other first-degree relatives not available to be interviewed at the time of the study. Of patients with FMS ($n = 78$), a strong familial relationship was found with both the presence of FMS

(18.5% in the family members who were interviewed and 6.4% in the overall sample) and increased tenderness to pain. This relationship, however, appears to be restricted mainly to female family members. In this sample of first degree relatives, Arnold et al. only observed two male family members (brothers of one of the patients with FMS) who met the criteria for FMS.

Mortality Risks

There is no difference in overall mortality rates between people with FMS and the general population. However, individuals with FMS have been shown to have an increased rate of death from suicide (Dreyer, Kendall, Danneskiold-Samsøe, Bartels, & Bliddal, 2010; Wolfe, Hassett, et al., 2011). Wolfe, Hassett, et al. (2011) also found a higher rate of death from accidental injuries in those with FMS as compared to the general population. Wolfe, Hassett, et al. were not able to provide a concrete explanation of their results but suggested that many of the deaths from accidental injuries may have truly been completed suicides that appeared accidental. Dreyer et al. (2010) suggested that the increased rate of suicides might be related to mental health problems (e.g., depression, anxiety, etc.; to be discussed later in the chapter) frequently observed in FMS patients. Suicide rates increased both at the initial diagnosis of FMS and at the time of follow-up 5 years later. Therefore, Dreyer et al. recommended that FMS patients be screened for suicide risk by their health care professionals.

Etiology and Pathogenesis

Researchers have not uncovered a single, specific, identifiable cause for FMS. Instead, it is generally thought that a predisposing genetic vulnerability may become

activated by some sort of trigger (ACR, 2010). For example, certain medical conditions (e.g., HIV, Hepatitis C, Lyme disease) or infections may act as potential triggers for the development of FMS (Buskila, Atzeni, & Sarzi-Puttini, 2008; Martinez-Lavin, 2012; Mease et al., 2009). Triggers could also include physical traumas (such as injuries or the development of arthritis), physical assault or abuse, or sexual assault or abuse (ACR, 2010; Haviland, Morton, Oda, & Fraser, 2010). Histories of childhood sexual and physical abuse have frequently been reported by FMS patients (Thieme, Turk & Flor, 2004). In Thieme et al.'s (2004) study, 40.9% of the FMS sample reported a history of sexual abuse, while 20.9% reported a history of physical abuse. Additionally, those in the study who had been sexually abused as children tended to report having more severe physical symptoms than other study participants (Thieme et al., 2004). Häuser, Kosseva, Üceyler, Klose, and Sommer (2011) conducted a meta-analysis of research related to emotional, physical, and sexual abuse in FMS patients. In their research, they observed that both physical and sexual abuse (either from experiences as a child or as an adult) were positively related to the development of FMS (Häuser et al., 2011). However, the results of their meta-analysis did not show emotional abuse to be related to the development of FMS (Häuser et al., 2011). In another study, Haviland et al. (2010) analyzed data obtained from self-report questionnaires (regarding religion and health) completed by older adults (N = 10,424). As with Häuser et al., they, too, found that having a history of physical and sexual abuse or assault was related to respondents reporting an FMS diagnosis (Haviland et al., 2010). In their study, emotional abuse and major life stress were not factors implicated in its development (Haviland et al., 2010).

Haviland et al. suggested that it appears that it might be the actual traumatic physical contact that plays a larger role in the development of FMS and not necessarily emotional stress.

This assertion seems to run counter to the outcomes found by Jones, Power, and Macfarlane (2009) in their large prospective study ($N = 7,571$). Jones et al. followed participants for 38 years (from ages 7 to 45). Data were gathered from their parents at age 7 regarding the incidence of various physical and psychosocial adverse events. Then at age 45, those individuals were interviewed regarding whether they experienced chronic pain. Several adverse events in childhood were found to significantly correlate with the later development of chronic widespread pain. These included being hospitalized specifically as a result of a motor vehicle crash (but not for hospitalization for surgery without a prior traumatic incident and not for other types of accidents or injuries), being separated from their mothers for more than 6 months, spending time in institutional care, experiencing their mother's death, and experiencing financial hardships. Contrary to Haviland et al.'s (2010) outcomes, it appears that in Jones et al.'s study, significant emotional stress and major life stressors were related to the later development of chronic widespread pain.

In another study, 73% of 2,569 FMS patients surveyed online identified particular triggers they believed to be associated with the development of their FMS (Bennett, Jones, Turk, Russell, & Matallana, 2007). These triggers are consistent with those discussed above and included chronic stress (the most frequently cited trigger, 41.9%), emotional trauma, acute illness, physical injury, surgery, vehicular accidents, emotional,

sexual, or physical abuse (both as children and as adults), thyroid dysfunction, menopause, and giving birth (Bennett et al., 2007).

Wolfe et al. (2014) argued that the extant research about potential triggers is largely based on case studies and small, less scientifically rigorous studies, and that we are limited by participant self-report regarding what is believed to have triggered FMS. Wolfe et al. suggested we are far from discovering a clear causal model of FMS development. However, it is commonly thought that a traumatic triggering event, such as those discussed above (e.g. the presence of chronic stress, emotional trauma, vehicular accidents, etc.), might potentially create changes in certain chemicals in the body that alter the central nervous system's (CNS) processing of pain signals (ACR, 2010; Bellato et al., 2012). Some of the chemicals that have been associated with some FMS symptoms include serotonin, norepinephrine, dopamine, and endorphins (Bellato et al., 2012). The resultant outcome is an increased sensitivity to pain stimuli (ACR, 2010) called central sensitization (Bellato et al., 2012). As the body of research has grown, there has been increasing evidence that the sets of symptoms observed with FMS may be caused by dysregulation in the CNS (Mease et al., 2009). This dysregulation is then influenced by other factors such as genetic expression, immune system functioning, and the presence of hormones, making this a complex and difficult syndrome to understand and treat effectively (Bellato et al., 2012).

Diagnosis

Because FMS is not readily revealed through characteristic findings on objective laboratory tests and cannot be observed physically (it does not result in distinctive tissue

inflammation or joint damage), it has historically been challenging to diagnose (ACR, 2010; Bellato et al., 2012; NFA, 2009; Wolfe et al., 2010); and the lack of objective markers for FMS has made the diagnosis "subject to numerous criticisms and controversies" (Wang et al., 2015, p. 677). Diagnosis is typically delayed for five years on average while patients are referred from physician to physician and undergo extensive testing in an effort to rule out other medical conditions (NFA, 2009). This period of time is difficult for the patients as they wait and wonder about potential diagnoses (Buskila, Neumann, Sibirski, & Shvartzman, 1997; NFA, 2009). Therefore, those in the medical community realized that it is important to have a standard set of criteria that physicians could use to enhance the accuracy and expediency of diagnosis (Wolfe et al., 1990).

1990 diagnostic criteria. The diagnostic criteria for FMS were first developed in 1990 by researchers at the American College of Rheumatology (ACR). The criteria were revised in 2010, and then modified again in 2011 (Garg & Deodhar, 2012; Wolfe et al., 2011; Wolfe et al., 2010). In their development of the original criteria, the ACR researchers found that 97.6% of the FMS patients (compared to 69.1% of control participants with disorders similar in presentation to FMS) experienced widespread pain (pain found in both upper and lower parts of the body, as well as in both the left and right sides). This became the first criterion for diagnosing FMS. The second criterion necessitated the patient endorsing tenderness in at least 11 of 18 potential tender points as determined by physician palpation (Wolfe et al., 1990). Both criteria had to be present in combination in order to receive a diagnosis of FMS. The tender point examination made the biggest impact in differentiating between FMS patients and controls with other types

of rheumatic disorders (sensitivity = 81.1%). The final criterion necessary for diagnosis of FMS, as determined by the ACR, was that the widespread pain must have been present for at least 3 months (Wolfe et al., 1990).

These criteria did not allow for differentiation between primary and secondary FMS (symptoms of FMS caused by the presence of another rheumatic disorder). FMS could still be diagnosed, even if another disorder was present. Though a large percentage (73% – 85%) of patients in the study conducted by Wolfe et al. (1990) also endorsed symptoms of fatigue, difficulties with sleep quality, or feeling stiff upon awakening, these symptoms were not deemed necessary for diagnosis. This is due to the variability in the experience of those symptoms. For instance, only 56% of the FMS patients endorsed experiencing all three symptoms, while 81% endorsed two of them. There were also other types of commonly reported signs and modulating factors (e.g., anxiety, irritable bowel syndrome, temperature fluctuations, etc.), but none were consistent enough within the sample to become a diagnostic criterion.

2010 revision of diagnostic criteria. Following the initial diagnostic criteria development, FMS began receiving greater attention and recognition. As the criteria were put into practice, some concerns and criticisms were raised (Wolfe et al., 2010). For instance, it was found that there was still confusion among family physicians regarding the specific FMS criteria. For example, Buskila et al. (1997) found that only 55% of their sample of family physicians were aware that widespread pain was a defining criterion of FMS, while only 25% of this same sample knew how many tender points were required for diagnosis. Physicians appeared to be more familiar with the associated signs and

symptoms of FMS (fatigue, headaches, disordered sleeping) than with the specific diagnostic criteria of widespread pain and tender points (Buskila et al., 1997). The focus on pain alone in the original criteria disregarded other hallmark signs and symptoms commonly associated with FMS. Crofford and Clauw (2002) argued that ignoring the constellation of other symptoms failed "to capture the essence of" FMS (p. 1136). Therefore, it was proposed that FMS should be evaluated based not just on the presence of pain and tenderness, but also on the presence of other types of symptom domains (e.g. cognitive dysfunction, disordered sleep, problems with mood, and impaired functioning; Mease et al., 2009).

It also appeared that, despite having a set of standardized diagnostic criteria, there was a problem with physicians making inaccurate diagnoses. For example, Fitzcharles and Boulos (2003) found that only 34% of patients ($N = 76$) were correctly diagnosed with FMS following a rheumatology consultation. In this sample, FMS appeared to be most often over diagnosed, but was also misdiagnosed. It had been over diagnosed in 37 of the patients who had been referred. These patients, instead, were diagnosed with conditions such as inflammatory arthritis, soft tissue rheumatism, and degenerative arthritis. On the other hand, 13 of the referred patients carried diagnoses other than FMS, such as arthralgia, OA, or back pain. Eleven of those patients were later diagnosed, instead, as having FMS (Fitzcharles & Boulos, 2003).

In addition, the original criteria did not allow for a continuum of severity. Though patients with FMS present with a range of symptoms, with more or less severity, there was no way to capture the qualitative differences with the present criteria (Wolfe et al.,

2010). Finally, there was also a concern regarding the standardization of physician palpation for the tender point examinations. It was found that physicians were quite variable in the pressure they exerted when assessing for the presence of tender points even after receiving formal training (Häuser & Wolfe, 2012; Wolfe et al., 1990). In addition, Staud, Price, Robinson, and Vierck (2004) found that tender point examination only accounted for 4% of the variance in pain intensity measures for FMS patients versus 16% of the variance in pain intensity accounted for by the patients shading in all painful body regions on a diagram of the human body. Therefore, Staud et al. (2004) suggested that tender point examinations may not be as useful to diagnosis or as a predictor of pain severity as the use of a pain diagram, and that areas that may be sensitive to the palpations may not necessarily be where the patient is currently feeling pain.

Keeping these various concerns in mind, Wolfe et al. (2010) devised an alternative set of diagnostic criteria. The new set of criteria includes a widespread pain index (WPI) scale and a symptom severity (SS) scale. The WPI assesses in how many areas of the body the patient has been experiencing pain over the past week (scores range from 0 to 19 body regions). The SS scale assesses the severity of symptoms patients are experiencing in four areas: 1) fatigue, 2) waking unrefreshed, 3) cognitive symptoms, and 4) somatic symptoms (e.g., frequent or painful urination, dizziness, nausea, diarrhea, etc.). In this way, a patient who may not have 11 or more tender points (as the number set by the original criteria) but who has sufficient symptom severity may still meet diagnostic criteria for FMS. As with the original classification criteria, the patient must also have been having symptoms for at least 3 months and alternative diagnoses must be

ruled out, but there is no longer a physical examination or tender point count palpation required for diagnosis. Instead, points are added on the WPI and SS. If scale scores fall into parameters established (WPI ≥ 7 and SS ≥ 5 or WPI between 3 and 6 and SS ≥ 9), the patients meet criteria necessary for FMS diagnosis. The importance of having the new scales means that symptom severity (as measured in levels of fatigue, cognitive symptoms, and a variety of somatic symptoms), ignored with the original diagnostic criteria, is now included as part of the diagnosis. These new criteria were found to accurately diagnose FMS 88.1% of the time without having the physician palpate for tender points or conduct a physical exam (Wolfe et al., 2010).

Wolfe et al. (2010) suggested that this new set of criteria would be especially helpful in those patients who were previously diagnosed with the original classification criteria (this was the case for 25% of the sample in the Wolfe et al.'s study), but no longer meet those criteria. Rather than eliminating the original classification criteria, the new set of criteria could be used to follow existing FMS patients on a long-term basis, as a way of monitoring their symptoms over time, according to its creators. Interestingly, in this iteration of the diagnostic criteria, a mood variable was going to be added to the SS scale (it was originally one of the six most important variables considered for the SS), but was ultimately discarded. Though indications of mood were found to be strongly correlated with the SS ($r = 0.73$), the researchers determined it was not a "primary feature of the illness" (Wolfe et al., 2010, p. 608); instead it may be a result of living with FMS (Wolfe et al., 2010).

Oncu, Iliser, and Kuran (2013) determined that the 2010 criteria were significantly more sensitive at diagnosing FMS than the original 1990 criteria, both upon receiving the initial diagnosis of FMS as well as when following up with patients a year later. The researchers recruited participants ($N = 100$) who had experienced chronic, diffuse pain for over 3 months (but who had not previously been diagnosed with FMS). After ruling out other medical disorders and excluding those with symptoms of major depression, participants were evaluated using both sets of criteria three times; at baseline (before receiving treatment), following the third month of receiving treatment, and after one year. At the time of initial diagnosis, the two sets of criteria were in concordance in only 49 of the cases. This number then fell to 25 at the one-year follow-up. Oncu et al. (2013) further determined that the discordance in diagnostic agreement was largely derived from tender point counts and scores on the symptom severity (SS) scale. The researchers argued that FMS is "more than just body pain and tender point count" (p. 441) and that if the 1990 criteria continue to be used for diagnosis, this could result in patients being under-diagnosed and therefore untreated.

2011 modification of criteria for research purposes. These criteria were modified once more in order to make assessment more useful for survey research or for epidemiological studies. The new criteria do not require a physician or interviewer as the scales are administered to the patient in questionnaire form (The Fibromyalgia Survey Questionnaire [FSQ]; Häuser & Wolfe, 2012; Wolfe et al., 2011). This assessment tool continues to measure a WPI, in which patients report how many areas of their bodies were painful over the previous 7 days (range of scores is 0 to 19) but the SS score has

been changed somewhat. Severity scores for fatigue, cognitive symptoms, and waking unrefreshed are tallied for the prior 7 days, and added to that score is the total of how many times in the past 6 months patients have experienced headaches, abdominal discomfort, and depressive symptoms. It is important to note that this is the first of the criteria sets to include depression in the diagnostic criteria. Scores necessary for diagnosis are WPI $\geq$ 7 and SS $\geq$ 5 or WPI falling between 3 and 6 and SS $\geq$ 9 (Wolfe et al., 2011). However, Wolfe et al. (2011) cautioned that this new set of criteria should not be used for patients to diagnose themselves and that it is still necessary to receive a formal diagnosis through their physicians. Diagnosis can be made using any one of the sets of criteria discussed. One is not meant to be a substitute for another. Rather, the set of criteria should be used that is most relevant to the specific circumstances. As discussed above, this 2011 modification of the criteria may be most helpful in research studies, so that a physician examination is not necessary (Wolfe et al., 2011). For initial diagnoses, it may be most helpful to use either the original 1990 criteria or the 2010 criteria. However, for the purpose of monitoring FMS patients over time, the 2010 criteria may be more useful (Wolfe et al., 2010).

Treatment

To date there is no cure for FMS, and there is no one treatment that effectively alleviates all symptoms. Additionally, because FMS is manifested in varying ways, with varying symptom sets and varying severity of symptoms from individual to individual, the optimal treatment strategy is likely to be one that is tailored to each individual. This tailored, multi-modal treatment plan would ideally treat the pain as well as other

problematic symptoms in order to produce the most beneficial patient outcomes. Though medication is one important tool frequently used to manage some symptoms of FMS, adding other types of treatments and making lifestyle modifications can more completely address the entire spectrum of symptoms (ACR, 2010; Bellato et al., 2012; Evans, Parthan, & Le, 2006; Mease, 2005; Mease et al., 2009; NFA, 2009; Tse et al., 2010; Turk et al., 2008).

Pharmacological strategies. Pharmacotherapy for the treatment of FMS has typically been used to manage pain levels, aid patients in obtaining restful sleep, and help to control symptoms of anxiety and depression. As such, FMS patients are frequently prescribed multiple medications, such as analgesics, antidepressants, and sleep-aids (White et al., 2009). During the course of treatment, medications may be changed frequently and used in varying combinations in order to gain the most therapeutic effects.

With the exception of tramadol (a mild opioid), opioids are generally contraindicated for the treatment of pain associated with FMS. It is thought that these types of pain relievers may result in paradoxically making the pain even more severe and making the patient increasingly sensitive to painful stimuli (ACR, 2010). Patients using opioid analgesics may also run the risk of abuse or dependence (Evans et al., 2006; White et al., 2009). Therefore, opioids should only be prescribed after all other pain remedies have been explored and found lacking (Evans et al., 2006). Despite this guidance, White et al. (2009) found that the prescription of opioids as analgesics was prevalent in FMS patients. They observed that 39.5% were prescribed opioids in the time period leading up to diagnosis, 43.3% following FMS diagnosis, and 43.9% in established FMS patients.

Similarly, Palacio et al. (2010) found that opioids were the most frequently prescribed pain medications for FMS patients both before and after receiving the FMS diagnosis.

Some medications prescribed for FMS act on the neurotransmitters serotonin and norepinephrine (neurotransmitters associated with the pain response). These include such medications as duloxetine, milnacipran, amitryptiline, cyclobenzaprine, venlafaxine, fluoxetine, paroxetine, or sertraline (ACR, 2010). Other commonly prescribed medications for FMS act to block the nerve cells' heightened response to pain signals. These include pregabalin and gabapentin. Unfortunately, all of the various prescribed medications for FMS pain have potentially deleterious side effects. Patients may also be advised to take over-the-counter pain relievers such as acetaminophen or non-steroidal anti-inflammatory drugs (NSAIDS), or may even have some areas of localized pain treated with injections of lidocaine (ACR, 2010; NFA, 2009). Currently, however, there are only three medications approved by the U.S. Food and Drug Administration (FDA) specifically for use with FMS: duloxetine (*Cymbalta)*, milnacipran (*Savella*), and pregabalin (*Lyrica;* Bellato et al., 2012).

Psychological interventions. As psychological factors may contribute to the exacerbation of symptoms, increased emotional distress, and increased disability associated with chronic pain, psychological treatment strategies have frequently been used as part of interdisciplinary treatment regimens for these patients (Kerns, Sellinger, & Goodin, 2011). Though psychological treatments do not completely ameliorate the pain, they may help individuals adapt to chronic pain and other related symptoms (Turk et al., 2008). They have also been shown to be helpful in reducing pain (both in the short-term

and in the long-term), improving life functioning, reducing symptoms of depression, improving sleep patterns, and in reducing catastrophizing thoughts (Glombiewski et al., 2010).

Overall, psychological intervention outcomes for FMS have been shown to be as effective as other medical interventions for pain (Glombiewski et al., 2010). These complementary treatments may include strategies such as biofeedback, cognitive behavioral therapy (CBT), hypnosis, guided imagery, or mindfulness meditation (Kerns et al., 2011; Turk et al., 2008). The most promising psychological treatments are CBT (Turk et al., 2008) and biofeedback (Glombiewski et al., 2010). For example, patients with FMS receiving CBT compared to controls (FMS patients receiving treatment as usual) reported increased pain reductions and increased overall functioning; these outcomes were sustained until a follow-up 9 months later (Woolfolk, Allen, & Apter, 2012). Glombiewski et al. (2010) conducted a meta-analysis ($N = 23$ studies) of psychological interventions for FMS. They found that CBT had the highest effect sizes of the studies reviewed, and that it outperformed other psychological interventions with regards to reducing pain in the short-term. They also found that biofeedback treatments were helpful in reducing problems with sleep quality in FMS patients. Glombiewski et al. concluded that it might be most helpful to combine CBT with biofeedback to address both pain and sleep quality.

Biofeedback may also be potentially helpful in reducing other FMS symptoms. Babu, Mathew, Danda, and Prakash (2007) administered biofeedback to 15 FMS patients. Compared to a group of control participants (15 FMS patients receiving sham

biofeedback), those receiving biofeedback reported significantly lower pain levels and significantly fewer numbers of tender points. Guided imagery may be another useful tool for managing some symptoms of FMS, but study outcomes have been mixed (Verkaik et al., 2014). For instance, Menzies, Taylor, and Bourguignon (2006) conducted a 6-week long guided imagery intervention with FMS patients. Participants ($N = 48$) were randomized to either a treatment as usual group or a guided imagery group. Though pain levels did not differ significantly between groups at the conclusion of the study, those participating in guided imagery reported significantly improved functioning and significantly higher ratings of self-efficacy in their ability to manage their pain ($p = <0.01$) compared to those in the treatment-as-usual group (Menzies et al., 2006).

On the other hand, Verkaik et al. (2014) did not observe any significant positive effects of guided imagery treatment in individuals with FMS. As in the Menzies et al. (2006) study discussed above, pain intensity did not differ significantly between fibromyalgia patients participating in guided imagery sessions compared to control group participants not participating. There was also no significant change over time within subjects over the course of the study (26 days). In addition, and in contrast to Menzies et al.'s outcomes, no significant differences were observed between the groups relating to functional status or pain-related self-efficacy. Verkaik et al. (2014) suggested that the lack of significant findings might have been related to factors such as the timing of pain ratings (participants rated their pain only once per day, at night). They proposed that findings might have been different if the ratings had been taken closely in time to when the guided imagery sessions took place.

Additionally, in Verkaik et al.'s (2014) study, the guided imagery sessions used a combination of positive imagery and direct focus on the pain perceived by participants. The researchers suggested that if they had simply focused on positive imagery and did not refer to pain intensity in the sessions, it might have made a quantifiable difference in the outcomes. Finally, Verkaik et al. speculated that their study might not have been long enough (4 weeks) to observe significant improvements. Though the participants doing guided imagery did not appear to have any objectively measured improvements compared to the control participants, 85% of them reported that they would recommend it to others and 96% of them reported that they found it useful for daily living (Verkaik et al., 2014). In their meta-analysis of the use of hypnosis and guided imagery for FMS, Bernardy, Füber, Klose, and Häuser (2011) found that overall outcomes tentatively supported a reduction in pain severity. However, they concluded that there were too many methodological concerns in the studies reviewed to draw any firm conclusions.

Mindfulness meditation has also been tested as a potential treatment for FMS symptoms. The three studies reviewed for this investigation yielded mixed outcomes. Sephton et al. (2007) investigated the influence of mindfulness meditation on symptoms of depression in FMS patients. They randomly assigned FMS patients to either an 8-week mindfulness-based stress reduction (MBSR) group ($n = 51$) or to a control group assigned to a waiting list for treatment ($n = 40$). Participants were assessed for depressive symptoms at baseline, post-treatment, and again two months later. At the conclusion of the study, those in the MBSR group reported significantly improved depression ratings compared to those in the control group, and those improvements were sustained at the

two month follow-up (Sephton et al., 2007). Similarly, positive outcomes from the use of mindfulness meditation with this population were also found by Cash et al. (2015). Cash et al. assessed participants on several measures: stress, pain, fatigue, quality of sleep, physical functioning, symptom severity, and salivary cortisol. As with Sephton et al.'s (2007) study discussed above, participants in Cash et al.'s study were randomized to either an MBSR group (n = 51) or a control group waiting for treatment (n = 40), and they were assessed at baseline, at the end of the study (8 weeks), and again two months later. Though no significant differences were observed between the groups in terms of pain, cortisol levels, fatigue, or in physical functioning, the MBSR group did evidence significant improvements compared to the control group in terms of perceived stress, sleep quality, and severity of symptoms, and these improvements continued through to the 2-month follow-up (Cash et al., 2015)

On the other hand, Schmidt, Grossman, Schwarzer, Jena, and Naumann (2011) did not find support for the use of mindfulness meditation with FMS patients. In their study, 177 FMS patients were randomized to either an MBSR group, an alternative control intervention (primarily relaxation exercises and stretching movements), or to a waitlisted control group and they were assessed for overall health related quality of life (HRQoL). All three groups evidenced significant improvement in HRQoL at the conclusion of the study, but there were no significant differences between the groups, indicating there was no advantage to the MBSR training for these patients (Schmidt et al., 2011). Schmidt et al. also conducted some secondary analyses with these patients, investigating 16 other variables such as pain, sleep quality, anxiety, depression, etc. Of

the secondary analyses, the researchers found only two significant outcomes—and of those, the only significant finding relating to the MBSR group alone was that those in the MBSR group reported themselves higher in mindfulness than the other two groups. The other significant outcome was that anxiety was significantly reduced in both active treatment groups compared to the control, waitlisted group.

Other complementary and alternative therapies. Some symptoms of FMS might be eased with the use of alternative treatments such as acupuncture, massage, or yoga (ACR, 2010). Langhorst, Klose, Musial, Irnich, and Häuser (2010) conducted a review of randomized, controlled studies ($N = 7$) testing the effectiveness of acupuncture for FMS. They found a significant reduction in pain across all studies ($p = .04$), but follow-up studies did not show this effect to hold up over time ($n = 2$). Additionally, acupuncture did not appear to have positive effects on any other FMS symptoms besides pain. No serious adverse events were reported, but aversive side effects (such as nausea, feeling sore from the needle, or experiencing an exacerbation of FMS symptoms) were reported in three of the studies reviewed (Langhorst et al, 2010). Langhorst et al. systematically rated the studies reviewed for potential sources of methodological bias and found that the most significant pain reductions were observed in those studies with the highest bias potential. The most methodologically rigorous study they reviewed did not demonstrate a significant reduction in pain. Though the overall reduction in pain finding appeared promising, Langhorst et al. concluded that there were too many methodological concerns and potential sources of bias in the studies reviewed to allow them to recommend acupuncture with confidence as a sole treatment for FMS.

Massage therapy has evidenced some potentially positive outcomes with FMS. In a review of the available research, Tsao (2007) found that massage was more beneficial than other types of treatments (e.g., transcutaneous electrical nerve stimulation [TENS], sham TENS, and progressive muscle relaxation) in three of the four studies they reviewed. These benefits included reduced symptoms of anxiety and depression, reduced pain severity and stiffness, less fatigue, and better sleep. However, in one of the studies reviewed by Tsao (Alnigenis, Bradley, Wallick, & Emsley, 2001), initial outcomes appeared promising, but at the conclusion of the study, no significant differences were observed between study groups. Alnigenis et al. (2001) investigated the use of Swedish massage versus standard medical care (randomly assigned) with 37 individuals with FMS. At 4 weeks, those receiving Swedish massage treatments showed improvement in self-efficacy and mobility compared to those receiving standard care, but at the conclusion of the study those differences were no longer observed and there were no other significant differences in treatment outcomes between the groups. Alnigenis et al. (2001) suggested this might have been due to the very small sample of participants (total $N = 16$; there were only four patients receiving the massage therapy, six receiving treatment as usual, and six receiving treatment as usual plus a call from a nurse). Additionally, in one of the studies Tsao (2007) reviewed (Brattberg, 1999), it was revealed that the benefits of massage therapy (in this case, it was connective tissue massage, administered over a 10 week period) do not appear to be long lasting. In Brattberg's (1999) study, participant outcomes included a 37% reduction in pain levels, improvements in depressive symptoms, reduced use of pain relievers, and improvements

in quality of life scores. However, within 3 months following the treatment, only 70% of the pain reduction remained, and within 6 months, only 10% of the reductions in pain were maintained, suggesting a potential need for maintenance massage treatments to sustain therapeutic gains (Brattberg, 1999).

In a more recent randomized, controlled study, Castro-Sánchez et al. (2011) also demonstrated some helpful benefits of massage therapy in FMS patients. Over the course of 20 weeks (one 90-minute treatment per week), they used myofascial release therapy on the participants, focusing on the eighteen tender point sites. Similar to improvements found in the review discussed above, Castro-Sánchez et al. found massage helped to significantly reduce pain and anxiety in FMS patients (n = 30) compared to FMS patients receiving sham treatment (n = 29). Massage therapy also led to significantly increased sleep quality as well as significant improvements in life quality. However, at the 6-month follow-up only improvements in sleep remained (Castro-Sánchez et al., 2011).

The practice of yoga also appears to provide some therapeutic benefits for FMS patients. It has been shown to significantly reduce pain severity ratings (Curtis, Osadchuk, & Katz, 2011; Da Silva, Lorenzi-Filho, & Lage, 2007), and to significantly improve overall scores using the Fibromyalgia Impact Questionnaire (FIQ; Da Silva et al., 2007). This scale, the FIQ, an assessment tool developed by Burckhardt, Clark, & Bennett (1991) assesses the impact of FMS symptoms across several areas of functioning, to include physical symptoms such as pain, fatigue, and stiffness as well as measures of subjective well-being, anxiety, and dysphoria.

Additionally, in a meta-analysis of 16 studies testing varying methods of alternative and complementary movement interventions (e.g., tai chi, yoga, qigong, Pilates) with FMS patients, Mist, Firestone, and Jones (2013) found a significant positive outcome overall (14 of the 16 studies reported significantly positive outcomes) in terms of improvements in pain ratings and overall functioning. Throughout all the studies reviewed, Mist et al. only found two reports of increased pain in participants (one reported planter fasciitis exacerbation and one reported increased shoulder pain severity). Other than those two specific examples, there were no reports of aversive side effects or "serious adverse events" (across all of the studies) related to the exercise interventions (Mist et al., 2013, p. 258). In contrast to these positive findings, though, FMS patients interviewed by Arnold et al. (2008) for a phenomenological study frequently noted that physical activity seemed to make their pain more severe. It appears, then, that some caution may be necessary before these patients embark on a treatment involving physical activity.

Most of the studies of nonmedical treatments for patients with FMS have been small pilot studies or have lacked control groups and randomization. To fully understand their effectiveness, larger, more rigorous trials are called for (Terhorst, Schneider, Kim, Goozdich, & Stilley, 2011). Although many studies have shown some potentially therapeutic benefits, it is not likely that any one alternative treatment in particular could feasibly replace more traditional therapies. If alternative treatments are used in conjunction with traditional treatment regimens, though, additional relief from some FMS symptoms might be obtained (Sueiro, Estévez, Ayán, Cancela, & Martin, 2008).

Patient self-management strategies. FMS patients may also benefit from adopting some self-management strategies. Self-management "refers to the individual's ability to manage the symptoms, treatment, physical, and psychosocial consequences and life style changes inherent in living with a chronic condition" (Barlow, Wright, Sheasby, Turner, & Hainsworth, 2002, p. 178). The implementation of self-management strategies is helpful in encouraging patients to become actively involved in managing their conditions (Iversen, Hammond, & Betteridge, 2010). Using these strategies may also assist with addressing symptoms that may not be completely targeted with other treatments and may help increase patients' physical functioning (Jones, Kindler, & Liptan, 2011). For example, patients may engage in activities geared toward reducing stress such as engaging in consistent physical exercise or stretching, meditative practice, or deep breathing techniques (ACR, 2010). Kelley, Kelley, and Jones (2011) conducted a meta-analysis of exercise studies with FMS patients. Overall (across both aerobic and strength training interventions) exercise significantly reduced tender point scores. The researchers suggested that engaging in regular exercise might help reduce pain and tenderness in this population (Kelley et al., 2011). In another meta-analysis, Häuser et al. (2010) reviewed aerobic exercise studies with FMS patients. They found that the most optimal outcomes for FMS patients were observed when they exercised 2 to 3 times a week (at a "slight to moderate intensity") for at least 4 to 6 weeks, and improvements were more likely to persist if the patients continued participating in aerobic exercise activities (p. R87). Significant improvements were observed in pain level, fatigue, and

fitness level. Additionally, depressive symptoms were significantly reduced and health related quality of life measures were significantly improved (Häuser et al, 2010)

Another potentially useful self-management tool for FMS patients includes practicing good sleep hygiene (e.g., going to bed at the same time every night, wearing earplugs, soaking in a warm bath before bed, etc.). Quality sleep is important in facilitating emotional and physical symptom repair and sleep disturbances are common in FMS (ACR, 2010; Jones et al., 2011). For instance, Theadom, Cropley, and Humphrey (2007) found that 99% of the FMS participants in their study ($N = 101$) reported poor sleep quality, including such problems as waking up frequently throughout the night and waking up feeling unrefreshed. Poor sleep quality in their study was significantly associated with increased pain and fatigue and significantly associated with poorer social functioning. Similarly, Wagner, DiBonaventura, Chandran, and Cappelleri (2012) found that FMS patients ($n = 2196$) reported significantly more trouble with sleep quality than matched control participants without FMS ($n = 2194$). In Wagner et al.'s (2012) study, 63.05% of their FMS participants reported two or more different types of problems with sleep quality.

It may also be empowering and helpful for patients to educate themselves about FMS. In this way, they can become more proactive in their treatment and are able to more easily explain their condition to others (ACR, 2010). In addition, FMS patients may benefit from attending individual counseling sessions or interacting with others in FMS support groups (NFA, 2009). Support groups tend to be seen as helpful in general by those attending. Of the active participants attending support groups for FMS and chronic

fatigue syndrome (CFS), 80.4% reported that attending meetings was helpful to them (Friedberg, Leung, & Quick, 2005). In addition, Barker (2008) found that postings on a popular fibromyalgia electronic support group were useful in validating for participants that FMS was a true medical condition. This validation was also reported by FMS members attending an in-person support group (Friedberg et al., 2005). Barker (2008) also found that the exchanges in the group helped empower participants to be more assertive in their relationships with their physicians, finding solidarity against those in the medical community who disregarded FMS as a mental condition. Those attending a traditional support group also reported learning beneficial information about their disorder (there were typically guest speakers at each meeting) and feeling an increased sense of understanding from others (Friedberg et al., 2005).

Costs Associated With FMS

Health care resources. The economic burden associated with FMS is significant. In the U.S., overall yearly costs are estimated to be between $12 and $14 billion (NFA, 2009). In a cross-sectional, retrospective study, Sicras-Mainar et al. (2009) reviewed claims for primary care in an insurance database, and found that those patients with FMS (1,081 out of a total of 63,526 patients) "used significantly more health care resources than the reference population and had more sick leave, and the percentage of subjects with premature retirement was also significantly higher ($p < 0.001$ in all cases)" [Sicras-Mainar et al., 2009, p. 1]. In another retrospective study, Berger, Dukes, Martin, Edelsberg, and Oster (2007) compared 33,176 FMS patients to an age and sex-matched group of non-FMS patients over a year (data were acquired from an insurance plan

database), and found that FMS patients' health care costs were about 3 times higher. Berger et al. (2007) also found that they visited the doctor 4 times as often, were 4 times more likely to need emergency room services, and were significantly more likely to have other comorbidities (e.g., mood disorders, sleep disorders, or irritable bowel syndrome.

In a retrospective observational study assessing the healthcare utilization costs of patients newly diagnosed with FMS ($N = 2613$), Sanchez et al. (2011) found that patients' health care costs increased during the 12 months prior to diagnosis, and then more steeply increased in the first six months following diagnosis (averaging $3481 for the six-month period). The researchers then followed the patients for three years following the diagnosis. During that time, costs stabilized, and then increased again—to an average of $3588 over the final six months they followed the patients. Interestingly, only 8% to 10% of these costs were from medications prescribed specifically for pain. This suggests a good proportion of health care costs may come from the various comorbidities associated with FMS, and not from costs directly related to FMS (Sanchez et al., 2011).

Berger et al. (2010) found that in the year leading up to a FMS diagnosis, patients (N =1803) averaged 20 visits to physicians for various medical complaints. Health care costs were also shown to rise by an average of $1725 over a 2-year period (the year leading up to the diagnosis and the year following diagnosis). Similarly, White et al. (2009) also saw health care costs rise significantly from the year prior to diagnosis ($5180) to the year following diagnosis ($6921). In contrast, those with established FMS diagnoses incurred medical expenses averaging $6673. This suggests that overall health

care expenses may level off after the diagnosis of FMS is established. However, White et al. (2009) found that prescription costs continued to increase across all groups, therefore driving health care costs even higher. In addition, following diagnosis of FMS, patients significantly increased visits to various health care providers (including primary care physicians, chiropractors, rheumatologists, and mental health professionals).

Similarly, Palacio et al. (2010) compared insurance data of FMS patients with that of matched controls (each group had 9,988 patients). They found similar outcomes to the studies discussed above. Those with FMS had significantly higher health care costs, particularly during the 12 months before receiving the diagnosis and in the first six months following diagnosis; mostly due to increased numbers of office appointments, increased numbers of laboratory tests, and increased prescriptions to control pain symptoms (Palacio et al., 2010). Even more support for the economic burden of FMS was found by Lachaine et al. (2010) in their retrospective cohort study using Canadian health care plan data. They found that FMS patients accumulated 30% more in yearly health care costs than matched controls (N =16,010 for both groups) without FMS (C$4065 versus C$2766). This translated into C$1299 more in yearly costs per FMS patient. To illustrate the substantial costs involved, the researchers calculated that in the cohort they studied, that added up to C$20,796,990. Lachaine et al. suggested that applying this finding to a U.S. population would drive the cost even higher because of the increased cost of health care provision in the U.S. These significant costs in health care utilization by FMS patients emphasize the necessity for more scientific inquiry regarding FMS in order to lead to increasingly efficacious treatments (Spaeth, 2009). When symptoms

become better targeted and FMS becomes better managed, health care costs should be reduced (Palacio et al., 2010).

Occupational. Having FMS can significantly impact occupational activities and productivity while on the job, leading to monetary losses for both employers and employees. A common theme reported by FMS patients in a focus group study ($N = 48$) was difficulties with occupational status. While nearly half of the sample reported leaving the job force completely, others reported needing to work fewer hours because of their symptoms or that they frequently switched jobs (Arnold et al., 2008). Additionally, Choy et al. (2010) interviewed 800 FMS patients, and found that 48% of those who were employed missed at least 10 days of work in the prior year due to their symptoms. Sicras-Mainar et al. (2009) found that 81% of economic losses related to an FMS diagnosis were due to losses in earnings (e.g., missing work or retiring early). Losses in productivity and days on the job as well as increases in health care costs were also observed by Kleinman et al. (2009). Compared to employees without FMS and those with OA, employees with FMS had the highest costs related to prescription medications, the most absentee days due to illness, and the highest costs due to workers' compensation claims (Kleinman et al., 2009).

In another study, Howard et al. (2010) investigated a group of patients with chronic disabling occupational musculoskeletal disorders (CDOMD) receiving rehabilitative treatment. Following a year-long treatment program, the patients in the group who met criteria for FMS (23.2%) were "5.6 times less likely to return to work and 2.7 times less likely to retain work" than those who did not have FMS (p. 1190). Those

numbers were even higher for the women with FMS in the group. They were "9.6 times less likely to return to work and 4.3 times less likely to retain work" (p. 1190). Those with FMS were also more likely to evidence psychological distress, report symptoms of depression, lower quality of life, increased perceptions of disability (Howard et al., 2010).

Interpersonal. FMS may negatively impact an individual's relationships. For instance, people with FMS may feel as if others do not understand or as if they discount the validity of their diagnosis because it has no outward signs (Juuso, Skär, Olsson, & Söderberg, 2011). FMS patients also report having reduced social interactions with friends and family due to the limitations placed on them by their condition (Arnold et al., 2008; Lempp, Hatch, Carville, & Choy, 2009). Caregiver responsibilities are also frequently compromised in these patients, with many of the tasks of providing care for children, as well as other daily household chores, falling on other family members (Arnold et al., 2008).

FMS has also been associated with sexual dysfunction in intimate relationships (Bazzichi et al., 2012; Prins, Woertman, Kool, & Geenen, 2006; Rico-Villademoros et al., 2012). For example, compared to healthy male and female control participants (n = 86), Rico-Villademoros et al. (2012) found that fibromyalgia patients (both male and female; n = 293) reported significantly higher rates of sexual dysfunction (86.9% versus 23.6%). Bazzichi et al. (2012) conducted a review of the extant literature (35 journal articles) regarding this topic, and found that FMS patients frequently had difficulty with their sexual relationships. Though some of the articles they reviewed had conflicting

outcomes on some measures, one consistent finding was that FMS patients reported low measures of sexual satisfaction. A decrease in sexual desire was also a frequently reported problem in this population. Some potential factors discussed that may contribute to reduced desire in these patients include the presence of depressive symptoms, localized pain syndromes (such as vulvodynia or interstitial cystitis), or the side effects of medications used to treat FMS symptoms (Bazzichi et al., 2012).

Interestingly, in their review of the literature Bazzichi et al. (2012) found the chronic pain experienced by these patients to have only a moderate association with sexual dysfunction. In other studies, they observed that the pain either played no role in sexual dysfunction or only had a weak relationship. In one of the studies they reviewed, Prins et al. (2006) found that psychological distress (and not pain) significantly predicted sexual dysfunction. Prins et al. concluded that the problems these patients tend to have with desire and satisfaction appear to be more strongly related to psychological disturbance than to actual physiology.

Psychological Functioning

Though FMS is not a psychological disorder, psychological variables may act to trigger symptom flare-ups, exacerbate existing FMS symptoms, and may also be associated with increased disability (Bennett, 2009; DeLeo, 2006; Verbunt, Pernot, & Smeets, 2008). For example, 83% of FMS patients who took part in an Internet survey (*N* = 2,596) reported that experiencing emotional distress worsened their symptoms. Other psychological factors noted by FMS patients that exacerbated symptoms included mental stress and worrying (Bennett et al., 2007). Verbunt et al. (2008) found that mental health

was the most significant predictor ($p < .02$) of perceived disability in FMS patients and was a stronger predictor than physical functioning ($p < .05$). These patients also reported significantly greater psychological distress compared to other chronic pain patients (patients with chronic lower back pain or chronic regional pain syndrome, $p < .01$) [Verbunt et al., 2008]. Bennett (2009) asserted that in some cases patients might not be able to attain relief from the mental distress and pain until the psychological factors are addressed.

FMS patients are likely to have comorbid psychiatric diagnoses (González, Elorza, & Failde, 2010; Hassett et al., 2008; van Middendorp, Lumley, Jacobs, Bijlsma, & Geenen, 2010). Uguz et al. (2010) found the prevalence of any Axis I disorder (American Psychiatric Association, 2013) in their sample of 103 FMS patients was 47.6% compared to 15.7% in 83 socio-demographically matched control participants. The most common Axis I diagnosis observed in Uguz et al.'s study was major depressive disorder—14.6% compared to 4.8% in controls and to an estimated 7% in the general population (American Psychiatric Association, 2013). Uguz et al. also found increased rates of Axis II (American Psychiatric Association, 2013) disorders in their sample of FMS patients compared to the controls—31.1% versus 13.3%. The most commonly observed personality disorder in the FMS patients in Uguz et al.'s study was obsessive-compulsive personality disorder—23.3% versus 3.6% of controls. This was a much larger percentage than that found in the general population estimate of between 2.1% and 7.9% (American Psychiatric Association, 2013).

Symptoms of depression that may not meet full criteria for diagnosis are also frequently observed in FMS patients. For example, in a study of 60 FMS participants, fully half of the sample reported symptoms of depression, and 33% of those reported moderate to severe symptoms (dos Santos et al., 2012). Similarly, Aguglia et al. (2011) found that 83.3% of their sample of FMS patients ($N = 30$) evidenced depressive symptoms, while 46% of them evidenced depressive symptom severity consistent with the diagnosis of major depressive disorder. Those participants reporting depressive symptoms also reported reductions in quality of life, increased pain severity ratings, and increased incidence of stressful life events compared to those without depressive symptoms.

This is important, because even though FMS patients with depressive symptomology may not meet the full criteria for diagnosable depressive disorders, having those symptoms would still have the ability to negatively impact their functioning. In addition, depressive symptoms are associated with greater disability (Phillips & Stuifbergen, 2010), reductions in pain thresholds and quality of life measures (Aguglia et al., 2011), and more severe pain ratings (Baker et al., 2008) in these patients.

FMS patients have also been found to have higher rates of depression than other chronic pain patients. Wolfe and Michaud (2009) found that 33.4% of FMS patients had depression compared to 15.1% of RA patients. Similarly, Hassett, et al. (2000) found significantly higher rates of depression in FMS patients compared to RA patients (nearly 44% versus 19.9%). In another investigation, Ozcetin et al. (2007) compared FMS patients with RA and knee OA patients. They found 41% of the FMS patients exhibited

depression compared to 26.50% of RA patients and 26.30% of knee OA patients. FMS patients in their study also evidenced lower quality of life scores in the domains of "physical role, emotional role, pain, general health, vitality, and social functioning" compared to RA and knee OA patients (Ozcetin et al., 2007, p. 128).

In Aguglia et al.'s study (2011), they concluded, "depressive symptoms are more the rule than the exception in patients with fibromyalgia" (p. 265). The first explanation for this they discussed was that depression might be a response to having a disorder such as FMS, which is chronic and impairs functioning. However, that would not explain why FMS patients have increased rates of depression compared to other patients with severe and chronic diseases. The second potential explanation they discussed was that perhaps depression was already present and produced the FMS symptoms. Aguglia et al. rejected that explanation as well, stating that it does not explain why some FMS patients never develop depressive symptomology. The more likely explanation for these authors is that depression and FMS likely "share overlapping pathophysiological processes" (Aguglia et al., 2011, p.264; Maletic & Raison, 2009). Maletic and Raison (2009) suggested that individuals may have similar genetic predispositions that are activated by risk factors. In their words,

> Chief among environmental risk factors are psychosocial stress and illness, both of which promote, in vulnerable individuals, relative resistance to glucocorticoids, increased sympathetic/decreased parasympathetic activity and increased production and release of proinflammatory mediators. Dysregulation of stress/inflammatory pathways promotes alterations in brain circuitry that

> modulates mood, pain and the stress response. Over time, these functional changes likely promote disruptions in neurotrophic support and disturbances of glia-neuronal communication. These changes, in turn, have been associated with the related processes of central sensitization in pain disorders and "kindling" in depression, both of which may account for the progressive and self-perpetuating nature of these disorders, especially when inadequately treated. (p. 4292)

Raphael, Janal, Nayak, Schwartz, and Gallagher (2004) found some potential evidence for this genetic underpinning. They had four groups of participants: 1) those who had both FMS and major depressive disorder (MDD), 2) those with FMS only, 3) those with MDD only, and 4) those who did not have either FMS or MDD. They then interviewed first-degree relatives of the participants and found that "rates of MDD in the relatives of probands with FM but without personal histories of MDD were virtually identical to rates of MDD in the relatives of probands with MDD themselves."(Raphael et al., 2004, p. 449). Labeling FMS a depression spectrum disorder, Raphael et al. concluded that FMS and depression are part of the same affective spectrum, and that FMS may present as a manifestation of the genetic risk for depression.

Symptoms of anxiety are also commonly observed in FMS patients. In Dos Santos et al.'s study (2012), 88% of their sample of FMS patients ($N = 60$) reported experiencing anxiety symptoms. Severe symptoms of anxiety were reported in 43% of the participants. Posttraumatic stress disorder (PTSD) also appears to be a frequent comorbid diagnosis with FMS (Peres, Gonçalves, & Peres, 2009). For example, in a sample of male patients ($N = 124$) who had experienced combat-related trauma, 49% of

those meeting the criteria for PTSD (n = 55) also met criteria for FMS (Amital et al., 2006). This was in contrast to only 5% of those diagnosed with major depressive disorder (n = 20) and with 0% in control participants (n = 49). In addition, symptoms of PTSD were significantly more severe in those with comorbid FMS. Symptoms of PTSD (though not meeting the full criteria) were also observed in 40.9% of dos Santo et al.'s (2012) participants.

Amital et al. (2006) attributed the development of FMS in these patients to the already present PTSD symptoms. They suggested that the distress that results from a traumatic life event and the subsequent development of PTSD might contribute to the later development of "ill-defined pain syndromes" (p. 667). They went on to propose that PTSD and FMS "might be driven from a common origin reflecting different aspects of adaptive behavior and somatization to an initiating traumatic event" (Amital et al., 2006, p. 667).

Coping With FMS

Considering that fibromyalgia patients tend to receive only moderate benefit from medical interventions for their multiple symptoms, it is important to consider how they manage to "cope with a life encumbered with chronic pain and fatigue" (Traska, Rutledge, Mouttapa, Weiss, & Aquino, 2011, p. 632). In their qualitative study, Traska et al. conducted a group interview with eight female fibromyalgia patients regarding the strategies they used to cope with their multiple symptoms. An important theme discussed was the need for pacing themselves and planning activities in advance. The participants wanted to avoid overdoing it or taking on more than they could handle for fear of

exacerbating symptoms or triggering a flare. This included such things as prioritizing tasks to be sure to complete the most important ones, seeking help with some of the more arduous tasks, and limiting their social activity participation. This also included making modifications as necessary to make tasks easier to complete, such as using a shower chair instead of standing in the shower to conserve energy, and avoiding known symptom triggers such as cold water and being out in chilly weather. These participants also noted that it was important to keep physically moving. They reported feeling physically restless, and that it helped to remain in motion (though not through exercise). Social support was also reported as being important for coping in Traska et al.'s participants. Some of the participants reported that they attended support groups and that it helped to share experiences with others who truly understood. Another theme that arose in their interviews was the use of mind and body methods to aid in coping. This included relaxation strategies such as meditation or listening to soothing music, distraction activities such as writing in a journal, singing, etc., and using biofeedback and breathing techniques to gain some control over physiological processes. Traska et al. (2011) suggested that these techniques may have been helpful because they either redirect the focus from the pain and other symptoms to the new activity, or because they redirect the focus to another physiological activity (such as with the use of biofeedback).

Sim and Madden (2008) conducted a meta-synthesis of qualititative studies (N = 23 studies reviewed) related to the subjective experiences of fibromyalgia patients. Some of the strategies that emerged in their meta-synthesis were similar to those discussed above in Traska et al.'s (2011) study. These included pacing activities, planning in

advance, limiting social activities, and seeking assistance from support groups. Other types of strategies discussed include working on thinking in a more positive manner, redefining one's self-identity, developing a more complete understanding of FMS, and reevaluating one's life and roles. However, in their meta-synthesis, Sim and Madden also found that emotion based (e.g., challenging aversive thoughts or feelings) and problem based (e.g., actively addressing challenges presented by FMS) coping methods had variable success, and were sometimes unhelpful. The individuals' responses to such coping strategies were idiosyncratic and it remained "unclear why some use such strategies effectively, whilst others struggle to cope" (Sim & Madden, 2008, p. 64).

It is important to identify strategies that offer the most optimal outcomes with FMS patients in order to improve treatment regimens in this population (Rodero et al., 2011). Rodero et al. investigated behavioral coping strategies and measures of pain acceptance in 167 FMS patients. They found that the acceptance of pain (e.g., continuing to function and carry out tasks in spite of symptoms) was significantly associated with more favorable outcomes in terms of reduction of symptoms, distress, life impact, and improvement in functioning. Interestingly, the coping strategies of resting and guarding—geared toward reducing FMS impact and symptoms and avoiding distressing thoughts and feelings, were shown to be associated with "poorer general functioning" (p. 146). Rodero et al. concluded that acceptance-based strategies might assist patients with adapting to FMS.

Similar themes were expressed by FMS patients in two narrative review studies relating to FMS patients' experiences with FMS (Juuso et al., 2011; McMahon, Murray,

Sanderson, & Daiches, 2012). Juuso et al. (2011) interviewed 15 FMS patients. When discussing their experiences with FMS and how they managed their lives with it, they reported that they learned to adapt to their symptoms and continued with the tasks of daily life despite the pain. Though they did not specifically state that they had accepted the pain, they did express that they had become able to live with the pain, and had come to a place of acceptance that this was the way life was going to be for them. They continued as many of the activities in their lives as was physically possible. They also reported that it was important for them to remain optimistic and to think positively (Juuso et al., 2011). Similarly, some of the participants with FMS (n = 10) in McMahon et al.'s narrative review study tended to report pushing past the symptoms and attempting to continue performing their daily tasks in order to fulfill role obligations. Others reported scaling back activities so as to not over exert themselves and increase their symptoms. Participants in McMahon et al.'s study also spoke of the importance of positive thinking and accepting their limitations.

Theadom et al. (2007) investigated the influence of coping strategies on health-related quality of life in fibromyalgia patients (N = 101). Participants reported which types of coping strategies they used most often (problem-focused vs. emotion-focused strategies). Only one aspect of health-related quality of life—physical functioning, was predicted by the use of a particular coping method. They found that the use of restraint coping (a problem-focused strategy that involves "delaying coping or not managing a stressful situation in some way") was significantly associated with reduced physical functioning (p. 149). Though the researchers did not offer an explanation for why this

may be so, they suggested that in individuals with FMS, putting off coping with a certain situation until a better time may be "detrimental to physical functioning" (Theadom et al., 2007, p. 149).

Ablin, Cohen, Neumann, Kaplan, and Buskila (2008) compared the coping styles of 77 patients with FMS to 48 healthy volunteer control participants. They found that the FMS patients were significantly more likely than the controls to engage in the coping strategies of suppression (avoiding the stressor), help-seeking (asking others to assist), replacement (finding alternative ways of fulfilling duties), substitution (engaging in activities geared toward reducing stress), and reversal (behaving in a way contrary to how one is actually feeling). These strategies were not compared to any health outcomes, so it is unclear how and to what extent they impacted the patients with FMS. However, Ablin et al. explained that more passive, avoidant strategies of coping such as suppression, replacement, and substitution (three of the strategies FMS patients engaged in significantly more than controls) tend to be related to maladaptive outcomes. They suggested that it might be useful to use cognitive treatment strategies to address and modify the coping strategies used by these patients.

Theories of Pain

Gate Control Theory

In order to understand how laughter may be related to affect and pain perception, it is important to first have foundational knowledge regarding the available theories about pain. Developed in 1965, the gate control theory of pain was the first to consider psychological factors and the central nervous system's relationships with the pain

experience (DeLeo, 2006; Melzack, 1999b; Melzack & Wall, 1965). Until that time, and dating back to Descartes in the 1600s, pain was thought to be more of a reflex response with a direct relationship between the noxious stimulus and the pain or injury. It was assumed that there was a particular pathway from the site of the stimulus (pain receptor) to a centralized pain center located in the brain and that the pain would be ameliorated if the pathway was cut. However, managing pain in this way may not lead to relief at all. Instead, cutting the nerves of the pathway sometimes enhanced the pain even further, leading to a chronic pain state (DeLeo, 2006). Because a direct stimulus-pain relationship was assumed, those presenting with chronic pain with no observable physiological signs of disease or injury were commonly referred for psychiatric care (Melzack, 1999b).

With the gate control theory, emphasis was placed on the roles of the spinal dorsal horns (where incoming stimuli were managed) and the brain (now considered an active and dynamic modulator of the pain experience) in the objective and subjective components of pain (Melzack, 1999b). It was proposed that there were neural gates that could be opened or closed by both information coming from sensory experiences as well as from signal transmissions from the brain (Melzack, 2008). In this way, psychological components such as "attention, emotion, and memories of prior experiences" could influence and modify the sensory input received (Melzack & Wall, 1965, p. 976). Though some pain can come on suddenly and be overwhelming and out of an individual's control (like the pain that comes with a heart attack), other types of pain may be subject to some individual influence. Melzack and Wall suggested that in those cases any intervention that reduces the sensory input might reduce pain. This could include

distracting oneself by thinking of other things or using other strategies to control pain levels. As an example, they cited the case of a man who reduced his pain through tapping "his fingers on a hard surface" (Trent, 1956, as cited in Melzack & Wall, 1965, p. 978). Psychological variables became more important to the pain process and led to new ways of thinking about how to manage pain. The focus switched from "cutting nerves and pathways" to relieve the pain to finding other treatments designed to modify the sensory input (Melzack, 1999b, p.880) and to alter the individual's perceptions of pain (Kerns et al., 2011).

Neuromatrix Theory

Despite the advances in our understanding of pain with the development of the gate control theory, phenomena like phantom pain experienced by individuals with amputations or paralysis and chronic pain in the absence of observable stimuli or injury (or with the pain response being disproportionate to the stimuli) remained perplexing for pain researchers (Melzack, 1999a; Melzack, 2005). In chronic pain syndromes, the pain itself is the disease, rather than a warning to the individual that injury is or will be occurring. It is an indication that something has malfunctioned within the neural mechanisms responsible for the pain warnings (Melzack, 2001).

To Melzack, this was evidence that the "brain itself can generate every quality of experience, including pain, which is normally triggered by sensory input" (Melzack, 1999b, p. 881). From these observations and further research, Melzack went on to expand on the concepts in the gate control theory and developed a new conceptualization of pain he titled the neuromatrix theory (Melzack, 2001). Regarding this new conceptualization,

Melzack (2001) stated, “good theories are instrumental in producing facts that eventually require a new theory to incorporate them. And this is what has happened (p. 1378). He went on to state that the neuromatrix theory “does not negate the gate theory”, but explained that the gate control theory did not explain well the experiences of phantom limb pain patients, and a new theory was necessary to more completely address these types of experiences (Melzack, 2001, p. 1378). Melzack proposed that pain is produced from a “neural network in the brain”, which is susceptible to multiple types of influences and stimuli (Melzack, 1999b, p. 880; Melzack, 2005). Melzack suggested that the neuromatrix’s structure is mostly brought about through the influence of genes, but that the expression of it will be modified by our experiences and various inputs (Melzack, 1999b; Melzack, 2005).

An important tenet of the neuromatrix theory is that the sensory input from a noxious stimulus (that causes pain and injury) is only one of the potential sources of input that can lead to the experience of pain (the output from the neuromatrix; Melzack, 1999b). According to this model, there are many dimensions in the perceptual experience. It is assumed that each dimension is managed by a certain subset of nerve cell networks within the neuromatrix (Melzack, 2005). Among these are the sensory dimension as well as the cognitive and affective dimensions (Melzack, 2005). The sensory dimension includes the stimuli from musculoskeletal and body tissue inputs; the cognitive dimension involves such inputs as the meaning attributed to pain, pain-related anxiety, or previous associations of pain experience; and the affective dimension is related to the emotional experience of pain along with the body’s attempt to maintain

homeostasis through the regulation of the stress response system (Melzack, 2005). Important to the affective dimension of the neuromatrix is the limbic system of the brain, which "evokes the essential motivational-affective dimension of pain" (Melzack, 1999b, p. 882).

Neuromatrix and Chronic Pain

Melzack (1999b) suggested that it is not a single particular sensory input that creates the chronic pain response. Rather, it is the "output of the neuromatrix" that leads to the perception of pain (p. 882). "Stimuli may trigger the patterns but do not produce them" (Melzack, 2005, p. 86). Melzack stated that "the neuromatrix, which is spontaneously active in the absence of sensory input, and which integrates multiple inputs from body and brain, provides a plausible explanation for the majority of chronic pain syndromes" (p. 882). "The brain does more than direct and analyze inputs; it generates perceptual experience even when no external inputs occur" (Melzack, 1999b, p. 883).

Melzack (2005) suggested that perhaps the neuromatrix is alerted when something stressful happens (e.g., a virus, an injury or accident, or a psychological stressor) but malfunctions and continues to remain alerted after the stress has passed. The constant state of arousal in the neuromatrix may lead to fatigue symptoms as well as to increased muscle tension (which may then be responsible for the characteristic tender points found in FMS). In essence, it is as if the neural gates are continuously open to be on guard against threats, causing a constant level of physiological stress. As the body attempts to regain a homeostatic state, cortisol is released in large quantities. If the pain state

continues, the cortisol continues to be pumped out, and eventually leads to it being depleted. This depletion is associated with symptoms such as muscle weakness and fatigue. It may also lead to bone decalcification and neural degeneration (Melzack, 2001). Because the chronic pain process appears to be related to a failed effort at regaining homeostasis instead of actual sensory inputs triggering the pain, it could help explain why traditional pain therapies geared toward managing stimulus driven pain do not work effectively with chronic pain syndromes (Melzack, 2001).

McAllister (2015) suggested that treatments for chronic pain, then, should focus on changing the neuromatrix in order to reduce pain in these patients. In order to change the neuromatrix, treatment should involve an interdisciplinary approach in order to target several dimensions of the pain experience. For example, in addition to conventional medical therapies and physical therapy, these patients should also receive interventions and education from health psychologists and cognitive behavioral therapists. In this way, the patient is also reducing the impact of cognitive and affective inputs on the pain experience (McAllister, 2015).

Laughter

Though laughter has been demonstrated to have positive influences on many varying physiological markers and conditions, it has yet to be used as a formal treatment in medical settings (Dolgoff-Kaspar, Baldwin, Johnson, Edling, & Sethi, 2012). For example, laughter is associated with an increase in the production of beta-endorphins and human growth hormone (HGH), not only during the actual laughter, but also in the anticipation of laughter. These beneficial changes in neuropeptides and neuroendocrine

functioning brought about by laughter may help reduce stress levels and may be accompanied by improvements in affect (Berk & Tan, 2006).

In terms of medical conditions, laughter is frequently used to enhance coping in cancer patients (Christie & Moore, 2005). Johnson (2002) interviewed nine breast cancer survivors and found that a common theme among them was that laughter helped them to cope with their diagnosis. They also reported that it became easier over time to find humor in their situation, and that laughter helped them to relax and persevere through their treatment and recovery. Also, in a cross-sectional, survey study of breast cancer patients, Lengacher et al. (2002) found that 21% of their sample ($N = 105$) reported using humor or laughter therapy to help them reduce stress. In a more formal use of laughter with breast cancer patients, Kim, Kim, Kim, Lee, and Yu (2009) found that laughter therapy (four sixty-minute group sessions over two weeks) significantly decreased measures of stress, depression and anxiety in those receiving laughter therapy ($n = 31$) versus those in the control group ($n = 29$).

Laughter has also been found to reduce levels of blood prorenin (a receptor gene implicated in the progression of kidney disease) and to decrease plasma renin (high levels are associated with injury to small blood vessels) in diabetic patients, potentially providing some protection against microvascular problems and the progression of diabetic nephropathy (Hayashi, Urayama et al., 2007; Nasir et al., 2005). Laughter has also been shown to modulate the physiological stress markers in patients with advanced kidney disease receiving hemodialysis treatment (Bertini et al., 2010) as well as in a healthy sample of adult males (Toda, Kusakabe, Nagasawa, Kitamura, & Morimoto,

2007); and it has been found to have several potentially beneficial effects on immune system functioning (Bennett, Zeller, Rosenberg, & McCann, 2003; Berk, Felten, Tan, Bittman, & Westengard, 2001; Hayashi, Tsujii et al., 2007; Matsuzaki, Nakajima, Ishigami, Tanno, & Yoshino, 2006).

More recently, Kong et al. (2014) tested laughter therapy on patients with breast cancer undergoing radiation therapy. Those in the experimental group receiving laughter therapy (n = 15) reported less severe pain and had a lower incidence of more severe radiation dermatitis than those in the control group (n = 19), but the results were not significant. However, the researchers found that the participants in the experimental group tended to have larger breasts and had increased incidence of diabetes compared to the participants in the control group, and those factors are related with increased risk of experiencing more severe radiation burns. Despite their increased risk of radiation dermatitis, they still reported less pain and observed lower incidence of more severe burns. Kong et al. suggested that this provided additional strength to their findings despite the results not reaching the level of statistical significance. Because this was simply a small pilot study, the researchers proposed a larger, randomized study to test this further.

Laughter appears to have many beneficial effects on health. However, in one study, Lebowitz, Suh, Diaz, and Emery (2011) found that the physical act of laughter was actually shown to worsen patients' physical status. It was found to lead to lung hyperinflation in patients with chronic obstructive pulmonary disease (COPD). However, Lebowitz et al. also found that having a positive emotional state had protective effects in

terms of life quality and psychological factors. The researchers concluded, "…less overt expressions of humor may be more favorable than overt laughter in patients with COPD." (p. 318). In contrast, Brutsche et al. (2008) found that only those COPD patients laughing the most intensely suffered any deleterious effects (increased hyperinflation of the lungs). Those who laughed less intensely demonstrated a beneficial reduction in lung volume and reported higher ratings of cheerfulness.

Similarly, Kimata (2004) found that laughter did not negatively influence patients with bronchial asthma. Kimata conducted two investigations with two sets of participants. In the first study, they tested 20 individuals with asthma triggered by dust mites (compared to 20 healthy participants without asthma), and in the second they tested 15 participants with asthma triggered by epigallocatechin gallate (EGCg; a component found in green tea leaves) compared to 15 healthy participants without asthma. Each group had baseline measures of allergen responsiveness taken and then were randomly assigned to watch a humorous or non-humorous film. Immediately following the film, participants were exposed to the allergen and bronchial responsiveness was measured. Two weeks later, participants watched the other video, and the same procedure was followed at the conclusion of the film. All participants were noted to be laughing during the humorous film, while none of the participants were observed laughing during the non-humorous film. Kimata found that laughter not only did not appear to aggravate asthma, but it acted to significantly decrease responsiveness to asthma triggers.

Laughter has also evidenced beneficial effects on patients with atopic eczema (Kimata, 2007a, 2007b, 2009). It has been shown to decrease the production of

immunoglobulin E (IgE) by seminal cells (providing potential protective effects against allergy responses affecting reproductive functioning), to increase the production of melatonin in nursing mothers with infants affected with atopic eczema (it also resulted in reductions in the infants' allergic responses), and has been found to increase the production of dermicidin-derived peptides in the sweat of patients with atopic eczema (enhancing antimicrobial protection; Kimata, 2007a, 2007b, 2009).

Simulated laughter (as part of a laughter yoga intervention) has also been shown to improve heart rate variability and mood in both healthy participants (Sakuragi et al, 2002) as well as in patients waiting for organ transplants (Dolgoff-Kaspar et al., 2012); and it has been shown to have positive effects on vascular function (Sugawara, Tarumi, & Tanaka, 2010). Additionally, among older adults, laughter therapy has produced improvements in levels of anxiety and depression, cognition, sleep, feelings of subjective wellbeing, and quality of life (Ganz & Jacobs, 2014; Ko & Youn, 2011). It may also provide some therapeutic benefits to those with Alzheimer's disease or dementia (Takeda et al., 2010; Walter et al., 2007).

Laughter's Influence on Pain

Laughter and induced acute pain. The effects of laughter on pain have typically been investigated using healthy study participants and have tended to be conducted in the laboratory where both the laughter and the pain (acute) were induced (Dunbar et al., 2011; Mahony et al., 2001; Stuber et al., 2009; Zweyer et al., 2004). Though the circumstances were artificially created, the outcomes were fairly consistent in providing

evidence that laughter is beneficial in reducing some of the deleterious effects of acute pain.

In an older study of induced laughter and acute pain (through the use of a blood pressure cuff), Mahony et al. (2001) investigated the influence of expectations on discomfort thresholds following the viewing of either a relaxing (a film about Hawaii) or funny (an episode of *Seinfeld)* video. Study participants (nonclinical volunteers from the community) were either led to believe that viewing the videos would reduce or increase their pain thresholds. A control group watched the videos without any instructions on what to expect. Following the viewing of the videos, participants rated them. The funny video was rated as significantly funnier (and nearly every participant in the funny video condition rated the video as funny) than the relaxation video, and the relaxation video was rated as significantly more relaxing than the funny video. In addition, each participant in the funny video condition was observed laughing on at least one occasion during the viewing (Mahony et al, 2001).

Overall, both the relaxing and funny videos increased participants' discomfort thresholds (they could tolerate the blood pressure cuff squeezing their arms for longer periods of time) from baseline. When looking at the influence of expectations, Mahony et al. (2001) found that those who expected their pain threshold to decrease did exhibit lower discomfort thresholds than those in the control group, whereas those who expected their pain threshold to increase did not evidence a significant difference from the control group. Mahony et al. suggested that might be due to culturally implicit expectations that laughter and relaxation will increase pain thresholds. Those in the control conditions may

have already expected their discomfort thresholds to increase following laughter or relaxation without being instructed.

An important finding of Mahony et al.'s (2001) study for the purposes of this current research is that scores on sense of humor measures were not associated with discomfort thresholds. Whether or not participants were high on the humor trait scale, there was significant concordance from them on how funny the *Seinfeld* episode was. This indicates that the benefits of laughter are available to anyone, not just those who measure higher on the humor trait scale. Though Mahoney et al. found that relaxation and laughter had similar effects on discomfort thresholds in this study, they suggested that laughter may have a qualitative benefit over relaxation, in that, "It is fairly safe to assume that most people in pain would prefer a laughter intervention, particularly one of their own choosing, over relaxation exercises, hypnotism, or reading a brochure arguing the benefits of a particular program" (p. 225). The researchers went on to speculate that laughter's unique qualitative benefits may be due to such factors such as resulting "…enhanced mood, physiological and emotional arousal, altered perspective, and increased sense of control" (Mahony et al., 2001, p. 225)—all factors that have yet to be investigated by researchers.

In another example, Dunbar et al. (2011) conducted a series of six experiments studying laughter's effects on induced acute pain tolerance. Five of the studies took place in a laboratory environment, while the sixth one took place in a public setting. In these studies, laughter was induced through either the use of a comedy video or through a live comedy show with actors, and pain was induced through a frozen wine-sleeve, a blood

pressure cuff, or a "ski exercise" (participants having their backs against a wall while bending their knees until they formed 90° angles). A baseline measure of pain tolerance was taken for each participant before each experiment and then once more following the experiment to assess for within-person differences. Dunbar et al. proposed that if increases in pain tolerance were observed following laughter, that would be an indication of increased endorphin levels brought about from the act of laughing. To test the possibility that changes in pain tolerance could be brought about through laughter-related affect changes rather than through the physical act of laughter alone, the researchers also measured affect in two of the studies. Laughter incidence was measured through one of the following methods: researcher observation and recording, recordings taken by tape recorders worn by the participants, or through participant self-report. Results showed that rates of laughter were significantly higher in the comedy video conditions than in control conditions. Pain tolerance was also found to be significantly higher in the comedy versus control video conditions. There was no direct effect of affect alone on pain threshold, which the researchers felt was increasing evidence for endorphins released during laughter being responsible for the changes in pain tolerance. They concluded that laughter itself and not affect was responsible for the increase in pain threshold. The researchers also found that those in comedy conditions that took place in groups evidenced even higher levels of pain tolerance than those in the funny video condition where they watched on their own. The researchers suggested, "Experiencing comedy in a group ramps up the laughter response, and this is reflected in a proportional change in pain threshold" (Dunbar et al., 2011, p. 3).

An increase in pain tolerance following the viewing of humorous video segments was also observed in a sample of 18 healthy children, ages 7 to 16 (Stuber et al., 2009). Before beginning the study, the researchers conducted a pilot phase in which they recruited 37 children (ages 7 to 13) to watch a series of five-minute-long video clips. During the clips, the researchers counted the frequency of laughs and following the viewing had the children rate how funny the videos were. They then decided which videos to use for the main study based on those that had consistently received the most laughs and highest funny ratings.

Stuber et al. (2009) then recruited 18 more children (they increased the age range to 16 due to the difficulty some of the children had with completing the rating scales during the first phase) to conduct the actual study. They used a cold pressor test to assess both subjective ratings of pain and tolerance (how long they could hold their hands in the cold water before taking them out). They were also asked to rate how funny they thought the videos were. In the first trial, baseline levels of pain intensity and pain tolerance were measured by having the children undergo a cold pressor test before viewing the videos. In the second trial, they watched funny video segments for 15 minutes, and then had the cold pressor test. In the final trial in Stuber et al.'s study, the children had the cold pressor test while they were engaged in watching the video (consisting of clips from the video they already watched once).

Pain severity ratings did not differ across conditions, but during and after the viewing of the humorous video segment the children were able to keep their hands in the cold water for significantly longer periods of time (increased pain tolerance).

Interestingly, frequency of laughter (raters coded all laughter episodes during the videos) did not appear to influence either pain severity or tolerance. Stuber et al. (2009) suggested that this might mean that watching something humorous can lead to an increased ability to cope with pain, but the increase in pain tolerance did not appear to be due to the physiological effects of laughter. This is in contrast to Dunbar et al.'s (2011) conclusions, discussed above, that laughter itself appears to be responsible for the increase in pain tolerance. However, in Stuber et al.'s (2009) study, the total length of time spent watching the funny video segment was only 15 minutes the first time (pain tolerance was measured directly following) and no longer than three minutes for the last trial, during which the children held their hands in the cold water during the viewing (three minutes was the maximum time the children could safely hold their hands in the cold water). Perhaps if there had been a longer segment, the outcomes would have been different. Laughter frequency was significantly associated with ratings of how funny the video was, but concordance rates for how funny the video was rated overall were not provided. The videos were chosen based on the ratings of children up to age 13, while the actual study was conducted with children up to age 16. It may be that some of the children in the study did not find the video segments as funny as those in the preliminary group. Perhaps the outcomes would have varied if the test sample had remained in the range of ages 7 to 13. However, the finding that pain tolerance was increased during the funny video intervention suggests that a humorous video (whether there is laughter or not) can provide a distraction for children who are enduring painful medical procedures (Stuber et al., 2009).

In yet another cold-pressor pain induced humorous video study, Zweyer et al. (2004) placed 56 healthy adult female participants into one of three conditions. The first group's instructions were to watch the video without smiling or laughing, but to "get into a cheerful mood" (p. 85); the second group was instructed to exaggerate their laughing and smiling reactions to the video; and the third group was instructed to produce a humorous commentary related to the video as it was shown. All groups reported significantly higher pain thresholds and tolerance immediately following the film (with no significant differences between them) and these ratings remained above baseline assessments when measured again 20 minutes later. On the other hand, though all three groups in Zweyer et al.'s study reported elevations in affect immediately following the film, those measures had already returned to baseline when measured again 20 minutes later. It would appear that pain effects might last longer than mood effects from watching a funny video.

Zweyer et al. (2004) conducted further within-group analyses and found that "facial enjoyment" (genuine smiles) was an important moderator of the pain effects. Those who engaged in more displays of facial enjoyment had significantly higher increases in pain tolerance and pain thresholds. This same effect was not observed with laughter, especially if the laughter was forced. The researchers suggested that the actual physiological act of laughter might not be as important as it is to find something genuinely funny. Zweyer et al. concluded that genuine enjoyment might be the key (with big smiles and lower intensity laughter) to maximizing the beneficial effects on pain threshold and pain tolerance. However, Zweyer et al.'s (2004) study did not also include

a control group that just watched the video and behaved normally. Each of their groups was instructed in how to behave during the viewing. It would have been interesting to note the differences between natural behavior during the video and the outcomes from the experimental groups.

Laughter and chronic pain. There have been few studies of the effects of laughter on chronic pain, and no studies were found that were focused specifically on FMS patients. However, Herschenhorn (1994) tested the use of focused laughter therapy with patients with the chronic pain of RA. Herschenhorn proposed that focused laughter therapy could help with pain by acting as a natural painkiller (releasing substances that act as opiates and binding to pain receptors), exercising the body's internal systems, releasing tension, and facilitating the release of anti-inflammatory hormones. In this therapy, participants were directed to focus on their pain (thereby causing a state of tension) and then laugh, which was expected to release the tension caused by focusing on the pain. Once the tension was relieved by laughter, it was expected that the body would then return to a state of homeostasis. Focusing on the pain became the trigger for laughter.

Herschenhorn (1994) placed eight female RA patients into two groups of four. The first group consisted of patients who had had RA for less than or equal to 5 years; and the second group consisted of patients who had had RA for at least 10 years. In each group, each participant was randomly assigned to one of four conditions: (a) control (no laughter therapy), (b) 30 minutes of laughter therapy, (c) 45 minutes of laughter therapy, and (d) 60 minutes of laughter therapy. For a week prior to the intervention, participants

recorded ratings of pain and how much the pain bothered them four times daily. The treatment intervention took place on the eighth day, with pre- and post-measures of severity and how much the pain bothered them. The participants then continued to rate their pain for the next 6 days. Herschenhorn also collected data pertaining to how many times each participant laughed (frequency) during the sessions, the intensity of the laughter, and how long each laugh lasted (duration).

Though the sample size in Herschenhorn's (1994) study was too small to be meaningfully analyzed quantitatively, her study did yield some promising information that could be used in testing larger populations of chronic pain patients. Though the findings were complex and it was difficult to make generalizations from them (each treatment condition only had one participant, and the results did not readily display obvious patterns), in general, it was found that half of the participants evidenced reductions in pain levels directly following the treatment. The rest of the participants also showed decreases in pain intensity within the following one to two days. Interestingly, two of the participants' pain levels continued to fall even further below their baselines past two days after treatment. Additionally, four of the six participants in the treatment conditions reported reductions in how much the pain bothered them directly following the therapy. The other two participants showed an increase in distress due to the presence of pain at first, but their scores began to decrease following the intervention and continued to do so over the next 48 hours. There was no effect from the treatment duration, and no differences were observed based on length of time since patients were diagnosed with RA. However, laugh intensity did show an effect with all treatment condition

participants. The results were idiosyncratic, however, with three participants showing reductions in pain intensity while the other three evidenced increases in pain intensity. In addition, four of the participants in Herschenhorn's study reported reductions in distress due to pain, while two reported an increase in pain-related distress as a function of laughter intensity.

Herschenhorn (1994) found partial support for the effects of the duration of laughter and the effects on pain levels. All eight participants experienced a change in pain levels after treatment (or no treatment, as was the case with the two control participants—which was attributed to the placebo effect), but not all of the changes reflected a decrease in pain. There was no clear trend in participant outcomes, but the participant in the first group (those with RA 5 years or less) with the longest duration of laughter reported the most improvement in pain after the treatment. However, over the next several days, pain levels climbed up again (though not to baseline levels). On the other hand, the participant with the longest duration of laughter in the second group (those with RA for at least 10 years) experienced an initial increase in pain following the treatment, but then her pain levels steadily declined over the next five days.

Based on these study outcomes, Herschenhorn (1994) was able to conclude that focused laughter therapy "does have an effect on RA pain and pain bothersomeness" and that "there is an additive effect of the frequency, intensity, and duration of laughter on pain intensity and pain bothersomeness over time" (p. 205). These findings, though preliminary, warrant a larger, more rigorous evaluation in order to be able to draw any

formal conclusions regarding the use of focused laughter therapy with chronic pain patients.

Though they did not study the specific effects of laughter alone, Tse et al. (2010) investigated the use of humor therapy with older persons with chronic pain who were residents of a nursing home. Compared to a control group of nursing home residents not participating in humor therapy (n = 34), those in the humor group (n = 36) evidenced significant decreases in pain intensity, significant reductions in feelings of loneliness, and experienced significant improvement in measures of happiness and life satisfaction. During the 8-week long study (1 hour per week), participants engaged in games and exercises designed to elicit laughter and also worked on projects geared toward increasing cheerfulness and humor. This included such things as telling jokes, sharing humorous life experiences, and creating collections of media participants found amusing. Based on study outcomes, it was concluded that humor therapy might be an "effective cognitive, non-pharmacological intervention in chronic pain management" (Tse et al., 2010, p. 5).

Laughter and Affect

There is a dearth of scientific literature about the influence of laughter on affect. One of the few studies found and reviewed for this study was conducted decades ago. Young (1937) collected data about the frequency of laughter in general and the types of stimuli that led to laughter in undergraduate students (N = 240). He found that laughter frequency was positively correlated with cheerfulness (r = 0.28). Young found that those who laughed more were more cheerful, and their laughter seemed to be related to social

stimuli (e.g., hearing someone tell a joke or laughing at the clumsiness of a friend). It has also been demonstrated that eliciting laughter may exert temporary effects on affect. Sakuragi et al. (2002) found that a sample of female undergraduate students reported significant, temporary mood improvements after watching funny videos that evoked laughter.

Mora-Ripoll (2011) posited that it may be possible to reap affective benefits of laughter even if the laughter is simulated or forced, in the absence of any type (social or otherwise) of humorous stimulus. An example of this was observed by Foley et al. (2002) when they conducted a forced laughter study with a group of college students. Participants were instructed to "laugh hilariously for one minute" (p. 184), and their moods were assessed before and after the minute of laughter. Foley et al. found there was a significant increase in positive affect from pre- to post laughter episode ($p < .01$). Mora-Ripoll (2011) suggested that, though an individual may cognitively be aware that he or she is engaging in simulated laughter, the effect may be the same. In addition, that simulated laughter may also lead to spontaneous and contagious laughter, which could then enhance any already existing laughter-related psychophysiological changes. On the basis of Foley et al.'s (2002) study outcomes, they concluded, "One may wonder if we may not be overlooking a powerful, readily available, and cost-free way to regularly boost the mood and psychological wellbeing of many adults" (p. 184).

In a follow-up study, Neuhoff and Schaefer (2002) compared the influences of forced laughing with howling (a vigorous vocalization to serve as an alternative to laughter in order to assess whether laughter is unique in its mood boosting effects) and

smiling on the affect of 22 adults recruited from a graduate school and the community. The forced laughter in both studies (Foley et al., 2002; Neuhoff & Schaefer, 2002) was engaged in alone, rather than in a group setting. The researchers were interested in controlling for any possible influences caused by the social setting of the laughter. Each participant engaged in all three activities for one minute each. Though howling was not found to have any significant effect on affective states, there were significant improvements in affect after smiling and laughing ($p < .01$ for both). However, there was a significantly higher increase in affect when the participants laughed than when they smiled (Neuhoff & Schaefer, 2002). This suggests that laughter may be used as an additive intervention at any time, without the need of a humorous set of circumstances or the need for a social setting.

One of the studies that served as inspiration for this study is older, but continues to be relevant. Kuiper and Martin (1998) instructed study participants from the community (a nonclinical sample) to record all instances of laughter for three days. They also rated their affect and reported their stressful life events during that time. The researchers found that although overall laughter frequency did not appear to directly influence affect (in contrast to Young, 1937), laughter was an important moderating effect of negative affect experienced from increasing numbers of stressful life events. Those who laughed more did not show as high an increase in negative affect as stressors increased compared to those who did not laugh frequently (Kuiper & Martin, 1998).

In a more recent study, laughter therapy was shown to significantly improve mood state among cancer patients going through radiation treatment. Kim et al. (2015)

randomly assigned cancer patients to an experimental laughter therapy condition (n = 33) or to a waiting list control group condition (n = 29). Those in the experimental condition participated in three 1-hour laughter therapy sessions daily for 3 days. Mood states were assessed before the beginning of the intervention and then again following the last laughter therapy treatment session. At the completion of the study, those in the laughter therapy intervention reported significant decreases in anger, tension, and depression and a significant increase in vigor compared to the control group. Kim et al.'s study was limited in that it did not assess for potential long-term effects of laughter therapy, but the positive outcomes on mood states suggests that laughter therapy may be a beneficial additive treatment for cancer patients while undergoing more conventional treatment.

Affect, Emotion Regulation, and Alexithymia

Affect

Though consistent relationships have been established in the literature between negative emotions and various medical conditions, there are fewer studies available detailing the influences of positive affect on physical health (Hassett et al., 2008; Zautra, Johnson, & Davis, 2005). Some researchers have demonstrated that in patients with chronic pain, positive affect may be an important tool in aiding the recovery from times of increased pain (Zautra et al., 2001; Zautra, Johnson, et al., 2005). However, when compared to others with different types of chronic pain conditions, individuals with FMS appear to have increased difficulty drawing from episodes of positive affect in order to mediate the aversive affective states related to their pain (Furlong, Zautra, Puente, López-López, & Valero, 2010).

For instance, Davis, Zautra, and Reich (2001) compared women with FMS (*n* = 20) to women with OA (*n* = 21). Participants in their study were either instructed to "relax quietly for several minutes" (p. 222) to induct a neutral emotional state, or were primed into a negative emotional state by the presentation of a sadness evoking scenario and being asked to imagine themselves experiencing it. Participants then discussed an upsetting interpersonal conflict for 30 minutes (creating a stress experience). Those FMS patients in the negative emotion priming condition demonstrated larger increases in pain severity compared to those with OA in the same condition, and their pain levels also remained elevated, while the other patients' pain levels returned to baseline. The researchers proposed that FMS patients may be especially vulnerable to pain exacerbations related to negative emotional states (Davis et al., 2001).

McAllister et al. (2013) surveyed 858 individuals with FMS. They found that both positive and negative affect were significantly associated with symptomology in their participants. Those with higher positive affect reported lower symptom burdens of FMS, while those reporting higher levels of negative affect reported increased symptomology. McAllister et al. proposed that finding ways to improve these patients' affect might have a beneficial impact on their symptoms.

Davis, Thummala, and Zautra (2014) compared depressed versus nondepressed chronic pain patients with OA (*n* = 38) or FMS (*n* = 72) on their ratings of pain and affect following a stress inducing task and a subsequent mood induction task (viewing either a neutral or a comedy video clip). All participants (both depressed and nondepressed) evidenced significantly higher levels of despondency affect following the stress inducing

task (recounting a stressful conflict with someone in their lives), and all evidenced significant declines in despondency following the mood induction condition (back to baseline levels). In addition, the positive affect state, joviality, declined significantly among all conditions during the stressful conflict task. However, there was a significant difference between depressed and nondepressed chronic pain patients on the recovery of joviality during the mood induction conditions. Nondepressed participants showed significant increases in joviality in both the neutral and positive mood induction conditions, but depressed participants only evidenced significant increases in joviality following the positive mood induction condition. Similarly, nondepressed participants' pain levels significantly decreased during both neutral and positive mood induction conditions, but depressed participants only saw decreases in pain levels during the positive mood induction condition. Unfortunately, there were not enough participants in the OA group for the researchers to compare findings across groups (FMS versus OA patients), so it is difficult to make generalizations to FMS patients alone based on these findings. However, Davis et al. (2014) suggested that nondepressed chronic pain patients in general might be able to naturally bounce back from stressful situations, whereas those with depression may need a strong positive affect stimulus to see such recovery.

Furlong et al. (2010) described positive emotions in FMS patients as assets they can harness to help mediate negative symptoms associated with their condition. In their study of fibromyalgia patients, they found that the presence of assets such as positive affect, self-efficacy with regards to coping with their condition, and the presence of an internal locus-of-control increased FMS patients' tolerance to thermal pain. Furlong et al.

argued that although prior research tended to focus on the influence of vulnerabilities (such as negative affect or stress) on FMS symptoms, their research demonstrated that assets also play a role in predicting how well those with FMS tolerate their symptoms and continue to function in their daily lives.

Additionally, in two separate studies, pain-related negative affect accounted for a significant proportion of the variance (25% and 19% respectively) for the pain intensity levels reported by FMS patients (Staud et al., 2004; Staud et al., 2006). Staud et al. (2004) assessed FMS patients ($N = 280$) for pain levels and pain-related negative affect (PRNA). PRNA in these patients was measured by having participants complete the Medical College of Virginia (MCV; Riley, Robinson, & Price, 2000) questionnaire. The PRNA component of this questionnaire asks patients to rate the severity of chronic pain related negative emotions on a scale of 0 to 100. Staud et al. (2004) also asked participants to use a diagram of the human body to shade in all of the body regions in which they were experiencing pain. Then they used a trained researcher to perform tender point examinations. PRNA was found to be a significant predictor of pain intensity. It accounted for 25% of the variance in levels of pain intensity. The participants' reported areas of local pain (shaded in on the diagram) accounted for 16% of the variance. On the other hand, the tender point examination only accounted for 4% of the variance. Staud et al. concluded that PRNA contributes significantly to FMS patients' perceptions of pain.

In a similar follow-up study, Staud et al. (2006) again found PRNA to be a significant predictor of pain intensity in FMS patients. In Staud et al.'s (2006) study, maximal and or average local pain levels (peripheral pain) accounted for 27% of the

variance in pain intensity; the number of body areas said to be painful (the participants again shaded all of the regions on their bodies where they experienced pain) accounted for 9% of the variance; and PRNA accounted for 19% of the variance. Because PRNA accounted for a significant proportion of pain intensity variance, treatments that aim to reduce accompanying negative affect may assist in enhancing pain relief.

Emotion Regulation

Emotion regulation refers to the influence individuals have over their own emotional lives. This includes not only what emotions they feel, but also at what times and in what manner they experience and express their emotions (Gross, 1998). Because emotions are paired with and influence the pain experience, emotional regulation may provide an important role in modulating the pain experience (Ruiz-Aranda, Salguero, & Fernández-Berrocal, 2010). Potential evidence of this relationship was observed in a prospective study of older adult patients ($N = 30$) in a rehabilitation hospital. Paquet, Kergoat, and Dubé (2005) assessed patients for measures of global and day-to-day emotional regulation and pain intensity. Those patients who more successfully managed their emotional states reported significantly lower pain intensity levels. Paquet et al. suggested that effective emotion regulation might enhance treatment outcomes for pain patients.

In another study, Ruiz-Aranda et al. (2010) investigated emotion regulation with a sample of female undergraduate students ($N = 177$). They assessed participants for emotional regulation and then subjected them to a cold pressor test to induce acute pain. In particular, participants were measured for their ability to "use positive thinking to

repair negative moods" (p. 565). Overall, those with high repair scores reported significantly lower levels of pain and lower levels of negative affect throughout the test than those with low repair scores. Additionally, those with high mood repair scores reported more positive affects before beginning the cold pressor test, and again following the test. This suggests that those with more ability to repair their moods evidenced less negative affect when being faced with a stressful pain-inducing task, and that they were "better able to reduce its emotional impact" (Ruiz-Aranda et al., 2010, p. 568). Another interesting finding in this study is that those who reported more positive affect before the test did not report significantly lower ratings of pain during the test, but they did report more positive affect during the test. It is possible that although they were feeling similar ratings of pain, they were not as bothered by it affectively than those with lower affect scores. Ruiz-Aranda et al. concluded that the ability to regulate emotions might delay the impact of negative emotions related to the pain experience.

Emotion regulation may therefore be an important factor in FMS patients' pain-related suffering. For instance, compared to medical controls (patients with resolved conditions or other chronic pain disorders), Hassett et al. (2008) found that FMS patients not only had increased incidence of negative affect, but they also had reduced incidence of positive affect, and more dysfunction in their styles of affective balance ("negative affect minus positive affect = affect balance"; p. 834). FMS patients were more likely to have reactive (high negative and high positive affect) or depressive (low in positive affect while high in negative affect) styles, and these dysfunctional styles were associated with

decreased ability to function and with the presence of comorbid mental disorders (Hassett et al., 2008).

Some of the most compelling evidence of affect dysregulation in FMS comes from a series of studies conducted by Zautra and colleagues (Finan et al., 2009; Zautra et al., 2001; Zautra, Fasman, et al., 2005; Zautra, Fasman, Parish, & Davis, 2007; Zautra, Johnson, et al., 2005). This present investigation is largely based on and modeled after these studies. In one of the initial studies, Zautra et al. (2001) investigated pain and affect in 89 individuals with FMS. For 30 days participants rated their affect and pain severity three times per day at random intervals. The researchers found that the presence of positive emotional states tended to significantly reduce the strength of the relationship between pain and negative emotional states. Interestingly, though, those participants who had higher on average positive affect scores did not fare better than those with lower on average positive affect scores. It appears that what was important in reducing the strength of the pain and negative affect relationship was having the positive affect episode take place within the day in which the pain was increased. Therefore, it's possible that even those individuals who tended to have lower affect ratings overall might still benefit from episodes of positive affect during times of increased pain.

Sustained positive affect may have protective effects against negative affect arising from increased pain or interpersonal stress. In another study conducted by Zautra, Johnson, et al. (2005), FMS and OA patients were assessed weekly for ratings of pain, affect, and the presence of interpersonal stressors. Though both OA and FMS participants reported significantly high ratings of pain and negative affect, FMS patients reported

significantly higher ratings of pain (p = .05) and stress (p = .027) than the OA patients. They also reported significantly lower ratings of positive affect than the OA patients (p = .001). Zautra, Johnson, et al. also found that "negative affect was highest during weeks when pain was high, interpersonal stress was high, and positive affect was low" (p. 215). In addition, when participants experienced weeks with elevated pain levels and increased stress, the strongest relationship was observed with negative affect. The researchers concluded, "A rise in positive affect not only lowers negative affect directly, but also blunts the effects of high pain and high interpersonal stress on negative affect." (p. 215). Interestingly, those participants with higher average positive affect ratings over the course of Zautra, Johnson et al.'s (2005) study tended to experience less of a rise in negative affect during weeks when they were experiencing increased pain or stress. This indicates that positive affect may be a possible resource to draw from when challenged with stress and increasing pain. Because there may be a possible deficit in FMS patients' ability to sustain positive affect, they may benefit from interventions targeted at increasing their overall affect. Zautra, Johnson, et al. pointed out that it was not that the patients had too much negative affect; instead they did not have enough positive affect stores available to buffer against increasing pain and stress.

In yet another study, Zautra, Fasman et al. (2005) again compared FMS patients to OA patients. Over the course of 12 weekly assessments, they found that those with FMS reported more severe ratings of pain and fatigue. Also, although there were no significant differences between the groups in levels of negative affect, the FMS participants reported significantly "lower levels of positive affect" (p. 147). This

difference was enhanced even further when participants reported increased interpersonal stress, indicating that FMS patients had more trouble holding on to positive emotions as stress increased. Based on these findings, Zautra, Fasman et al. proposed that a core symptom of FMS might be a decreased ability to regulate positive affect. They further suggested that this feature might uniquely differentiate FMS patients from other chronic pain conditions. The researchers concluded,

> If indeed the lack of positive affect contributes to the maintenance or worsening of this chronic health condition, then treatments that assist patients with FMS in broadening their emotional repertoire and increasing their capacity for positive emotion, especially during stressful times, may be particularly effective as a means of improving their condition. (Zautra, Fasman et al., p. 154)

Dysfunction in FMS patients' positive affect regulation was observed also in a study conducted by Finan et al. (2009). In this study, patients with FMS were compared to patients with OA, and also to patients who had comorbid FMS and OA. Participants were assessed once per day for ratings of affect and pain. FMS patients had reduced average positive affect ratings compared to the OA patients (trending toward significance, $p = .055$). They also experienced significantly more pain than the OA patients (but the pain ratings of the group of patients with FMS and OA were significantly higher than both the OA and FMS groups). In addition, the FMS and FMS and OA groups were more likely to report a loss of positive affect when negative affect was also present in the same day. The OA patients' positive affective states appeared less susceptible to being diminished by the presence of negative affective states. Finan et al.

explained this by suggesting that individuals with FMS have an impaired ability to "differentiate between the two affects" (p. 479). Additionally, compared to OA patients, the FMS patients in Finan et al.'s (2009) study showed increased negative affect and decreased positive affect in response to elevations in pain severity. This provides additional evidence for an impaired ability in these patients to sustain a positive affective state when also experiencing negative affect. The apparent deficit of positive affect in FMS patients was again observed in a study investigating fatigue in chronic pain patients (Zautra et al., 2007). Compared to patients with OA and RA, those with FMS showed a stronger relationship between low ratings of positive affect and daily fatigue. FMS patients seem to be particularly vulnerable to having difficulty with affective regulation compared to other chronic pain patients. Because FMS is difficult to diagnose (it is not readily revealed upon physical exams or laboratory tests like RA or OA) and treat, Davis, Zautra, and Smith (2004) suggested that the increased affective dysfunction observed in this population might be related to the increased uncertainty regarding their condition and the inability to predict symptomology.

Van Middendorp et al. (2008) also found evidence of significantly increased negative affect and reduced positive affect in FMS patients compared to control participants (women without FMS). In addition, negative affective states were associated with increased symptomology, while the opposite was true for positive affective states. In this same study, FMS patients also reported feeling their emotions more intensely than did the controls, and engaged in significantly more emotion-avoidance strategies, particularly endorsing items consistent with evidence of alexithymia (difficulty with

identifying one's affective state). Interestingly, though, "affect intensity was related to more severe pain only in combination with the inability to process or verbalize emotions, suggesting that the intense experiencing of emotions is not necessarily maladaptive as long as these emotions are adequately processed" (van Middendorp et al., 2008, p. 165). In contrast to the studies discussed above (Finan et al., 2009; Zautra et al., 2001; Zautra et al., 2007; Zautra, Fasman, et al., 2005; Zautra, Johnson, et al., 2005), van Middendorp et al. did not find positive affective states to be a mediator of the relationship between pain and negative emotional states in individuals with FMS.

Alexithymia

Alexithymia is a concept developed by Sifneos (1973) through his observations of patients with psychosomatic illnesses, and it generally refers to having a lack of emotional awareness, constricted emotional expression, and, in particular, having difficulties with identifying and describing emotions. Sifneos suggested that this inability to verbally describe their emotions was likely both psychological and neurophysiological in nature. Evidence for this suggestion may have been found by Kano, Hamaguchi, Itoh, Yanai, and Fukudo (2007). They conducted a study with 45 healthy participants. First, they assessed the participants for alexithymia using the TAS-20 (Bagby et al., 2013) and then during colonoscopy procedures subjected them to colonic distension (with varying amounts of pressure) to induce discomfort. Those who were alexithymic in Kano et al.'s study showed greater activation in several brain regions, produced more adrenaline, and expressed greater anxiety during the procedure than those who were not alexithymic. The

physiological hypersensitivity noted in these participants may partially explain how alexithymia can impact physical disease.

Though a prevalence study of alexithymia in the general population of the United States was not found in the literature search, a randomly selected and stratified representative sample of the Finnish population ($N = 1285$) showed an overall rate of 13%, with men significantly higher than women in alexithymia ratings—17% versus 10% (Salminen, Saarijärvi, Äärelä, Toikka, & Kauhanen, J., 1998). Alexithymia has been frequently observed in patients with chronic pain (Huber, Suman, Biasi, & Carli, 2009). For instance, Evren et al. (2006) found 39.2% of a sample of FMS participants were alexithymic, and Steinweg et al. (2011) found that 44% of the fibromyalgia patients in their study were alexithymic –compared to 8% in a group of general medicine patients and 21% in a group of RA patients.

Tooyserkani et al. (2011) assessed 100 patients with chronic musculoskeletal pain for alexithymia, affect, and pain intensity (participants reported their affect and pain levels over the week prior to the study). Some clear relationships were observed in the outcomes. Alexithymia was positively correlated with pain intensity ($r = 0.51$, $p = 0$ .001) and negative affect ($r = 0.51$, $p = 0.001$) and negatively correlated with positive affect ($r = -0.38$, $p = 0.001$). Tooyserkani et al. also observed that as positive affect increased, pain intensity decreased ($r = -0.67$, $p = 0.001$), and that experiencing positive affect acted to moderate perceptions of pain intensity. In addition, alexithymia and negative affect were significant predictors of pain intensity. However, this relationship between alexithymia and pain intensity was not found in a later study of chronic pain patients conducted by

Makino et al. (2013), but alexithymia was shown to be positively associated with negative affect in study participants. Though it was not found to predict pain intensity, alexithymia was significantly correlated with pain interference (how much the pain impacted the patients' daily lives) and pain catastrophizing (how frequently patients experienced ruminative pain-related thoughts, magnification of pain, and feelings of helplessness, as measured by the Pain Catastrophizing Scale; Sullivan, Bishop, & Pivik, 1995).

Martínez et al. (2014) compared 97 women with FMS to 100 sociodemographically matched, healthy women. They found those with FMS were significantly more likely to report having difficulties with both identifying and describing their emotions. The researchers went on to analyze the relationship between alexithymia and other clinical measures in the FMS participants. Two particular aspects of alexithymia—problems with identifying emotional states and problems with describing those states, were associated with reductions in sleep quality, increases in symptoms of anxiety and depression, fear related to the pain experience, and pain catastrophization. Difficulty in describing emotional states was also associated with increases in sensory pain, and increases in pain vigilance. Those who tended to catastrophize about their pain also tended to have increased anxiety. The researchers summarized their findings in this way:

> Our findings suggest that FM patients have difficulties identifying their affective states, differentiating them from other emotions or physical complaints, and expressing and communicating their feelings. These facets of alexithymia in

> interaction with negative pain appraisal (catastrophizing about pain and fear of pain) may contribute to the development of emotional distress (anxiety), which in turn is associated with more severe symptoms (increased pain experience and poorer sleep quality). Therefore, interventions that guide patients to acquire an adequate knowledge of their emotional experiences may improve their clinical condition. (Martinez et al., 2014, p. 20)

In another study with FMS patients ($N = 51$), Huber et al. (2009) found alexithymia to be associated with reduced pain tolerance, increased affective distress, and increased psychological distress in their initial correlational analyses. However, when Huber et al. conducted further multiple regression analyses, they found that when psychological dysfunction ratings were controlled, alexithymia no longer significantly predicted pain-related affective distress. This indicates that psychological dysfunction may be an important mediating variable in the effects of alexithymia. Evren et al. (2006) also found a relationship between alexithymia in FMS patients and measures of anxiety, depression, and other psychiatric symptoms. However, alexithymia was not related to pain severity in their sample. Evren et al. concluded that alexithymia appeared to be more closely related to psychopathology in FMS patients than it was to pain intensity.

Compared to patients with RA and to patients with other medical conditions than RA and FMS, Steinweg et al. (2011) found that patients with FMS had significantly higher rates of alexithymia (44% of the sample versus 8% for those in general medicine and 21% for those with RA). A strong relationship was observed between alexithymia and depression in the FMS participants. However, when the Steinweg et al. controlled for

depressive symptoms, the differences between the groups were no longer significant. FMS patients "may have problems expressing their feelings, particularly compared with patients with other medical conditions, and the comorbid state of depression is likely responsible" (Steinweg et al, 2011, p. 260).

Affect Induction and Pain Response

Researchers have effectively induced emotional states in the laboratory setting in order to observe their effects on pain responses and tolerance (Tang et al., 2008; Weisenberg, Raz, & Hener, 1998; Willoughby, Hailey, Mulkana, & Rowe, 2002). Weisenberg et al. (1998) used movies (humorous ones versus an account about the Holocaust) to elicit positive and negative emotional states. Serving as controls were a group who did not see any movie and a group who saw a neutral movie. The movies were varied in length (15 minutes, 30 minutes, and 45 minutes). Participants (volunteers from the community) were also subjected to a cold pressor test. The cold pressor tests took place before the film condition, right after viewing the movie, and again 30 minutes later. Results showed that those in the positive mood induction conditions showed significantly higher pain tolerance (left their hands in the cold water longer) and significantly lower ratings of pain—but, interestingly, these differences were only observed after the 30 minute delay, and the effects were only seen in the longer movies. The first two cold pressor tests showed no significant differences in pain ratings between the positive and negative mood induction conditions. Additionally, following the 30-minute delay, those participants who did not view a movie at all evidenced higher ratings of pain and reduced pain tolerance compared to the other groups (Weisenberg et al., 1998).

In another mood induction and cold pressor study, Willoughby et al. (2002) randomly assigned healthy undergraduate students to either a neutral mood state group, a depressed mood state group, or an elation mood state group. Mood induction was performed by having participants read a set of cards while being instructed to try to feel the emotion elicited by the cards. Immediately following the mood induction task, affective measures were quickly obtained. The induction task successfully elicited a depressed mood state, but was unsuccessful in eliciting an elated mood state, so Willoughby et al. compared the neutral and depressed mood state groups (n = 50). The participants were then subjected to a cold pressor test. Analyses following the test revealed that those in the depressed mood state group evidenced significantly lower pain tolerance (p = .05) as well as higher rates of catastrophizing about pain. In other words, the participants in the depressed mood state were unable to keep their hands in the ice water as long as those in the neutral mood state, and they also experienced more negative cognitions about the pain following the test (Willoughby et al., 2002).

A similar type of study was also conducted with a group of chronic lower back pain patients (N = 55). Tang et al. (2008) randomly assigned participants to one of three inducted affective state groups (depressed, neutral, or happy) and then measured pain levels and pain tolerance following a task designed to elicit pain. In this study, the researchers used music to induce mood, and the task to elicit pain was holding a "moderately-heavy shopping bag" (p. 394) for as long as they could. First, Tang et al. assessed participants for baseline measures of affect and pain. The participants then completed the task of holding the bag, and were then assessed again for pain. The mood

induction then took place, followed by a measure of affect and another rating of pain severity. They then held the bag for a second time, and were finally assessed once more for pain. Study outcomes were as the researchers predicted, "The induction of depressed mood resulted in significantly higher pain ratings at rest and lower pain tolerance, whilst happy mood resulted in significantly lower pain ratings at rest and greater pain tolerance" (Tang et al., 2008, p. 398).

In another emotion induction study, van Middendorp et al. (2010) compared 62 female FMS patients with 59 females from the general population without FMS (although they could have had other types of medical conditions). The researchers induced neutral states, as well as affective states of anger and sadness (through having participants recall episodes in their lives that continued to elicit such emotions). Following the emotion induction, pain was elicited through the use of electrical current, while assessing threshold and tolerance levels. Both the normal controls and the FMS patients evidenced significantly reduced pain thresholds and tolerance levels following both conditions as compared to a neutral state. This suggests that people in general (whether they have FMS or not) may experience a pain amplification response while in an aversive emotional state. Van Middendorp et al. noted, however, "Nonetheless, it is a clinically relevant finding that pain in the women with fibromyalgia was increased above an already high baseline level when anger and sadness were induced." (van Middendorp et al., 2010, p. 1374). This indicates that, for individuals who may already be in pain, aversive emotional states can serve to exacerbate pain levels to an even less tolerable level. Therefore, it seems to be important to address the incidence of aversive emotional states in FMS

patients as part of their treatment in order to minimize the amplification of pain. Importantly, the researchers did not induce any positive emotional states. Comparisons were only made between two negative emotional states and a neutral state. Outcomes may have been different if a positive emotional state induction had been added for comparison.

Emotion Intervention

No studies were found directly related to increasing positive emotion states in FMS patients. However, Hsu et al. (2010) conducted a psychosocial intervention with female FMS patients ($N = 45$) geared toward helping to increase their awareness of their emotional states. Each participant had one individual session and then met each week in groups for 3 weeks. Besides the group sessions, the participants also had daily exercises to complete. The treatment plan consisted of four components. The first was psychoeducational in nature, and assisted participants with understanding chronic pain and its biopsychosocial influences; the second component was 30 minutes per day of free-writing about stress and emotions experienced; the third component was designed to help participants become more aware of their moment to moment emotional states and to accept them without judgment (using a CD with guided exercises); and the fourth component was encouraging participants to reengage with activities they had stopped due to the impact of FMS pain. Participants were assessed prior to the study, again after 6 weeks, and once more at 6 months following the intervention. Compared to participants in the control group (participants were randomly assigned to intervention and control waitlist groups), those in the intervention group reported significantly lower pain levels

of pain severity both at the six-week and six-month assessments. More specifically, while none of the control group participants reported reductions in pain severity, 45.8% of the intervention group participants reported 30% or more improvements in pain ratings, and 20.8% of them reported improvements above 50%. Those in the intervention group also reported significantly increased levels of physical functioning, and higher pain thresholds at both post-study assessments. Importantly, Hsu et al. (2010) demonstrated that the effects from exercises geared toward increasing affective awareness and exploring the relationship between psychological and physiological processes could produce sustained improvements in pain and functioning in individuals with FMS.

Dynamic Model of Affect Theory

Zautra et al. (2001) developed the dynamic model of affect. The researchers proposed that during times of increased stress (such as when pain becomes more severe) or uncertainty, affective processing may become more simplified, resulting in reduced ability to differentiate between positive and negative affective states (Davis et al., 2004). The dynamic model of affect serves to explain how being able to experience and sustain positive emotions may be able to reduce the impact of negative pain-related emotion states (Zautra et al., 2001; Zautra, Johnson, et al., 2005), and increase patients' resilience to heightened pain and stress (Davis et al., 2004).

If these individuals also tend to have reduced positive affect in general, they become increasingly vulnerable to the deleterious impact of negative affective states during times of increased stress (Zautra et al., 2001). Zautra, Johnson, et al. (2005) suggested that the tendency for FMS patients to have lower positive affect overall may

help drive the "cycle of increased pain and negative affect so frequently observed in chronic pain conditions" (p. 216). They found that increased pain leads to increased negative affect and this was especially true for those with low average positive affect. Further, in the dynamic model of affect theory, the timing of the positive emotions experienced may be important, as positive emotions present during the actual time of increased pain may produce the most benefit to FMS patients in helping to modulate pain-related negative affective states (Zautra, Johnson, et al., 2005).

Considering the principles behind the dynamic model of affect, specific treatments could be used or developed that assist these individuals in increasing their ability to differentiate between positive and negative emotions, and in improving their ability to hold on to positive emotions even when their pain has worsened or if they are experiencing other stressors that could result in dominant negative affective states (Davis et al., 2004). It is my intention with this study to examine the principles in the dynamic model of affect theory as they relate to people with FMS. If increased laughter frequency is associated with higher levels of positive affective states and decreased pain levels, it is possible that positive affect (laughter) can mediate the relationship between pain and negative affect. In turn, that may potentially open the door to future research using laughter as a formal intervention with this population.

Discussion and Chapter Summary

In this chapter, the signs and symptoms of FMS and related syndromes were discussed, as well as the diagnosis of FMS, its treatment, and its related costs. A literature review pertaining to the topics of pain theories, laughter, and affect was conducted. This

concluded with a discussion of the dynamic model of affect—the theory that will be tested in the course of this study. Laughter has been shown repeatedly to have beneficial effects on acute pain (Dunbar et al., 2011; Mahony et al., 2001; Stuber et al., 2009; Zweyer et al., 2004), but there is less information available regarding its effects on chronic pain, and there are no studies found regarding laughter and the chronic pain that comes from FMS. In addition, the research available regarding laughter and affect also suggests it has a positive influence on emotional state (Foley et al., 2002; Neuhoff & Schaefer, 2002; Sakuragi et al., 2002; Young, 1937). Again, though, it has not been tested on affective states in individuals with FMS.

Individuals with FMS have difficulties with affect and emotion regulation (Finan et al., 2009; Zautra et al., 2001; Zautra et al., 2007; Zautra, Fasman, et al., 2005; Zautra, Johnson, et al., 2005), and experience alexithymic rates higher than that of the general population (Evren et al., 2006; Steinweg et al., 2011). On the other hand, positive mood induction studies have produced decreases in pain levels and increases in pain tolerance (Tang et al., 2008; Weisenberg et al., 1998; Willoughby et al., 2002). This leads to an important question: If we can induce mood to bring about changes in pain levels and tolerance, will that give patients more perceived control over their symptoms? If mood can be induced in a lab, perhaps the patients can learn ways of inducing positive emotional states (like laughing) themselves in order to help reduce pain symptoms. The next chapter will discuss the design of the study, the recruitment process for participants, assessment tools that were used, the procedures for the study, and a discussion of statistical methods that were used to analyze the data.

Chapter 3: Research Method

In this study, I investigated the influence of laughter frequency on affect and perceived chronic pain levels of individuals who have FMS, while controlling for the potential influence of depressive symptoms and alexithymia. The purpose of the study was to analyze whether increased laughter frequency is predictive of increases in positive affect or decreases in negative affect as well as reductions in perceived chronic pain levels using multiple linear regression analysis. In this chapter, in addition to discussing and justifying the research design and analyses used, I detail characteristics of the sample, including who was chosen, how participants were chosen, and inclusionary and exclusionary variables. I also discuss the procedures followed as well as the specifics pertaining to the various measures employed. Following is a discussion of the potential threats to validity, how the data were collected and analyzed, and how participants were protected from harm during the course of the study. I conclude the chapter with a summary and an introduction to Chapter 4.

Research Design and Approach

A quantitative, correlational design was used in this investigation. The decision to conduct a quantitative study arose from the nature of the problem to be investigated, the questions asked, and the literature reviewed (see Creswell, 2012). After reviewing the extant quantitative research discussing the benefits of laughter for dealing with acute pain (Dunbar et al., 2011; Mahony et al., 2001; Stuber et al., 2009; Zweyer et al., 2004), I wondered if laughter could have similar effects with chronic pain. The types of research questions asked in this study lent themselves to a quantitative, statistical analysis.

Similarly, this study's research questions were rooted in a review of the literature. There were three variables of concern in this study. The independent variable was laughter frequency. Affect and perceived pain levels were the dependent variables in this study. Relationships were explored between laughter frequency and affect as well as between laughter frequency and levels of perceived pain in patients with FMS. In addition, the instruments used in this study are objective assessment tools that produce numerical data to be analyzed statistically.

Setting and Sample

Population and Sampling Method

Participants consisted of persons aged 18 and over who have been diagnosed with FMS by their physicians. Study volunteers were recruited through a mixture of convenience and snowball sampling. Firstly, I delivered the flyer to an alternative therapist's practice and support group for distribution. Participants were also recruited through posting the flyer to community bulletin boards at a local Starbucks as well as at a local recreation center. The study was then advertised via local newspapers, and the flyer was additionally posted to the PsiChi web site (http://www.psichi.org/?Research_Rules#.VvAUDXn2aUK) and to the Clinical Trials web site (http://www.clinicaltrials.gov). The flyer was also posted within the Walden Participant Pool, as well as to social media. Social media tended to yield the most interest, and the most fruitful social media source for participant recruitment was the NFA Facebook support group page (https://www.facebook.com/fmaware). The administrator of this group posted the flyer twice, and these postings were directly

responsible for recruiting the majority of the study sample. Finally, participants were also recruited via referrals from individuals who knew of other FMS patients who might have been willing to participate.

The study sample depended upon those who saw the flyer, were available, and chose to participate. Since the sample depended on those volunteering to participate, it is more difficult to generalize study outcomes to the larger population than it would be if the sample was randomly selected (see Creswell, 2012).

Expected Effect Size Calculation

Studies related to this research yielded a mix of small, medium, and large effect sizes. In terms of improvements in mood and or reductions in levels of depression following humor or laughter interventions, effect sizes (all reported as Cohen's *d)* were as follows: .60 (medium; Foley et al., 2002), 1.29 (large; Ganz & Jacobs, 2014), .45 (small; Ko & Youn, 2011), 1.40 and 1.41 (large; Walter et al., 2007), and 1.48 (large; Tse et al., 2010). Tse et al. (2010) also found significant reductions in chronic pain levels (Cohen's d = 1.25; large).

In terms of laughter and its effects on discomfort thresholds and/or pain tolerance in the case of acute pain, effect sizes (again, all reported as Cohen's *d)* were as follows: .57 (medium; Stuber et al., 2009) and .82 (large; Zweyer et al., 2004). Related to the influence of mood induction (elation) on pain tolerance in individuals with chronic back pain, Tang et al. (2008) found a large effect size (Cohen's d = .98). Finally, the effect sizes (reported as Cohen's *d)* for the influence of affect in individuals with FMS were as follows: .45 (small; Zautra et al., 2001), and .67 (medium; Zautra, Johnson, et al., 2005).

The average effect size from the studies discussed above is .95 (Cohen's *d*; large). The sample size for this study, therefore, was based on an expected large effect size.

Sample Size

A sample size power analysis was conducted in G*Power 3.1.9.2 (see Faul, Erdfelder, Buchner, & Lang, 2009). To examine the research questions, multiple hierarchical linear regressions were planned, with a total of six predictor variables (laughter frequency, depression, alexithymia, and potential demographic confounds: age, gender, and ethnicity). Using a large effect size ($f^2 = 0.35$), an alpha level of .05, and a power of .80, the power analysis calculated the required sample size for a multiple linear regression with six predictors at 46. Thus, information from at least 46 participants should have been gathered to assess the research questions.

Eligibility and Exclusion Criteria

To be eligible for the study, participants had to have been adults (18 and older) with confirmed diagnoses of FMS. Participants were either expected to sign a release of information form (see Appendix A) to allow me to contact their physicians for confirmation or to provide documentation of diagnosis, such as a letter from their medical provider, a printout from an electronic medical data base, or a printout from a doctor appointment. In this way, diagnosis was confirmed for each participant in the study.

Procedures

The study flyer contained my email address and phone number, and first contact with me was initiated by the participants. When potential participants made initial contact (typically by email or responding to a social media post), I would email them with a brief

overview of the study, including a discussion of exclusionary criteria (diagnosis confirmation required), attaching a copy of the study's flyer and the informed consent form. Because the duration of participant recruitment stretched out longer than 1 year, it was necessary to return to the IRB to obtain an updated one (IRB No. 2017.07.07; 16:00:45-05'00').

In the same email, prospective participants were encouraged to follow up with any questions they had, and that if they felt they were ready at that time to commit to joining the study, to email back with the words, "I consent." Once the commitment to participate was received, participants provided diagnosis confirmation or were emailed a release of information form to review and sign. Participants then completed two screening instruments (for symptoms of depression and for the trait of alexithymia) and a demographics form. These forms were either mailed via regular mail or emailed to participants, depending on their preferences and computer and or printer and scanner access.

Participants completed the BDI-II (Beck et al., 1996) in order to screen for depression. Those reporting moderate to severe symptoms of depression (scores of 21 or higher) were encouraged to seek treatment if not currently receiving treatment for depression. Depression, a disorder of mood, is associated with negative affect. Anas and Akhouri (2013) assessed depressed patients and normal controls for measures of affect and found that those who were depressed were more likely to score significantly higher on levels of negative affect, whereas the normal participants had significantly higher scores on measures of positive affect. Depression is also associated with increased pain

intensity ratings in those with chronic pain. Baker et al. (2008) found that depression and locus of control variables accounted for 13% of the variance in chronic pain intensity ratings. Thus, participants' laughter frequency as well as measures of affect and pain may have been influenced by active depressive symptoms. To avoid potentially misleading study outcomes, it was necessary to control for symptoms of depression in the analyses.

To measure alexithymia, participants completed the TAS-20 (Bagby et al., 2013; Appendix B). As discussed in the second chapter, alexithymia is frequently observed in chronic pain and FMS patients (Evren et al., 2006; Huber et al., 2009; Steinweg et al., 2011; Tooyserkani et al., 2011). Steinweg et al. (2011) found that moderate to severe depression was also increased in FMS patients, with the measures of depression closely correlated with measures of alexithymia. When they controlled for moderate to severe depression in their analyses, however, FMS patients no longer evidenced significantly higher alexithymia measures compared to general medicine patients and RA patients. To reduce the likelihood of either depression or alexithymia affecting this study's results, all participants were screened for depression and assessed for alexithymia, and both of those measures were held constant in the analyses. Finally, participants completed a questionnaire in order to gather personal and demographic data (see Appendix C).

Once the initial screening tools and demographics form were completed, I either mailed or emailed participants the forms needed to complete their daily assessments. For 14 days, participants completed the PANAS (Watson et al., 1988; Appendix D) and rated their pain using the PI-NRS (Farrar et al., 2001; Appendix E) 3 times daily: shortly after waking up in the morning, at 3:00 p.m., and an hour before bedtime. Additionally, they

recorded all daily episodes of laughter on the adapted DLR (Martin & Kuiper, 1999; Appendix F). Participants recorded the time of each episode of laughter, and for analysis, the researcher then divided the frequency of laughter into two time frames: from wake-up to the 3:00 p.m. measures, and from 3:00 p.m. to the hour before bedtime measures.

Typically, I sent participants automatic email reminders (via an automatic calendar scheduling program) to assess their affect and pain shortly before the 3:00 p.m. collection time, as well as later in the evening for the nightly assessments. However, some preferred to receive text messages, and others preferred to set their own alarms or reminders. In general, participants were expected to submit their data to the researcher each night (via email) when their final assessments of the evening were completed.

At the conclusion of their 2 weeks of participation, study volunteers received a $50.00 Visa® gift card as compensation (either via mail or electronic delivery, depending on the participants' preference). However, for the international participants (n = 4), it was not possible to order the gift card. For those participants, I sent $50.00 via PayPal accounts, which was automatically converted into their individual currencies. Finally, I entered the data into a spreadsheet corresponding to each participant's assigned numeric code that I analyzed following the conclusion of the study.

Data Collection and Analyses

Instrumentation and Materials

In this study, basic demographic information was collected and participants completed assessments for depression, alexithymia, affect, pain, and laughter frequency. The measures are discussed below.

BDI-II. The BDI-II (Beck et al., 1996) is a widely used self-report instrument used to assess adolescents and adults for the presence and severity of depressive symptoms. It typically takes five to ten minutes to complete, and it consists of 21 items that correspond to varying symptom criteria of depression, as classified in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV; American Psychiatric Association, 1994). Patients are asked to circle the choice under each item that reflects most closely their experience over the previous two weeks. The options on each item provide a score range from 0 to 3, with possible total score ranges from 0 to 63. The instrument is scored by adding all of the circled items together. Those with scores totaling from 0 to 13 are considered to have minimal depressive symptoms; those with scores from 14 to 19 are considered to have mild symptoms of depression; those with scores from 20 to 28 are considered to have moderate symptoms of depression; and those with scores from 29 to 63 are considered to have severe symptoms of depression (Beck et al., 1996).

The BDI-II was normed with 500 patients from four psychiatric outpatient clinics (two urban-based and two suburban-based), and with a group of undergraduate students to act as a comparison group (n = 120). It was found to have high coefficient alphas for reliability--.92 for the outpatient population, and .93 for the undergraduate normal comparison group. Test-retest stability was assessed by having 26 outpatients take the test twice, a week apart. The test-retest correlation was .93. To assess construct validity, 191 outpatients were administered the BDI-II as well as the BDI-IA (the previous version of the BDI) in a counterbalanced order. The correlation between them was .93. With

regard to convergent validity, the BDI-II has been shown to be significantly positively associated with other similar measures, and an estimate of factorial validity (.95) was evidenced "by the intercorrelations among the 21 BDI-II items" (Beck et al., 1996, p. 28).

TAS-20. The TAS-20 (Bagby et al., 1993; Parker, Taylor, & Bagby, 2003; Appendix B) is an instrument developed to assess the trait of alexithymia, and consists of three distinct, related factors. The first factor is difficulty in identifying feelings; the second factor is difficulty in describing feelings; and the third factor is a measure of externally oriented thinking (a lack of focus on inner experience). It is a self-report measure that consists of 20 questions. The items are rated on a five point Likert scale from strongly disagree (1) to strongly agree (5). When scoring the instrument, points are added up according to the number circled, except for five items which are reverse scored (assigned the opposite score of what is circled; e.g. if a 1 is circled, the score assigned is 5). According to G. J. Taylor (personal communication, June 27, 2017), alexithymia is dimensional rather than categorical, so alexithymia scores fall on a continuum. Scores $\leq$ 51 indicate low or nonalexithymia, while scores $\geq$ 61 indicate a high range of alexithymia.

The internal consistency of the TAS-20 has been found to be good (Cronbach's alpha = 0.81), and each of the factors also has adequate internal consistency. F1 (difficulty identifying feelings) = 0.78; F2 (difficulty describing feelings) = 0.75, and F3 (externally oriented thinking) = 0.66. Additionally, it has demonstrated good test-retest reliability (0.77; Bagby et al., 1993). Its internal reliability has also been found to be replicable in a large community population (N = 1933--all factors demonstrated

coefficient alphas greater than .70; Parker et al., 2003) and across undergraduate students in three varying cultures (Canada, Germany, and the United States), with an average Cronbach's alpha of 0.79 (Parker, Bagby, Taylor, Endler, & Schmitz, 1993). It has also been used to assess the prevalence of alexithymia in the FMS patient population. Evren et al. (2006) and Steinweg et al. (2011) found that 39.2% and 44% of their samples of FMS patients had alexithymia as measured by the TAS-20.

To assess the convergent and discriminant validity of the TAS-20, Bagby et al. (1994) had undergraduate students complete the TAS-20 as well as other measures expected to have either no relationship (conscientiousness and agreeableness on the NEO Personality Inventory (McCrae & John, 1992)—assessing discriminant validity) or a negative relationship (Psychological Mindedness Scale; Conte, Ratto, & Karasu, 1996) and The Need for Cognition Scale (Cacioppo & Petty, 1982) -assessing convergent validity) with alexithymia. As predicted, there was a strong, negative relationship between alexithymia and the psychological mindedness scale and the need for cognition scale, demonstrating good convergent validity; there also was a nonsignificant relationship between alexithymia and conscientiousness and agreeableness, providing evidence of discriminant validity. Concurrent validity was assessed with a sample of behavioral medicine outpatients. The patients completed the TAS-20 and were also clinically interviewed while two other interviewers observed behind one-way glass (for inter-rater reliability). There was a strong, positive correlation between TAS-20 ratings and clinician interviews, demonstrating good concurrent validity (Bagby et al., 1994).

In this study, participants completed the TAS-20 either via mail or via electronic communication. The online administration version has been demonstrated to have adequate validity and reliability compared to the paper version of the TAS-20. This was assessed through administering the different versions to undergraduate students (N = 621)—randomly assigned to either the paper or internet versions. Measures of internal consistency between them were similar—Cronbach's alpha for the paper administration was .75 and Cronbach's alpha for the internet administration version was .80 (Bagby et al., 2013). The factors of the scale were also similar and significantly correlated, supporting consistent external validity between them. Bagby et al. concluded that the tests are "comparable and can be used interchangeably" (p. 5).

PANAS. The PANAS (Watson et al., 1988; Appendix D) is a 20-item self-report assessment tool, and it consists of two scales: the positive affect (PA) scale and the negative affect (NA) scale. Each scale consists of ten items—words that characterize various positive or negative affect states. PA is described as "the extent to which a person feels enthusiastic, active and alert", whereas NA is described as "a general dimension of subjective distress and unpleasurable engagement that subsumes a variety of aversive mood states" (Watson et al., 1988, p. 1063). PA items include "interested, excited, strong, enthusiastic, proud, alert, inspired, determined, attentive, and active". NA items include "distressed, upset, guilty, scared, hostile, irritable, ashamed, nervous, jittery, and afraid" (Watson et al., 1988, p. 1070). Items are rated by participants on a 5-point Likert scale, ranging from one being "very slightly or not at all" to five being "extremely" (p. 1070). The item ratings are summed for each scale, and range from 10 to 50, with higher scores

indicating higher levels of that affect. The PANAS is brief, easy to complete, and flexible in that it can be used to rate affect in the current moment, over the course of a day, a few days, a week, or longer intervals (Watson et al., 1988). The standardized instructions for the PANAS include a space to insert the researcher's time frame for ratings. It was used in this study to assess affect at the present moment, three times per day.

Reliability data for the PANAS were gathered from mostly undergraduate students. Internal consistency ratings were "all acceptably high, ranging from .86 to .90 for PA and from .84 to .87 for NA" (Watson et al., 1988, p. 1065). The researchers also found the reliability scores to be unaffected by ratings given for different time frames (e.g., over the past day versus the present moment). Test-retest reliability was also stable, and became more so as the length of time from which ratings were taken increased (e.g., ratings of how a person has felt over the past year).

The researchers also collected reliability data from a smaller sample of adults who were not students (n= 164; coefficient alpha for PA = .86 and for NA = .87) as well as from a small group of psychiatric inpatients (n = 61; coefficient alpha for PA = .85 and for NA = .91). Though the researchers cautioned that the sample sizes were small, they suggested this indicated that the PANAS was likely reliable across patient and non-patient samples (Watson et al., 1988). The PANAS was later normed with a large adult population in the United Kingdom (N = 1003). With this population, reliability for PA was Cronbach's alpha = .89 and NA = .85 (Crawford & Henry, 2004).

Scale validity was similarly robust, with convergent validity correlations ranging from .89 to .95 and discriminant validity correlations ranging from -.02 to -.18. Watson et

al. (1988) also determined there was strong item validity, with a factor analysis revealing that the two dimensions (PA and NA) accounted for "virtually all of the common variance"—from 87.4% (from ratings taken at the present moment) to 96.1% (from ratings of how affect is in general).

PI-NRS. The PI-NRS is frequently used in studies assessing chronic pain (Farrar et al., 2001; Appendix E). It is a simple, 11-point scale, ranging from 0 (no pain at all) to 10 (the worst pain one can imagine). Ratings of 1, 2, or 3 indicate mild pain; ratings of 4, 5, or 6 indicate moderate pain, and 7, 8, 9, or 10 indicate severe pain. It is brief and quick to administer (less than 3 minutes), and the individual selects the number that best represents the pain he or she has been experiencing (Van Der Laan, 2013). Farrar et al. (2001) observed that, though the PI-NRS was used quite often in the literature, it was still not known what constituted a clinically important change in pain intensity ratings. From their analysis of 10 chronic pain studies (with varying chronic pain populations) that used similar methods, they determined that a 2-point difference reduction in pain ratings represented a clinically significant improvement.

Reliability and validity of the PI-NRS were tested with 200 chronic pain patients (Jensen & McFarland, 1993). Test-retest reliability was tested by comparing the ratings given on the first day of the first week of the study and the ratings given on the first day of the second week of the study (both taken at the second hour of the day). The correlation coefficient of these two ratings resulted in a correlation of 0.63, but as the researchers increased the numbers of ratings compared (two hours of ratings on two days during the two weeks and upward all the way to 28 ratings compared), test-retest

reliability also increased. The range was from 0.63 to 0.95. To reach an adequate stability coefficient (correlations greater than 0.90), they indicated that participants would need to assess their pain levels three times per day for four days; and excellent reliability was reached (0.95) when participants rated pain four times per day for all seven days of the week. Similarly, validity coefficients also rose as more measures were included in the analysis—ranging from 0.74 (with a single rating of pain), to 0.97 (three ratings per day for four days) to 1.00 (four ratings per day for seven days). Internal consistency of the PI-NRS was also excellent, ranging from 0.94 to 0.96—with minimal difference between them whether ratings were taken from a single day or multiple days. Based on their findings, Jensen and McFarland concluded, "the reliability and validity of pain intensity measurement may be increased by increasing the number of assessments made, and by assessing pain over multiple days" (p. 202).

DLR. Though the DLR is an unpublished instrument, I gained permission from Dr. Rod Martin (Appendix F; Martin & Kuiper, 1999) to adapt it for use in this study. This instrument is a tool participants used to log each instance of laughter per day, and to capture some descriptive information as well. This form has six columns. In the first column, the participant counted laughter frequency. He or she began with the number one and continued down the column until completing his or her final assessments of the evening, and then began a new DLR each day for 14 days. In the second column, participants noted the time the laughter took place. The third column was used for noting what types of things made the participants laugh. The options include mass media (M), a spontaneous situation (S), a joke (J), or an event (E). In the fourth column, participants

noted the strength of their laughter: 1) a silent chuckle or forceful exhale/snort, 2) a little bit of laughter, or 3) a lot of laughter. In the fifth column, participants noted who caused their laughter: self (S) or other (O). Finally, in the sixth column, participants noted whether others were present or not at the time of the laughter. Though this study primarily investigated laughter frequency alone, regardless of the circumstances surrounding each laugh, gathering additional information may yield some interesting qualitative data for follow-up studies.

Data Analysis and Research Questions

Data analysis. Data were entered into SPSS version 24.0 for Windows. Descriptive statistics were conducted to describe the sample demographics and the research variables used in the analysis. Frequencies and percentages were calculated for nominal data. Means and standard deviations were calculated for continuous data. Data were collected via email once a day for baseline (shortly after wake up), afternoon (3:00 p.m.), and night (an hour before bed) observations. Hierarchical regressions were conducted to assess the research questions.

Research Question 1. Will laughter frequency influence the affect of FMS patients after controlling for depression and alexithymia?

$H_0$1: Laughter frequency will not influence the affect of FMS patients after controlling for depression and alexithymia.

H_a1: Laughter frequency will influence the affect of FMS patients after controlling for depression and alexithymia.

To examine Research Question 1, a hierarchical multiple linear regression was conducted to assess if laughter frequency influences affect. A hierarchical multiple linear regression is the appropriate analysis to conduct when the goal is to assess the relationship between a set of continuous predictor variables and a continuous dependent variable. It may also be used when the researcher wants to control for the influence of another variable (see Pallant, 2010). In this case, laughter frequency, depressive symptoms, alexithymia, and affect are all continuous variables.

Prior to conducting the hierarchical regression the demographic variables were tested for as covariates. If any of the demographic variables, such as age, gender, or ethnicity, were related to the affect scores, then they would have been controlled for in the regression. Covariates were entered into the model first followed by any predictor variables. Additionally, bivariate correlations were conducted to examine the bivariate relationships between the potential predictor variables and the dependent variables. Any predictor variable not related to the dependent variable would have been removed from the regression. The multiple linear regression was assessed using the *F* test. If the regression model was found to be significant, the individual predictors would also be assessed. An alpha level of .05 was used to assess significance. Prior to analysis, the assumptions of the regression were assessed. Normality was assessed with a P-P plot of the residuals. Homoscedasticity was assessed with a scatterplot of the residuals (Pallant, 2010). Lastly, multicollinearity was assessed for by examining Variance Inflation Factors (VIFs).

Research Question 2. Will laughter frequency influence the perceived chronic pain levels of FMS patients after controlling for depression and alexithymia?

$H_0$2: Laughter frequency will not influence difference in perceived chronic pain levels of FMS patients after controlling for depression and alexithymia.

H_a2: Laughter frequency will influence difference in perceived chronic pain levels of FMS patients after controlling for depression and alexithymia.

To examine Research Question 2, another hierarchical linear regression was conducted to assess if laughter frequency influences difference in perceived chronic pain levels after controlling for depressive symptoms and alexithymia. In this case, laughter frequency, depressive symptoms, alexithymia, and perceived chronic pain levels are continuous variables. The hierarchical regression was then conducted in an identical manner to that of the procedure used above for the first research question.

Threats to Validity

In this particular study there were several potential considerations. Perhaps the most important and most salient potential threat was the danger that a completely different variable other than laughter frequency could be responsible for changes in affect and pain in participants. Two of those potential cofounding variables (depressive symptoms and alexithymia scores) were controlled for through holding them constant in the statistical analyses. When analyzing outcomes these potential covarying factors needed to be considered. History was another potential confounding variable. This research was not conducted in a strictly regulated laboratory environment. Instead, data were gathered as participants went about their daily lives. During the course of this study,

the participants may have had events happen in their lives that influenced study outcomes.

In addition, selection of participants may have been a confounding variable. Because I relied on volunteers to participate instead of using random selection, there may be differences between the study's participants and the larger population of FMS patients—making it difficult to generalize this study's results to other FMS patients, or to those with any other chronic pain conditions. Attrition of participants may also have been a problem for this study. The study was two weeks long and required participants to assess affect and pain three times per day while also logging each instance of laughter. This may have been perceived by some as too taxing, or it may have been difficult for them to keep up with all data submissions. Over the course of the study, there was a risk that participants may have dropped out, leaving potentially too few remaining to ensure the power of the study would be adequate. During the participant selection process, it was planned to gather more participants than strictly needed (46) for .80 power to guard against this happening. After averaging dropout rates from several related studies (Finan et al., 2009; Ganz & Jacobs, 2014; Ko & Youn, 2011; Tang et al., 2008; Tse et al., 2010; Walter et al., 2007; Zautra et al., 2001; Zautra, Fasman, et al., 2005; Zautra, Johnson, et al., 2005) it was estimated that at least 16 additional participants should have been recruited. This means that an initial total of at least 62 participants should have been recruited to take potential attrition into account.

Protection of Human Participants

To protect confidentiality, each participant's data were de-identified through the assignment of a numerical code. They used this code instead of their names to submit all assessments and daily logs. All data and assessments are stored on a password-protected computer or in a locked filing cabinet (for those who preferred to compete the study via regular mail). The original list containing their names and matching code numbers is also stored in a password protected computer. The computer used to analyze data in SPSS is also password protected. All data and protocols will be retained in a locked filing cabinet and/or a password-protected computer in the researcher's home for a minimum of six years (Institutional Review Board for Social & Behavioral Sciences, 2012), and will then be shredded and or disposed of via a commercial software-erasing program.

Additionally, though it is unlikely, it may be possible that the enhanced focus on pain and affect in this study could have exacerbated symptoms of psychological distress. Broderick and Vikingstad (2008) tested whether frequent reporting of symptoms (in their study, they looked at pain and fatigue) exacerbated symptoms of depression in rheumatology patients. Patients were assessed for levels of depression before and after a 30-day period in which they rated symptoms 6 times per day. The researchers found that overall levels of depression actually improved significantly at the end of the study. Though it was observed that 10% of their participants experienced a worsening of symptoms, 20% of their participants reported fewer symptoms of depression from pre- to post-study. Compared to their six assessments per day, in this study participants only reported 3 times per day, and the study only lasted 2 weeks (compared to a month in

Broderick & Vikingstad's study). Participants received a handout at the beginning of the study with crisis hotline numbers and helpful guidance on what to do should they experience significant worsening of mental health status during the course of the study (see Appendix G). In addition, if any participants had reported worsening physical status, they would have been encouraged to see their physicians for care. None did.

Summary

In this study, I set out to examine the influence of laughter frequency on affect and perceived chronic pain levels in individuals who have FMS. After completing initial assessments and a demographics form, participants rated their pain and affect 3 times per day for 14 days, while at the same time documenting each time they laughed. Descriptive statistics were generated in order to describe the characteristics of the sample, and hierarchical multiple linear regressions were conducted in order to assess the research questions. In this chapter, I have also discussed the participant selection process and sample size as well as all procedures followed and instruments employed. I also presented the research questions and discussed the various potential threats to this study's validity. The chapter concluded with a discussion of how it was planned to protect participants from a potential breach in confidentiality and procedures were put in place to follow in the event their symptoms were exacerbated during the course of the study. In the next chapter, study analyses and results will be discussed.

Chapter 4: Results

The purpose of this study was to analyze whether increased laughter frequency is predictive of increases in positive affect or decreases in negative affect as well as reductions in perceived chronic pain levels using multiple linear regression analysis. I addressed the following research questions: (a) Will laughter frequency influence the affect of FMS patients after controlling for depression and alexithymia? and (b) Will laughter frequency influence the perceived chronic pain levels of FMS patients after controlling for depression and alexithymia? In this chapter, I present a discussion of the data collection procedures as well as descriptive statistics to describe the sample. Finally, I present the analyses used to answer each research question.

Data Collection

Participant recruitment took place over the course of 13 months from September 2016 through October 2017. A total of 71 people formally consented to participate. Of those, 18 dropped out before completing any of the initial assessments. Ten participants completed the initial forms only but dropped out before beginning daily assessments, and two participants completed their initial forms and began daily assessments, but dropped out after completing very few measures. This left a total of 41 participants who completed the study. Though the original intended sample size was 46, recruitment had slowed after exhausting all recruitment methods. At that time, I decided to close the study to new participants and to move forward with data analysis.

The original plan called for participants to begin their daily assessments the next day following the completion of their initial forms. Several participants experienced a

delay in beginning their daily assessments, depending on their individual circumstances. Generally, they began within a few days, but there were two participants who were delayed longer than 2 weeks. In those cases, they were asked to complete a current BDI-II (Beck et al., 1996) due to the time sensitive nature of the instrument (participants are asked to rate their symptoms for the previous 2 weeks including the day of completion).

Additionally, though the general expectation was that participants would submit their daily assessments each evening following their last assessments, there were times that extenuating circumstances prevented some from submitting them on time. When that happened, participants were encouraged to submit their data as soon as possible. For those completing the forms via regular mail, it was typical that all measures would not be submitted until the conclusion of their 2 weeks of participation. For those participants, I communicated with them periodically via email in case they had any questions and to ensure the assessments were being completed.

Descriptive Statistics

The sample consisted of 41 participants, the great majority of whom were female (95.12%) and White (82.93%). Participants' ages ranged from 19 to 75 years old, with an average of 41.88 (*SD* = 15.12) years old. The largest percentage was married or partnered (46.34%) and had a college graduate education (39.02%). The largest proportion of participants was employed full-time (39.02%). The largest percentages of participants made $15,000 to $29,000 (19.51%) and $30,000 to $44,000 (19.51%). See Table 1 for the frequencies and percentages of participant demographic characteristics.

The largest proportion of participants was diagnosed with FMS 1 year to 5 years ago (36.59%). The vast majority was taking medications (95.12%) and were engaged in alternative therapies (82.93%). The majority (92.68%) reported having comorbid medical conditions. The most commonly reported conditions include inflammatory bowel syndrome (*n* = 10), hypertension (*n* = 8), migraine syndrome (*n* = 7), high cholesterol (*n* = 6), allergies/rhinitis (*n* = 6), temporomandibular joint dysfunction (*n* = 5), asthma (*n* = 5), degenerative disc disease (*n* = 5), polycystic ovary syndrome (*n* = 5), vitamin D deficiency (*n* = 5), and sleep apnea/obstructive sleep apnea (*n* = 4). The majority of the sample (58.4%) had also engaged in behavioral health treatment (attending sessions with psychiatrists, psychologists, social workers, and/or other counselors). More than half of the participants reported moderate to severe symptoms of depression (53.6%). A majority of the sample reported low alexithymia (58.5%), although 24.4% reported high alexithymia. See Table 2 for the full frequencies and percentages of diagnosis and medical-related demographic variables.

Table 1

Frequencies and Percentages of Demographic Variables

Variable	*n*	*%*
Sex		
Female	39	95.12
Male	2	4.88
Ethnicity		
African American/Black	1	2.44
Asian/Pacific Islander	2	4.88
White	34	82.93
Hispanic/Latino	1	2.44
Other	1	2.44
Missing*	2	4.88
Marital status		
Married/Partnered	19	46.34
Single	11	26.83
Divorced	8	19.51
Widowed	2	4.88
Other	1	2.44
Education		
High school graduate	3	7.32
Some college	10	24.39
College graduate	16	39.02
Post graduate degree	12	29.27
Employment status		
Full-time	16	39.02
Part-time	6	14.63
Self-employed	2	4.88
Student	3	7.32
Retired/Medically retired	9	21.95
Unemployed	5	12.20
Average family income		
Less than $15,000	4	9.76
$15,000 to $29,000	8	19.51
$30,000 to $44,000	8	19.51
$45,000 to $59,000	5	12.20
$60,000 to $74,000	4	9.76
$75,000 to $89,000	3	7.32
$90,000 to $114,000	3	7.32
$115,000 to $129,000	1	2.44
$130,000 to $200,000	4	9.76
Missing	1	2.44

Table 2

Frequencies and Percentages of Diagnosis and Medical-Related Demographic Variables

Variable	*n*	*%*
Years ago FMS diagnosed		
1 year ago or less	8	19.51
1 year to 5 years ago	15	36.59
6 years to 10 years ago	14	34.15
Greater than 10 years ago	4	9.76
Taking medications		
No	2	4.88
Yes	39	95.12
Engaged in alternative therapies		
No	6	14.63
Yes	34	82.93
Missing	1	2.44
Comorbid medical conditions		
No	2	4.88
Yes	38	92.68
Missing	1	2.44
Behavioral health treatment		
No	17	41.46
Yes	24	58.54
Depression		
Minimal	14	34.1
Mild	5	12.2
Moderate	11	26.8
Severe	11	26.8
Alexithymia		
Low alexithymia	24	58.5
Mid-range alexithymia	7	17.1
High alexithymia	10	24.4

Depression scores were considered minimal if the score on the BDI-II was between 0 to 13, mild if between 14 to 19, moderate if between 20 to 28, and severe if 29 to 63. Study participants reported an average depression score of 21.80 (*SD* = 12.16), which corresponds to moderate symptoms of depression (Beck et al., 1996). Alexithymia scores were considered low if the score on the TAS-20 was less than or equal to 51, midrange if between 52 to 60, and high alexithymia if greater than or equal to 61 (Bagby et al., 1993; G. J. Taylor, personal communication, June 27, 2017; Parker et al., 2003). Participants reported an average alexithymia score of 49.61 (*SD* = 12.92), which corresponds with a low level of alexithymia. Although this sample reported a higher average alexithymia score than that of the norming population (45.57, *SD* = 11.35, *N* = 1933; Parker et al., 2003), it was similarly in the low alexithymia range.

Participants had an average overall (i.e., all ratings for each day) positive affect score of 20.95 (*SD* = 6.13), with a lower evening positive affect score of 19.21 (*SD* = 6.16). Participants had an average overall negative affect score of 14.14 (*SD* = 3.64), with a slightly higher evening negative affect score of 14.86 (*SD* = 5.26). Participants had an average overall pain level of 5.17 (*SD* = 1.62), which was higher in the evening (*M* = 5.46, *SD* = 1.76). Participants had an average overall laughter frequency of 3.97 (*SD* = 2.77). See Table 3 for the ranges, means, and standard deviations of these variables.

Table 3

Means and Standard Deviations of Continuous Variables

Variable	Min	Max.	*M*	*SD*
Depression	4.00	52.00	21.80	12.16
Alexithymia	24.00	75.00	49.61	12.92
Factor 1	8.00	30.00	19.54	6.34
Factor 2	5.00	24.00	12.90	5.21
Factor 3	8.00	26.00	17.17	4.27
Overall positive affect	10.44	34.38	20.95	6.13
Midday	10.50	39.00	23.20	7.09
Evening	10.42	37.14	19.21	6.16
Overall negative affect	10.21	25.48	14.14	3.64
Midday	10.21	40.36	14.60	5.21
Evening	10.07	35.07	14.86	5.26
Overall pain level	1.95	7.98	5.17	1.62
Midday	1.64	8.14	5.05	1.64
Evening	1.71	8.15	5.46	1.76
Overall laughter frequency	0.89	11.96	3.97	2.77
Morning	0.21	15.36	3.75	2.92
Evening	0.36	12.00	4.19	2.93

Covariates

I assessed the preliminary bivariate relationships between potential covariates and overall positive affect, overall negative affect, and overall pain level through a correlation matrix. I used a Pearson's correlation for the correlation between continuous variables. However, some covariates were not continuous, which would make interpretation of Pearson's correlations conducted on these variables faulty (see Field, 2013). I dichotomized (i.e., turned into a single variable with two categories) the multicategory categorical variables and assessed them with a point-biserial correlation instead. The point-biserial correlation is appropriate to use when assessing the relationship between a

continuous and a dichotomous variable (Field, 2013). Only depression and alexithymia had a significant relationship with the dependent variables of interest. As such, I did not include any other variable as a covariate while hypothesis testing. See Table 4 for the full correlation matrix.

Table 4

Correlation Matrix for Potential Covariates

Variables	Positive affect	Negative affect	Pain level
Sex	.10	.14	-.06
Ethnicity	.21	-.14	-.04
Age	.13	-.20	-.10
Marital	-.24	.01	.04
Education	.24	-.15	-.16
Employment	.24	.05	-.22
Income	-.01	.00	-.10
Taking medications	-.12	.05	.21
Engaged in alternative therapies	-.12	.15	-.02
Comorbid medical conditions	.02	.08	.01
Behavioral health treatment	-.11	-.04	-002
Depression	-.40*	.68*	.46*
Alexithymia	-.19	.41*	.13

Note. *Significant at the .05 level.

Regression Results

I performed hierarchical multiple linear regressions in order to answer the research questions. This is the appropriate analysis to perform when assessing the relationship between two or more continuous or categorical independent variables and one continuous dependent variable in several steps (Field, 2013). For Step 1 of each regression, I entered the covariates of depression and alexithymia. For Step 2 of each regression, I added the main independent variable of interest, laughter frequency, to the

model. As the results of Step 2 were most important, I only provided a detailed narrative of the results of Step 2, although the full results are presented in each regression table. I conducted each main analysis with the overall scores of interest (i.e., an average of each measurement overall). If there was a significant result for the main analysis, I conducted two follow-up multiple linear regressions where the dependent variables were midday and evening scores, respectively. For these analyses, the independent variable of laughter frequency was split into morning and evening laughter frequency. Morning laughter frequency was defined as laughter frequency from the time of the first morning assessments to the 3pm assessments. Evening laughter frequency was defined as laughter frequency from the 3pm assessment to the bedtime assessment. Each main analysis was assessed at the $p = .05$ level. Prior to interpreting each regression, I assessed the assumptions of normality, homoscedasticity, and absence of multicollinearity.

Research Question 1

Will laughter frequency influence the affect of FMS patients after controlling for depression and alexithymia?

$H_0$1: Laughter frequency will not influence the affect of FMS patients after controlling for depression and alexithymia.

H_a1: Laughter frequency will influence the affect of FMS patients after controlling for depression and alexithymia.

In order to answer this research question, I performed two hierarchical multiple linear regressions. For each regression, the independent variable of interest was overall laughter frequency and the covariates were depression and alexithymia. The dependent

variable for the first regression was positive affect, while the dependent variable for the second regression was negative affect.

Prior to conducting the analysis, I assessed the assumptions of normality, homoscedasticity, and absence of multicollinearity for both regressions. I assessed normality through a Normal P-P plot. As the data involving positive affect generally conformed to the diagonal normality line, the assumption was met (see Figure 1; Field, 2013). I assessed homoscedasticity through a scatterplot of the residuals. As the data involving positive affect presented in a generally equally distributed, random pattern, the assumption was met (see Figure 1; Field, 2013). There was slight deviation of normality and homoscedasticity for the plots involving overall negative affect (see Figure 2), but according to Stevens (2009), violations of normality and homoscedasticity are a matter of degrees, and merely weaken the power of the analysis rather than invalidating the results. I assessed absence of multicollinearity through VIF values (see Tables 5 and 6). VIF values were below 10.00, indicating that the assumption was met (Stevens, 2009).

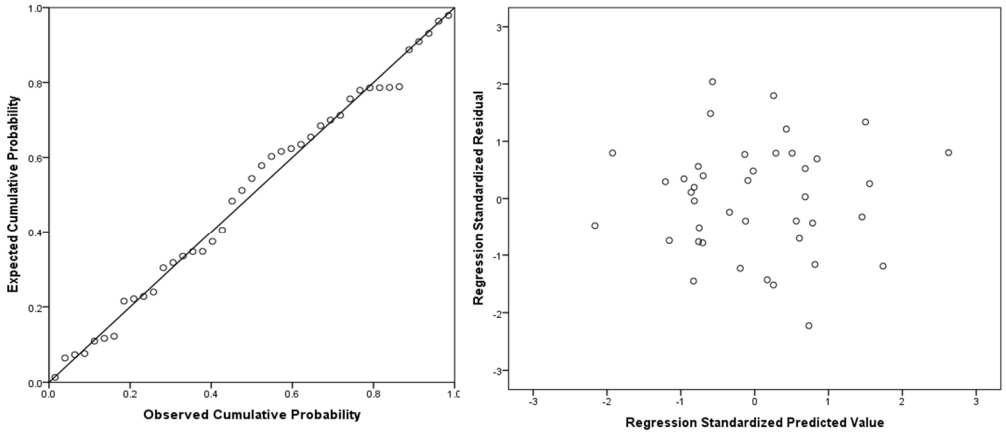

Figure 1. Normal P-P plot (left) and scatterplot of residuals (right) for regression involving overall positive affect.

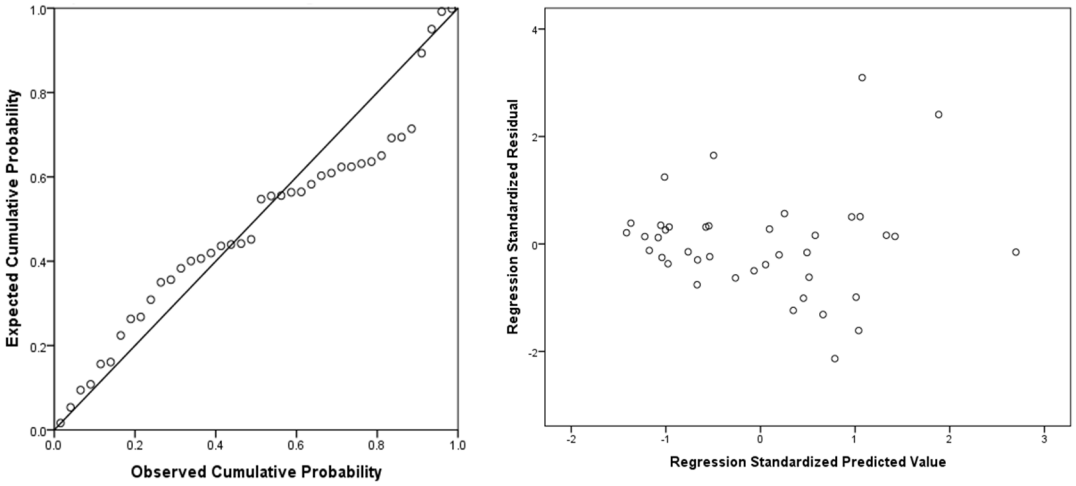

Figure 2. Normal P-P plot (left) and scatterplot of residuals (right) for regression involving overall negative affect.

The overall results of Step 2 of the analysis involving overall positive affect were significant, $F(3, 37) = 6.05$, $p = .002$, $R^2 = .275$. This indicates that when assessed collectively, the covariates and overall laughter frequency significantly predicted approximately 27.5% of the variability in overall positive affect. Examination of the individual predictors indicated that depression ($B = -0.18$, $p = .031$) and overall laughter frequency ($B = 0.92$, $p = .005$) were individually significant predictors of overall positive affect. For every one-unit increase in depression, there was a 0.18 unit decrease in overall positive affect. For every one-unit increase in overall laughter frequency, there was a 0.92 unit increase in overall positive affect. See Table 5 for the full results of this analysis.

Table 5

Results of the Regression With Overall Laughter Frequency and Covariates Predicting Overall Positive Affect

Step	Variable	*B*	*SE*	β	*t*	*P*	VIF
1	Depression	-0.22	0.09	-0.43	-2.43	.020	1.43
	Alexithymia	0.02	0.08	0.05	0.28	.778	1.43
2	Depression	-0.18	0.08	-0.36	-2.24	.031	1.46
	Alexithymia	0.04	0.08	0.08	0.51	.614	1.44
	Overall laughter frequency	0.92	0.31	0.42	3.02	.005	1.05

The overall results of Step 2 of the analysis involving overall negative affect were significant, $F(3, 36) = 10.62$, $p < .001$, $R^2 = .425$. This indicates that when assessed collectively, the covariates and overall laughter frequency significantly predicted approximately 42.5% of the variability in overall negative affect. Examination of the individual predictors indicated that depression ($B = .21$, $p < .001$) was an individually significant predictor of overall negative affect. For every one-unit increase in depression, there was a 0.21 unit increase in overall negative affect. There was no significant relationship between overall laughter frequency and overall negative affect after controlling for the covariates ($p = .55$). In Table 6, I present the full results of this analysis. The null hypothesis may be partially rejected, as there was a significant relationship between overall laughter frequency and overall positive affect, but not overall negative affect (see Table 6).

Table 6

Results of the Regression With Overall Laughter Frequency and Covariates Predicting Overall Negative Affect

Step	Variable	*B*	*SE*	β	*T*	*P*	VIF
1	Depression	0.22	0.05	0.69	4.55	.000	1.57
	Alexithymia	0.00	0.04	-0.01	-0.05	.962	1.57
2	Depression	0.21	0.05	0.68	4.46	.000	1.57
	Alexithymia	-0.01	0.04	-0.02	-0.11	.914	1.58
	Overall laughter frequency	-0.10	0.16	-0.07	-0.60	.554	1.04

Because there was a significant relationship between overall laughter frequency and overall positive affect, I conducted two additional hierarchical linear regressions with a main independent variable of morning and evening laughter frequency, and a dependent variable of midday and evening positive affect, respectively. Due to the inflated risk of Type I error (i.e., making a "false positive" conclusion) due to familywise error, I used the Bonferroni correction to reduce the alpha level to .016 (Field, 2013). The assumptions for these analyses were met (see Figures 3 and 4 and Tables 7 and 8).

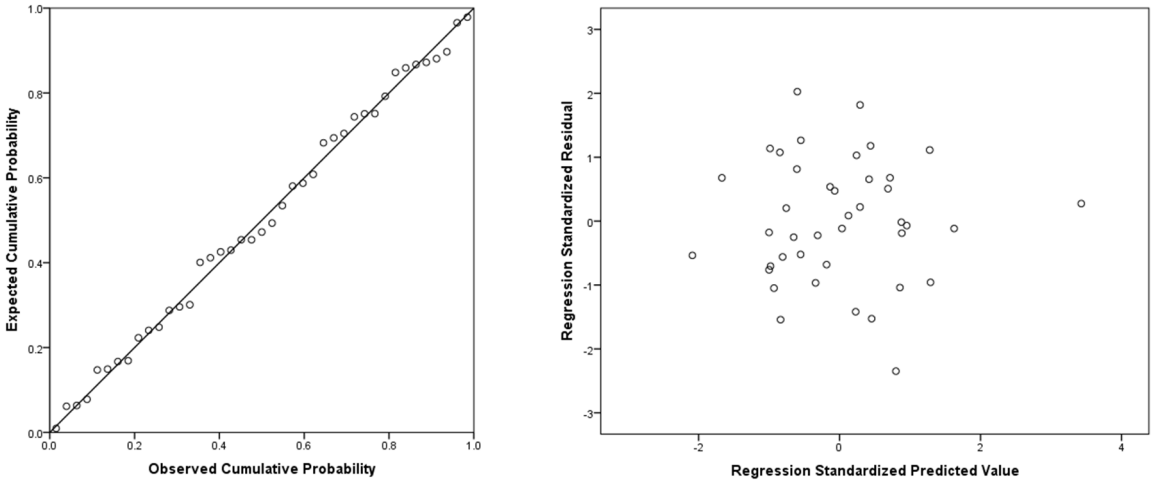

Figure 3. Normal P-P plot (left) and scatterplot of residuals (right) for regression involving midday positive affect.

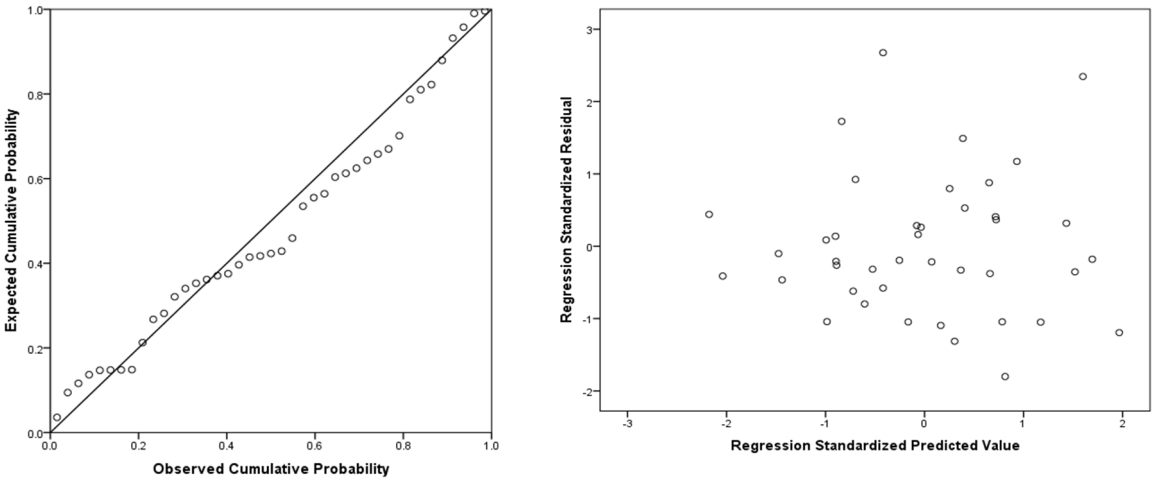

Figure 4. Normal P-P plot (left) and scatterplot of residuals (right) for regression involving evening positive affect.

For morning laughter and midday positive affect, the results of the overall regression for Step 2 were significant, $F(3, 37) = 6.34$, $p = .001$, $R^2 = .286$ at the reduced alpha level, indicating that the covariates and morning laughter significantly predicted up to 28.6% of the variability in midday positive affect. Morning laughter frequency was the only individually significant predictor ($B = 1.05$, $p = .003$) at the reduced alpha level. For every one-unit increase in morning laughter frequency, there is a corresponding 1.05 unit increase in midday positive affect (see Table 7).

Table 7

Results of the Regression With Morning Laughter Frequency and Covariates Predicting Midday Positive Affect

Step	Variable	*B*	*SE*	β	*T*	*P*	VIF
1	Depression	-0.24	0.10	-0.42	-2.34	.024	1.43
	Alexithymia	0.01	0.10	0.02	0.09	.926	1.43
2	Depression	-0.19	0.10	-0.32	-2.00	.053	1.48
	Alexithymia	0.03	0.09	0.06	0.35	.730	1.44
	Morning laughter frequency	1.05	0.34	0.43	3.12	.003	1.08

For evening laughter and evening positive affect, the results of the overall regression for Step 2 were not significant at the reduced alpha level, $F(3, 37) = 3.83$, $p = .017$, $R^2 = .175$, indicating that the covariates and evening laughter overall did not significantly predict variability in evening positive affect. Evening laughter frequency was not an individually significant predictor ($p = .031$) at the reduced alpha level. See Table 8 for the full results of this analysis.

Table 8

Results of the Regression With Evening Laughter Frequency and Covariates Predicting Evening Positive Affect

Step	Variable	*B*	*SE*	β	*t*	*P*	VIF
1	Depression	-0.19	0.09	-0.37	-2.03	.050	1.43
	Alexithymia	0.00	0.09	0.00	0.00	.998	1.43
2	Depression	-0.17	0.09	-0.34	-1.95	.059	1.44
	Alexithymia	0.01	0.08	0.02	0.10	.921	1.43
	Evening laughter frequency	0.68	0.30	0.32	2.24	.031	1.02

Research Question 2

Will laughter frequency influence the perceived chronic pain levels of FMS patients after controlling for depression and alexithymia?

$H_0$2: Laughter frequency will not influence difference in perceived chronic pain levels of FMS patients after controlling for depression and alexithymia.

H_a2: Laughter frequency will influence difference in perceived chronic pain levels of FMS patients after controlling for depression and alexithymia.

To answer this research question, I performed a hierarchical multiple linear regression with a dependent variable of overall pain level, an independent variable of

overall laughter frequency, and covariates of depression and alexithymia. I concluded that the assumptions of the regression were met (see Figure 5 and Table 8).

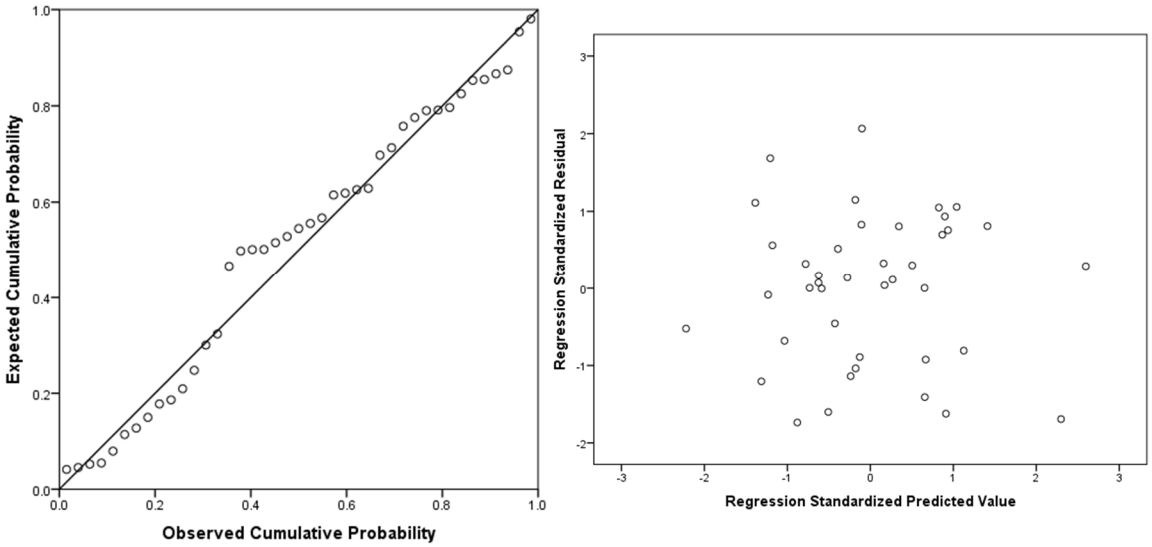

Figure 5. Normal P-P plot (left) and scatterplot of residuals (right) for regression involving overall pain level.

The overall results of Step 2 of the analysis were significant, $F(3, 37) = 5.44$, $p = .003$, $R^2 = .25$. This indicates that when assessed collectively, the covariates and overall laughter frequency significantly predicted approximately 25% of the variability in overall pain level. Examination of the individual predictors indicated that depression ($B = -0.07$, $p = .004$) and overall laughter frequency ($B = -0.17$, $p = .05$) were individually significant predictors of overall pain level. For every one-unit increase in depression, there was a 0.07 unit increase in overall pain level. For every one-unit increase in overall laughter frequency, there was a 0.17 unit decrease in overall pain level. See Table 9 for the full results of this analysis. The null hypothesis was rejected.

Table 9

Results of the Regression With Overall Laughter Frequency and Covariates Predicting Overall Pain Level

Step	Variable	*B*	*SE*	β	*t*	*P*	VIF
1	Depression	0.07	0.02	0.55	3.23	.003	1.43
	Alexithymia	-0.02	0.02	-0.17	-0.99	.327	1.43
2	Depression	0.07	0.02	0.51	3.05	.004	1.46
	Alexithymia	-0.02	0.02	-0.19	-1.16	.253	1.44
	Overall laughter frequency	-0.17	0.08	-0.28	-2.03	.050	1.05

Because there was a significant relationship between overall laughter frequency and overall pain level, I conducted two additional hierarchical linear regressions with a main independent variable of morning and evening laughter frequency, and a dependent variable of midday and evening pain levels, respectively. Due to the inflated risk of Type I error (i.e., making a "false positive" conclusion) due to familywise error, I used the Bonferroni correction to reduce the alpha level to .016 (Field, 2013). The assumptions for these analyses were met (see Figures 6 and 7, Tables 10 and 11).

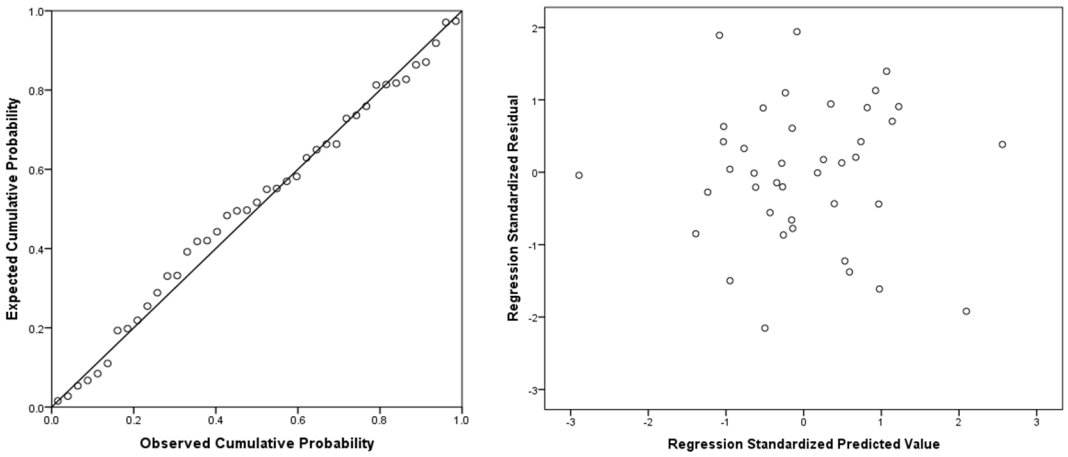

Figure 6. Normal P-P plot (left) and scatterplot of residuals (right) for regression involving midday pain levels.

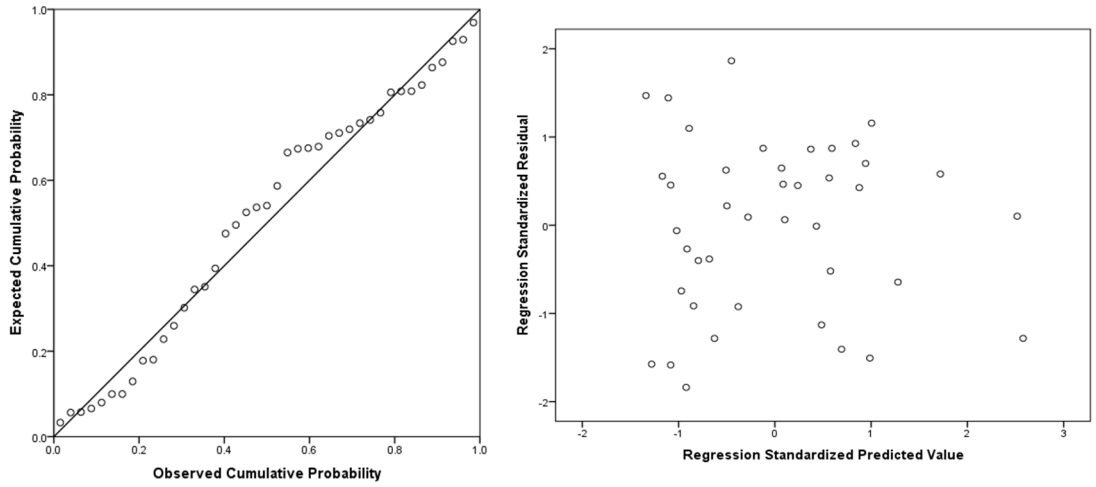

Figure 7. Normal P-P plot (left) and scatterplot of residuals (right) for regression involving evening pain levels.

For morning laughter and midday pain levels, the results of the overall regression for Step 2 were significant, $F(3, 37) = 7.48$, $p < .001$, $R^2 = .327$ at the reduced alpha level, indicating that the covariates and morning laughter significantly predicted up to 32.7% of the variability in midday pain levels. Depression was an individually significant predictor at the reduced alpha level ($B = 0.07$, $p = .002$); for every one-unit increase in depression, midday pain levels would increase by 0.07 units. Morning laughter frequency was also an individually significant predictor at the reduced alpha level ($B = -0.19$, $p = .016$). For every one-unit increase in morning laughter frequency, midday pain levels were predicted to decrease by 0.19 units. See Table 10 for the full results of this analysis.

Table 10

Results of the Regression With Morning Laughter Frequency and Covariates Predicting Midday Pain Levels

Step	Variable	*B*	*SE*	β	*t*	*P*	VIF
1	Depression	0.08	0.02	0.59	3.57	.001	1.43
	Alexithymia	-0.02	0.02	-0.17	-1.01	.317	1.43
2	Depression	0.07	0.02	0.52	3.30	.002	1.48
	Alexithymia	-0.03	0.02	-0.20	-1.28	.209	1.44
	Morning laughter frequency	-0.19	0.08	-0.34	-2.53	.016	1.08

For evening laughter and evening pain levels, the results of the overall regression for Step 2 were not significant at the reduced alpha level, $F(3, 37) = 3.21$ $p = .034$, $R^2 = .142$, indicating that the covariates and evening laughter overall do not significantly predict variability in evening pain levels. The covariate of depression was the only individually significant predictor ($B = 0.07$, $p = .011$), indicating that for every one-unit increase in depression, there is a 0.07 unit increase in evening pain levels. However, the individual result should be treated with caution due to the nonsignificance of the overall regression. See Table 11 for the full results of this analysis.

Table 11

Results of the Regression With Evening Laughter Frequency and Covariates Predicting Evening Pain Levels

Step	Variable	*B*	*SE*	β	*t*	*p*	VIF
1	Depression	0.07	0.03	0.48	2.77	.009	1.43
	Alexithymia	-0.01	0.02	-0.10	-0.55	.588	1.43
2	Depression	0.07	0.03	0.47	2.68	.011	1.44
	Alexithymia	-0.01	0.02	-0.10	-0.58	.565	1.43
	Evening Laughter Frequency	-0.07	0.09	-0.12	-0.83	.411	1.02

Post-Hoc Analyses

In addition, I performed two post-hoc regressions. I used the first regression to examine the relationship between morning laughter and evening positive affect, and the second regression to examine the relationship between morning laughter and evening pain levels. The assumptions for these regressions were met (see Figures 8 and 9, Tables 12 and 13). Additional Bonferroni corrections resulted in reduced alpha level of .013.

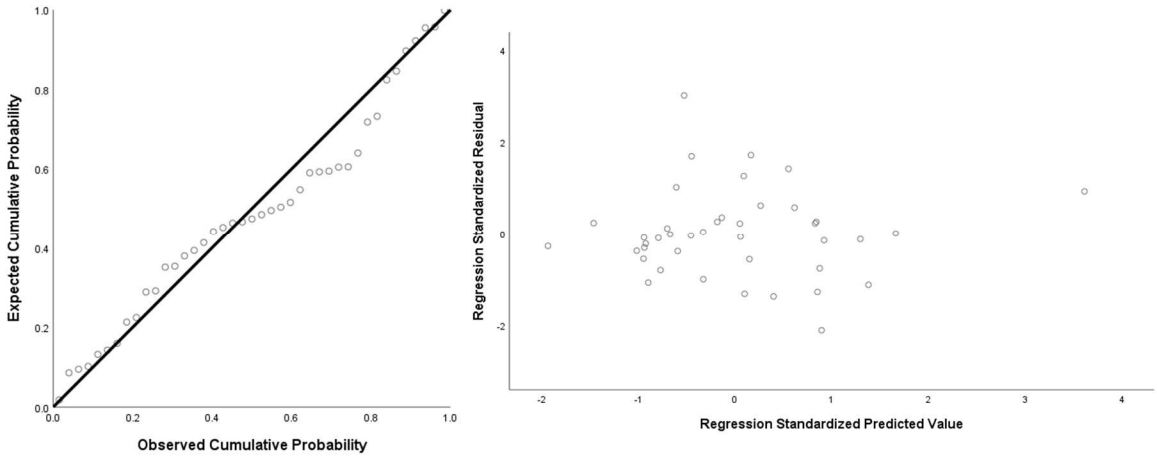

Figure 8. Normal P-P plot (left) and scatterplot of residuals (right) for regression involving morning laughter and evening positive affect.

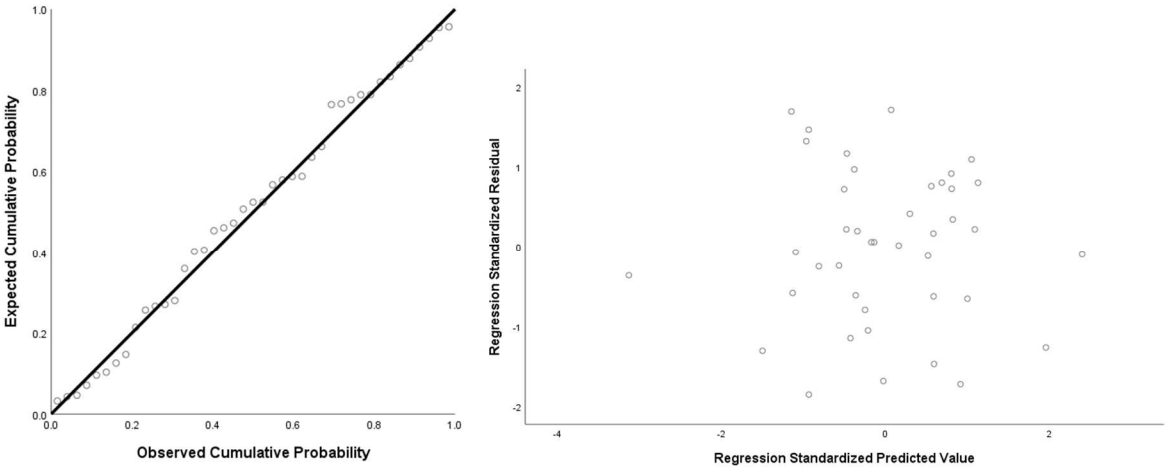

Figure 9. Normal P-P plot (left) and scatterplot of residuals (right) for regression involving morning laughter and evening pain levels.

The results of Step 2 of the regression with a dependent variable of evening positive affect were significant at a Bonferroni-controlled alpha level, $F(3,37) = 6.54$, $p = .001$, $R^2 = .293$, indicating that overall, covariates and morning laughter together significantly predict variability in evening positive affect. Morning laughter frequency was the only individually significant predictor at a Bonferroni-controlled alpha level, $B = 1.01$, $p = .001$. This indicates that for every one-unit increase in morning laughter frequency, there is a corresponding 1.01 unit increase in evening positive affect (see Table 12).

Table 12

Results of the Regression With Morning Laughter Frequency and Covariates Predicting Evening Positive Affect

Step	Variable	*B*	*SE*	β	*t*	*P*	VIF
1	Depression	-0.19	0.09	-0.37	-2.03	.050	1.43
	Alexithymia	0.00	0.09	0.00	-0.00	.998	1.13
2	Depression	-0.13	0.08	-0.27	-1.64	.109	1.48
	Alexithymia	0.02	0.08	0.04	0.27	.790	1.44
	Morning laughter frequency	1.01	0.29	0.48	3.47	.001	1.08

The results of Step 2 of the regression with a dependent variable of evening pain levels were significant at a stringent alpha level, $F(3,37) = 12.67$ $p = .003$, $R^2 = .249$, indicating that overall, covariates and morning laughter significantly predict variability in evening pain levels. However, morning laughter frequency was not an individually significant predictor at a Bonferroni-controlled alpha level, $B = -0.21$, $p = .019$. See Table 13 for the full results of this analysis.

Table 13

Results of the Regression With Morning Laughter Frequency and Covariates Predicting Evening Pain Levels

Step	Variable	*B*	*SE*	β	*t*	*P*	VIF
1	Depression	0.07	0.03	0.48	2.77	.009	1.43
	Alexithymia	-0.01	0.02	-0.10	-0.55	.588	1.43
2	Depression	0.06	0.02	0.041	2.46	.019	1.48
	Alexithymia	-0.02	0.02	-0.13	-0.77	.445	1.44
	Morning laughter frequency	-0.21	0.09	-0.35	-2.46	.019	1.07

Summary

The sample consisted mostly of White women whose ages ranged from 19 to 75 years, were married, had a college education, and were employed full time. The majority of them were taking medications, engaged in alternative therapies, had comorbid conditions, and had engaged in behavioral health treatment. In the results for Research Question 1, it was indicated that the null hypothesis could be partially rejected; higher overall laughter frequency was associated with higher overall positive affect, but not overall negative affect. In follow-up testing, it was found that higher morning laughter frequency was associated with higher midday positive affect, but that higher evening laughter frequency was not associated with higher evening positive affect.

In the results for Research Question 2, it was indicated that the null hypothesis could be rejected; higher overall laughter frequency was associated with lower overall pain levels. In follow-up testing it was found that higher morning laughter frequency was associated with lower midday pain levels, but there was not a significant relationship between evening laughter frequency and evening pain levels. Post-hoc testing revealed that there was not a significant relationship between morning laughter frequency and evening pain levels. However, higher morning laughter frequency was associated with higher evening positive affect.

In Chapter 5, I will present a discussion of these results contextualized by the relevant literature. I will discuss the strengths and weaknesses of this study. Finally, I will provide recommendations for future research.

Chapter 5: Discussion, Conclusions, and Recommendations

The purpose of this correlational study was to examine whether increased laughter frequency is predictive of increases in positive affect and or decreases in negative affect as well as reductions in perceived chronic pain levels in FMS patients using multiple linear regression analysis.

FMS is typically incompletely treated via conventional medicine alone (ACR, 2010; NFA, 2009). There is no cure, and it may result in significant disabilities (ACR, 2010; NFA, 2009) and reductions in patients' quality of life (Howard et al., 2010). Thus, additive alternative treatments or coping strategies may be helpful in assisting these patients with ameliorating residual symptoms (ACR, 2010; NFA, 2009).

Laughter has been shown to be helpful in improving emotional states (Dolgoff-Kaspar et al., 2012; Ganz & Jacobs, 2014; Ko & Youn, 2011; Sakuragi et al., 2002), in increasing pain thresholds and pain tolerance with laboratory-induced acute pain (Dunbar et al., 2011; Mahony et al., 2001; Stuber et al., 2009; Zweyer et al., 2004), and in reducing symptoms of various types of medical conditions (Bennett et al., 2003; Berk et al., 2001; Bertini et al., 2010; Christie & Moore, 2005; Hayashi, Urayama et al., 2007; Hayashi, Tsujii et al., 2007; Kim et al., 2009; Kimata, 2007a, 2007b, 2009; Kong et al., 2014; Lengacher et al., 2002; Matsuzaki et al., 2006; Nasir et al., 2005; Sugawara et al., 2010; Takeda et al., 2010; Walter et al., 2007). Laughter has also shown promise within a small sample of patients experiencing the chronic pain of RA (Herschenhorn, 1994). However, it has not yet been studied with regards to FMS patients. This present study

was conducted in order to investigate whether laughter has positive effects on pain and affective states of those with FMS.

Summary of Findings

After controlling for measures of alexithymia and depression, it was indicated in the results of the hierarchical analyses that higher overall laughter frequency among study participants was significantly associated with higher overall positive affect but not with overall negative affect. In follow-up and posthoc testing, it was indicated that higher morning laughter frequency was associated with significantly higher midday positive affect, as well as with significantly higher evening positive affect, but that higher evening laughter frequency was not associated with higher evening positive affect.

It was also indicated that higher overall laughter frequency was associated with significantly lower overall pain levels. In follow-up and posthoc testing, it was indicated that higher morning laughter frequency was significantly associated with lower midday pain levels, but there were no significant relationships observed between evening laughter frequency and evening pain levels or between morning laughter frequency and evening pain levels.

Interpretation of the Findings

General Analysis

Descriptives. The great majority of this sample was female (95.12%) and White (82.93%), and their ages ranged from 19 to 75 years old, with an average age of 41.88 (*SD* = 15.12) years old. These demographics are consistent with literature reviewed for this study. FMS tends to be seen predominantly in females in middle age (ACR, 2010;

CDC, 2011), and though it has been observed in all races (NFA, 2009), it appears it may more frequently occur in White populations. For instance, Bennett et al. (2007), in their extensive survey of 2,569 FMS patients, found that the preponderance of their sample was White (91.5%), similar to the higher percentage (82.93%) found in this study. Therefore, findings from this study may potentially be generalized to other samples of FMS patients, but may not so easily generalize to other, more diverse, medical or general populations.

Depression. An overall average depression score of 21.80 (suggestive of moderate levels of depression) was observed in this study's sample. Over half of the participants reported moderate to severe symptoms of depression (53.6%). This percentage is higher than figures reported in other research samples of FMS patients reviewed for this study, which ranged from 14.6% to 46% (Aguglia et al., 2011; dos Santos et al., 2012; Hassett et al., 2000; Ozcetin et al., 2007; Uguz et al., 2010; Wolfe & Michaud, 2009).

As discussed in earlier chapters, depression has been shown to be associated with higher levels of negative affect (Anas & Akhouri, 2013) and with increased severity of pain ratings in those who have chronic pain (Aguglia et al., 2011; Baker et al., 2008). Because depression symptoms could potentially influence participants' pain and affect ratings, these scores were controlled for in the hierarchical analyses. Indeed, when I tested for covariates, depression was found to be significantly associated with decreased positive affect, increased negative affect, and increased pain severity ratings. Although depression continued to be a significant predictor of the variability in positive affect,

negative affect, and overall pain levels even after being entered in the analyses as a covariate, laughter frequency was also shown to be a significant individual predictor of both reduced pain and improved positive affect. Because depression is so common among those with FMS, this is a hopeful result. It is suggestive that even those FMS patients who have depression can still benefit from laughter.

Alexithymia. The average alexithymia score for study participants was 49.61 (*SD* = 12.92), corresponding to a low level of alexithymia. This is consistent with the TAS-20 general population norms in which the average alexithymia score is also in the low range (45.57, *SD* = 11.35). High levels of alexithymia are associated with physiological hypersensitivity (Kano et al., 2007) and could potentially influence the symptoms experienced by FMS patients. As such, measures of alexithymia were held constant in order to minimize any influence on this study's results. However, a majority of the current study's sample reported low alexithymia (58.5%) although 24.4% reported high alexithymia. This is in contrast to higher percentages observed in FMS patient samples by other researchers. For example, Evren et al. (2006) found that 39.2% of their FMS patient sample reported high alexithymia, and Steinweg et al. (2011) found that 44% of their FMS patient sample reported high alexithymia.

When breaking apart the individual alexithymia factors, the sample reported average alexithymia Factor 1 (difficulty in identifying feelings) scores of 19.54 (*SD* = 6.34), average Factor 2 (difficulty in describing feelings) scores of 12.90 (*SD* = 5.21), and average Factor 3 (externally oriented thinking) scores of 17.17 (*SD* = 4.27). The highest score for this sample was Factor 1: difficulty in identifying feelings. The second highest

was Factor 2: externally based thinking, and the lowest measure was Factor 3: describing their emotions. To put this in context according to the literature, Martínez et al. (2014) found that when compared to a healthy control group, FMS patients evidenced significantly higher ratings on measures of both identifying and describing their emotional states. In their study, however, those in the control group scored higher than the FMS participants on the third factor: externally based thinking (Martínez et al., 2014).

Alexithymia has been shown to be positively correlated with negative affect (Makino et al., 2013; Tooyserkani et al., 2011). This was also the case in this study. When performing the analysis of covariates, alexithymia was shown to have a significant positive correlation (r = .41) with negative affect. As alexithymia scores increased, so too did measures of negative affect. Tooyserkani et al. (2011) also observed a positive correlation between alexithymia and pain levels as well as a negative correlation between alexithymia and positive affect. These findings were not observed in this current study. However, the majority of the participants in this study reported low alexithymia scores—which is in contrast to what has previously been found in other samples of FMS patients, so it could be that these correlations were not found because alexithymia did not seem to be problematic overall in this sample of FMS patients.

Laughter frequency. Participants in this current study laughed, on average, 3.97 times per day (SD = 2.77), with an overall range of 0.89 to 11.96. This is considerably lower than what was found by Martin and Kuiper (1999) in their study with 80 community volunteers. Martin and Kuiper had participants log their overall laughter incidence for 3 days, and their study participants averaged 18 instances of laughter per

day, with a range of 0 to 89. The seeming deficit of reported laughter found in this sample may be worthwhile researching further with larger populations of FMS patients as well as with other chronic illness populations. Though it appears that laughter frequency has not yet been studied with medical outcomes of FMS patients (or with other chronic pain populations), it has been studied with regards to cardiovascular disease and as a predictor of disability in older adults (Hirosaki et al., 2011; Hayashi et al., 2016).

Hirosaki et al. (2011) conducted a 1-year prospective study with 162 older adults (aged 65 and older) in Japan. At the initial interview, it was confirmed that the participants did not have any functional disabilities. Information collected from participants included self-reported measures of laughter frequency, medical conditions present, and other psychological, sociological, and demographic information. The researchers found that those with lower reported frequency of laughter were significantly more likely to have subsequent functional disabilities a year later (Hirosaki et al., 2011). Although I did not measure or predict functional disabilities in this study, worsening symptoms of FMS have been shown to be associated with increasing disability and may render patients unable to complete everyday tasks (see ACR, 2010). In this study, it has been demonstrated that laughing more for these patients results in improvements to positive affect and pain levels. If FMS patients are feeling better, it would intuitively suggest that laughing more frequently might be associated with an increased ability to carry out the tasks of daily living—perhaps a worthwhile topic for future investigations with this population.

Hayashi et al. (2016) analyzed cross-sectional survey data from a large sample of older adults in Japan (N = 20,934). Those who reported never or almost never laughing per day had a significantly increased likelihood of having experienced a heart attack or stroke when compared to those who reported laughing daily. In Hayashi et al.'s study, depression was also shown to be a predictor of heart attack and stroke, but when depression was controlled for in the analyses, laughter frequency remained an independent predictor. Similarly, in this present study, depression was shown to be a significant predictor of decreases in positive affect, increases in negative affect, and increases in pain, but when depression was controlled for, laughter frequency remained an individually significant predictor of decreased pain and increased positive affect ratings. Hayashi et al. suggested that laughter frequency may be health protective in terms of ameliorating symptoms caused by psychological stress and that increased laughter frequency may also be indicative of people who enjoy "physically and or mentally positive lifestyles" (p. 549). They cautioned, however, that, it could also be possible that those who had experienced cardiovascular disease "may experience fewer occasions in daily life to feel cheerful" (Hayashi et al., 2016, p. 549). The same might also hold true for those with FMS.

Hierarchical Analyses

Hypothesis 1. In the first hypothesis, I investigated the influence of laughter frequency on participants' positive and negative affect ratings while controlling for measures of depression and alexithymia. In studies with undergraduate students, it has been shown that more frequent laughter is significantly associated with increased

cheerfulness (Young, 1937). It has been shown that elicited laughter from humorous videos produces significant temporary improvements in positive affective states (Sakuragi et al., 2002), and it has been shown that forced (simulated) laughter has been found to significantly improve positive affect ratings (Foley et al., 2002; Neuhoff & Schaefer; 2002). In this study, I demonstrated that those beneficial outcomes to positive affect from laughter appear to also be available to those with FMS. Those who laughed more frequently in this study reported significantly higher ratings of overall positive affect.

However, laughter frequency was not found to have a significant relationship with participants' negative affect ratings in this study. Negative affect is associated with adverse effects in those with FMS. Those FMS patients who report higher measures of positive affect also tend to report lower symptomology, whereas those reporting higher levels of negative affect tend to report increased symptom burden in FMS (McAllister et al., 2013). Pain-related negative affect has also been shown to account for a significant proportion of variance in pain intensity with these individuals (Staud et al., 2006). These patients appear to also be especially vulnerable to pain exacerbations when experiencing aversive emotional states (Davis et al., 2001). Davis et al. found that patients with FMS primed into an aversive emotional state evidenced increases in their pain levels, and those pain levels then remained elevated, not returning to baseline during the 10-minute recovery period.

There are few recent studies regarding laughter frequency and affect in the literature to compare with the outcomes of this study, however, the findings by Kuiper

and Martin (1998) continue to be relevant to this investigation. In their three-day study involving community volunteers, Kuiper and Martin (1998) similarly did not show a direct effect of laughter frequency on negative affect ratings. However, they did find laughter frequency acted to moderate the effects of stressful experiences on their ratings of negative affect. Those who laughed more in their study did not report as much of an increase in their negative affect ratings as their stressors increased. However, Kuiper and Martin's study was conducted with volunteers from the community, not with chronic pain patients, and their participants reported laughing more frequently on average (18 times per day) than the participants in this study (3.97). It could be that with the pain and other symptoms being experienced by this group of participants, that the frequency of laughter was not quite enough to also produce improvements in negative affect ratings.

Hypothesis 2. In the second hypothesis, I investigated the influence of laughter frequency on the participants' perceived chronic pain levels while controlling for measures of depression and alexithymia. The findings of these analyses indicated that as overall laughter frequency increased, participants' overall perceived chronic pain levels significantly decreased. This is consistent with the outcomes of other studies reviewed for this investigation, with both acute and chronic pain conditions. With regards to acute pain, laughter has been found to increase discomfort thresholds and pain tolerance (Dunbar et al., 2011; Mahony et al., 2001; Stuber et al., 2009; Zweyer et al., 2004). With regards to chronic pain, fewer studies have been conducted, but it appears that laughter may appear to exhibit positive effects in terms of reducing how bothersome the pain is

with RA patients (Herschenhorn, 1994), and in reducing the intensity of pain in older adults with chronic pain participating in humor therapy (Tse et al., 2010).

Follow-up and posthoc analyses: Hypotheses 1 and 2. In the follow-up and post hoc analyses, it was found that increases in morning laughter frequency (laughter incidence from wake-up ratings to the time of midday ratings) were shown to be associated with significantly higher midday and evening ratings of positive affect, as well as with significantly lower midday ratings of pain. However, there were no significant relationships observed between increased evening laughter frequency (laughter incidence from the midday ratings to the evening ratings) and evening positive affect ratings or evening pain ratings. Based on these outcomes, it appears study participants benefited most from increased laughter frequency earlier in the day, and those benefits to positive affect were sustained from the morning to the evening ratings.

It was observed in the analyses that participants tended to report higher pain levels in their evening ratings, along with lower positive affect and higher negative affect ratings compared to their midday ratings. It is possible that they were fatigued in the evenings, or that their increased evening symptomology could have led to a decreased ability to benefit as much from episodes of laughter in the afternoon and evening. Although levels of fatigue were not measured in this study, Reilly and Littlejohn (1993) assessed fibromyalgia patients ($N = 17$) in the morning and then again in the evening, and found that participants reported worsened fatigue (as well as pain) in the evening ratings compared to the morning ratings. The authors also reported that their participants reported that "they felt at their best around mid-day" (Reilly & Littlejohn, 1993, p. 237),

and concluded that FMS symptoms tend to become more prominent toward the evening. This appears to be consistent with this study's outcomes. Study findings were significant at the midday ratings, but the only significant finding for the evening ratings was the sustained increase in positive affect related to morning laughter frequency. It would be interesting to know if fatigue was an influencing factor in this study's results, and it might be something to consider adding to the analyses for future studies.

Additionally, as discussed in the second chapter, Zautra, Fasman, et al. (2005) suggested that those with FMS tend to have trouble sustaining positive affect, and as such they may not have enough positive affect stores to mediate the effects of increasing pain and stress. They may also have difficulty drawing from the positive affect stores they do have when experiencing aversive states related to increased pain or stress (Furlong et al., 2010). In this study, increases in morning laughter were related to sustained improvements in evening positive affect ratings—indicating that participants were able to shore up their positive affect reserves. Despite evening increases in pain and in negative affect ratings, morning laughter frequency continued to be significantly associated with higher evening positive affect ratings. This suggests that these participants had long lasting stores of positive affect that did appear to mediate the increases in evening pain and negative affect. As such, it appears that direct interventions geared toward improving positive affect states and increasing the available stores of positive affect in these individuals may assist them in being able to sustain positive affect to buffer against increasing levels of pain or negative affect related to other stressors.

Another consideration is the extended duration of this study. It is possible that over time, participants may have become tired of completing the assessments, and that perhaps they were less diligent in recording laughter frequency and less thoughtful in completing their daily assessments. Okifuji, Bradshaw, Donaldson, and Turk (2011) asked FMS patients to document eight symptom measures 3 times per day for 30 days. They found that after 1 week, participants were more likely to begin missing measures. With longer duration of the study, more measures were missed. Based on their outcomes, the Okifuji et al. (2011) concluded that the ideal length of time for symptom reporting is likely to be 1 week in duration. If this study is to be replicated, it might be worthwhile to change the reporting time frame to 1 week only.

Dynamic model of affect. The findings of this study do appear to provide support for the tenets of the dynamic model of affect theory. According to the principles of this model, it is predicted that if individuals experience episodes of positive affect during the time they are experiencing increased pain or stress, the positive emotions (in this case, the positive emotional state of laughter) should act to moderate pain-related negative emotions. The developers of this model suggested that experiencing (and being able to sustain) positive affective states is important in being able to reduce the impact of aversive emotional states caused by increased pain (Zautra et al., 2001; Zautra, Fasman, et al., 2005), which in turn is expected to increase their ability to recover from episodes of heightened pain and stress (Davis et al., 2004). Though this study's outcomes did not show a significant direct effect of laughter frequency on negative affect, it was shown that increased laughter frequency was significantly associated with increases in overall

positive affect. This indicates that increased laughter did appear to produce improvements in positive affect for this group of FMS patients, and those improvements were sustained from midday ratings to evening ratings.

Pain theories. Findings of these analyses appear to support the influence of psychological factors on the experience of pain in individuals with FMS. As suggested by Melzack and Wall (1965), in their gate control theory of pain, rather than a simple stimulus-response type of relationship, some pain experiences may also be influenced by the individual's attention, memories, and emotional state. In these cases, the individual might be able to alter his or her pain experience through distraction techniques or other types of strategies geared toward exerting some control over the pain (Melzack & Wall, 1965). Because increased laughter frequency was associated with lower pain levels in this sample, this might provide some evidence that laughter could be an effective strategy (or distraction) for ameliorating some of the discomfort associated with FMS pain.

Similarly, within the neuromatrix theory of pain theory (Melzack, 1999b; Melzack, 2005), it was proposed that the pain experience could be subject to being altered by many types of influences and stimuli. These potential influences include the sensory, cognitive, and affective dimensions (Melzack, 2005). In this particular study, it appears that the activation of the affective dimension was associated with reductions in pain. As overall laughter frequency increased, overall positive affect increased, and overall pain levels decreased. In this way, laughter frequency appears to have influenced positive affect rating scores, which may have then served to modulate the pain experienced by these individuals. McAllister (2015) suggested that treatments geared

toward reducing pain severity in chronic pain patients should target various dimensions of the pain experience in the neuromatrix. This would ideally include a comprehensive, interdisciplinary approach—including conventional treatments, physical therapy, and health psychologist and cognitive therapist interventions.

Limitations

As discussed in the first chapter, because this study did not take place in a rigorously controlled laboratory setting in which extraneous variables could be minimized, it is possible that there were other confounds that could have influenced this study's results. There also could have been unknown events or experiences in the participants' lives that exerted effects on their ratings and on their frequency of laughter.

Additionally, there are limitations to the generalizability of this study to other populations. For example, this sample was disproportionately composed of women (95.12%). Study results may not necessarily generalize to men with FMS. Additionally, because this study was conducted solely with FMS patients, results may not easily generalize to other chronic pain patients, or to patients with other medical conditions. Also, as discussed in the first chapter, study results may not even be easily generalizable to the larger population of FMS patients. This study's participants were all volunteers and there may be intrinsic differences between those FMS patients who chose to volunteer for the study and those who did not. There could be variances in personality traits, or it could be that those who did not choose to participate may have been more symptomatic than those who volunteered for the study, making it more difficult for them to fulfill the requirements of the study. As such, it might be useful for future researchers to consider

methods that could potentially target a larger population of FMS patients with various symptom profiles—perhaps through the use of a simple survey that is less burdensome for participants to complete. Indeed, several prospective participants in this study believed they were volunteering to complete a survey, and when they were instructed in what was expected of them for this two-week long investigation, they did not continue with the study.

It is also possible that results might have been influenced by participants' implicit expectations that they would experience reductions in pain and improvements in emotional states if they laughed more frequently. For example, Mahony et al. (2001) showed videos to their participants (the content of the videos was either relaxing or funny), and then applied blood pressure cuffs to participants in order to elicit acute pain. They found that both control participants (no priming) as well as those who had been primed to expect their discomfort thresholds to increase evidenced increases in pain thresholds. Mahony et al. (2001) concluded that it might be attributed to the existing implicit expectations the control group participants already had regarding the effects of relaxation or humor. However, as discussed above, if this were the case in this study, it seems that their negative affect ratings would also have been affected by laughter frequency. This also does not explain why laughter frequency was associated with lower pain ratings in the afternoon, but not in the evening ratings. It seems that if implicit expectations were influencing the results, they would have influenced all measures.

Another potential limitation to the study may be the nature of the way the data were gathered. Participants found it necessary to interrupt their activities and document

each time they laughed. It could be that some laughter incidents were missed or recorded after the fact, increasing the risk that the data may not have been precisely accurate. Future researchers may consider other options for tracking laughter, such as employing simple clicker counters that are less disruptive or using a recording device to capture laughter in real time. It may also have been beneficial to use computer applications or Smart Phone Apps to complete and submit the daily measures as they were taken.

Recommendations for Future Research

As I have mentioned above, future researchers might consider investigating how frequently FMS patients laugh in general as compared to samples of patients with other types of chronic pain, to patients with other types of medical conditions, as well as to samples of healthy volunteers. Based on this study's results, it appears FMS patients laugh relatively infrequently (3.97 times per day, on average). It would be interesting to learn whether this holds true for a larger sample of FMS patients. Adding fatigue as a measurable variable in future studies might also be useful. It would be interesting to know whether and how fatigue impacts FMS patients' affect ratings as well as their levels of pain, along with considering the role of laughter frequency. Also, it might be worthwhile to conduct a similar study, but shortening the time frame to 1 week of data collection.

Because it is not known whether strength or duration of laughter episodes may have played a role in this study's findings, for a potential future follow-on study I would also be interested in analyzing whether that data captured by participants on their laughter logs intensity or duration of laughter had any influence on their outcome measures. Also,

because negative affect ratings in this sample were largely unaffected by laughter frequency, efforts to target negative affect ratings with this population might also be an interesting topic to research in future investigations. If interventions are found that are associated with a decrease in negative affect that might also assist in bringing about decreases in symptomology for these patients.

Finally, since this study relied on participants simply recording each episode of laughter as it occurred naturally in their everyday lives, it might be useful in future studies to conduct a formal laughter intervention with this population. This more controlled, laboratory approach to this topic could help us understand how deliberate increases in laughter frequency influence affect and pain in this population.

Implications

Positive Social Change

The outcomes of this study have the potential to be associated with various levels of positive social change. At the individual level, if laughing more frequently can lead to improvements in positive affect and pain, these decreases in symptomology can, over time, potentially lead to improvements in overall mood, increased productivity in daily activities, and perhaps even enhanced interpersonal relationships and increased involvement in community events. The better FMS patients feel, the more likely they will be to participate more in their lives. Laughing more is also something they can do with their family, thereby having more fun and improving relationships. It may also mean fewer days missed from work, or the ability to more fully participate in longer work hours, which would enhance their economic position. Even a slight improvement brought

about by a self-care strategy such as laughing more frequently may have the effect of reducing visits to medical providers, thereby decreasing health care costs. Something as simple as laughter could make a meaningful impact (no matter how small) in these individuals' lives, those of their friends, family, and coworkers, and in the field of health care. Finally, it may also have implications for future research. Because of what has been observed in this study's outcomes, other researchers may be influenced to conduct further investigations. As more and more is learned about the potential effects and influences of laughter, the results can be used to foster more study or to be put into practice in the health care arena. For instance, laughter yoga, shown to have promise as a treatment modality in research (Sakuragi et al., 2002), could be implemented more widely as part of a comprehensive, interdisciplinary plan of care. Those implementing the treatments could gather pre and post data on participants in order to provide evidence-based outcomes. If such programs appear to produce beneficial outcomes for patients, the more likely it will be that laughter interventions will be more formally (and widely) used within medical settings.

Recommendations for Practice

This study paves the way for research involving more formal applications of laughter with FMS patients. This research could also represent a step forward toward the acceptance of laughter therapy as an alternative treatment modality as part of an interdisciplinary team approach to care with these patients. If nothing else, it provides some support for the beneficial effects of laughter for pain and temporary emotional states in those with FMS. Providers could encourage their FMS patients to seek out

frequent laughter opportunities. This might mean participating in activities such as watching some of their favorite humorous videos, spending time with friends, or even attending formal laughter workshops.

Conclusion

In this study, I set out to investigate whether the positive benefits of laughter observed with acute pain and in other health conditions also held true for those with the chronic pain and affective difficulties characteristic of FMS. Indeed, the findings of this investigation do appear to support the assertions that increased laughter frequency is associated with improvements in pain levels and affective states in those with FMS. It is hoped that this knowledge might inspire and encourage FMS patients to seek out reasons to laugh, and to laugh more often. Because conventional treatment typically does not ameliorate all symptoms, it is important for FMS patients to have a set of alternative strategies to help boost their treatment's effectiveness. Some may find laughter to be a helpful strategy added to their interventional toolbox. It is also hoped that interdisciplinary health care teams might consider encouraging laughter (whether that be individually or as part of formal laughter interventions) as part of a comprehensive treatment and self-care plan. Finally, it is hoped that researchers continue adding to this foundation of knowledge with regards to laughter and its potential health effects.

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Appendix A: Release of Information

Authorization to Use or Disclose PHI for Research Purposes

The top portion of this form (above the dotted line) should be completed by the researcher. A copy of the form should be given to the research participant for his/her personal records.

Research Participant Name: _____
Phone: _____
Address: _____
Discloser of Information: _____
Recipient of Information: **Deidre Molchan, MA**
Means of disclosing information (i.e., verbal, written, etc.): **Verbal, written, or electronic**
Information to be disclosed:
School district/educational data
Mental Health/psychological data
Legal data
Chemical dependency/abuse data
Medical data
Other (specify) Diagnosis Confirmation
_____
Reason for the Release: This information is being released/obtained for the purpose of **Researcher confirming fibromyalgia syndrome diagnosis.**

Authorization Provided by Research Participant:
I understand that this authorization permits the release of information between the two parties named above.

I understand that I have the right to refuse to sign this release form.

I understand that upon release, this information will be kept confidential; my identity will be concealed and data will not be re-disclosed outside of the specified individuals or agencies.

I understand a photocopy of this release will be as effective as the original.

I understand this authorization will be in effect for 12 months from the date signed unless cancelled by me in writing. Upon receipt of the written cancellation, this release will be void.

_____
Signature Date

_____

Witness Date

Appendix B: TAS-20

Sex: M / F **Age:** **Date:** **ID #:**

T A S – 20

Using the scale provided as a guide, indicate how much you agree or disagree with each of the following statements by circling the corresponding number. Give only one answer for each statement.

Circle 1 if you STRONGLY DISAGREE
Circle 2 if you MODERATELY DISAGREE
Circle 3 if you NEITHER DISAGREE NOR AGREE
Circle 4 if you MODERATELY AGREE
Circle 5 if you STRONGLY AGREE

	Strongly Disagree	Moderately Disagree	Neither Disagree Nor Agree	Moderately Agree	Strongly Agree
1. I am often confused about what emotion I am feeling.	1	2	3	4	5
2. It is difficult for me to find the right words for my feelings.	1	2	3	4	5
3. I have physical sensations that even doctors don't understand.	1	2	3	4	5
4. I am able to describe my feelings easily.	1	2	3	4	5
5. I prefer to analyze problems rather than just describe them.	1	2	3	4	5
6. When I am upset, I don't know if I am sad, frightened, or angry.	1	2	3	4	5
7. I am often puzzled by sensations in my body.	1	2	3	4	5
8. I prefer to just let things happen rather than to understand why they turned out that way.	1	2	3	4	5
9. I have feelings that I can't quite identify.	1	2	3	4	5
10. Being in touch with emotions is essential.	1	2	3	4	5

Date: **ID #:**

T A S – 20

	Strongly Disagree	Moderately Disagree	Neither Disagree Nor Agree	Moderately Agree	Strongly Agree
11. I find it hard to describe how I feel about people.	1	2	3	4	5
12. People tell me to describe my feelings more.	1	2	3	4	5
13. I don't know what's going on inside me.	1	2	3	4	5
14. I often don't know why I am angry.	1	2	3	4	5
15. I prefer talking to people about their daily activities rather than their feelings.	1	2	3	4	5
16. I prefer to watch "light" entertainment shows rather than psychological dramas	1	2	3	4	5
17. It is difficult for me to reveal my innermost feelings, even to close friends.	1	2	3	4	5
18. I can feel close to someone, even in moments of silence.	1	2	3	4	5
19. I find examination of my feelings useful in solving personal problems.	1	2	3	4	5
20. Looking for hidden meanings in movies or plays distracts from their enjoyment.	1	2	3	4	5

Appendix C: Demographic Questionnaire

ID #:_____ _____Female ____Male
Date: _____

Fibromyalgia Syndrome
Demographic Information Form

Marking Instructions: Please complete the choice which best reflects your experience.

1. How old are you? _____

2. What is your ethnicity? _____

3. You are:
□1 Married/Partnered
□2 Single
□3 Divorced
□4 Widowed
□5 Other: _____

4. If you are married/partnered, do you live with your spouse?
□1 Yes
□2 No

5a. Do you have any children?
□1 Yes
□2 No

5b. How many children do you have? _____

5c. How old are they? _____

5d. If your children are grown, where do they live? _____

6. What is the highest grade you completed in school? (Check one)
□1 8th grade or less
□2 Some High School
□3 High school graduate
□4 Some college
□5 College graduate
□6 Post graduate work

7. Are you currently employed?

□1 Yes
□2 No

7a. If you are employed, are you working:
□1 Full-time
□2 Part-time
□3 Self-employed
□4 Never worked outside the home

7b. What is your occupation (if retired, what was your occupation)?
_____

7c. If you are retired, when did you retire? _____

8. What is your average yearly family income? (Check one)
□1 < $15,000:
□2 $15,000-29,000:
□3 $30,000-44,000:
□4 $45,000-59,000:
□5 $60,000-74,000:
□6 $75,000-89,000
□7 $90,000-114,000
□8 $115,000-129,000
□9 $130,000-200,000
□10 $201,000-500,000
□11 $501,000-1,000,000
□12 > $1,000,000

9. When were you first diagnosed with fibromyalgia syndrome?
_____

10a. As a result of your fibromyalgia syndrome diagnosis, have you had a change in income?
□1 Yes
□2 No

10b. If yes, have you had:
□1 Increased Income
□2 Decreased Income
□3 No change in Income

11a. Are you taking any medications for symptom management?
□1 Yes

□2 No

11b. If yes, please list the medications and dosages below:

□_____

□_____

□_____

□_____

□_____

□_____

12a. Have you engaged in any alternative therapies or activities as an adjunct to conventional medical treatment for fibromyalgia symptom management?
□1 Yes
□2 No

12b. If yes, please list those alternative therapies or activities
□_____

□_____

□_____

□_____

□_____

□_____

13a. Have you been diagnosed with other medical conditions in addition to fibromyalgia syndrome?
□1 Yes
□2 No

13b. If yes, please list those diagnoses
□_____

□_____

□_____

□_____

□_____

□_____

14a. Have you ever seen a mental health professional to help you cope with your fibromyalgia symptoms?
□1 Yes
□2 No

14b. If yes, what type of mental health professional was it?
□1 Psychologist
□2 Psychiatrist
□3 Social worker
□4 MFCC
□5 Other

14c. If yes, for how long did you see this person? _____

Appendix D: Positive and Negative Affect Schedule (PANAS)

PsycTESTS®

Positive and Negative Affect Schedule

PsycTESTS Citation:
Watson, D., Clark, L. A., & Tellegen, A. (1988). Positive and Negative Affect Schedule [Database record]. Retrieved from PsycTESTS. doi: 10.1037/t03592-000

Test Shown: Full

Test Format:
The 10-item Positive Affect (PA) and Negative Affect (NA) scales comprise the 20-item PANAS. Participants are asked to indicate to what extent they felt each of the 20 terms based on various time instructions on a 5-point scale (1 = very slightly or not at all, 2 = a little, 3 = moderately, 4 = quite a bit, 5 = extremely). Based on the preference of the researcher, participants are asked to what extent they felt a certain way either: (a) "right now (that is, at the present moment)" (moment instructions); (b) "today" (today); (c) "during the past few days" (past few days); (d) "during the past week" (week); (e) "during the past few weeks" (past few weeks); (f) "during the past year" (year); or (g) "in general, that is, on the average" (general).

Source:
Watson, David, Clark, Lee A., & Tellegen, Auke (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. Journal of Personality and Social Psychology, Vol 54(6), 1063-1070. doi: 10.1037/0022-3514.54.6.1063

doi: 10.1037/t03592-000

Positive and Negative Affect Schedule
PANAS

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent [INSERT APPROPRIATE TIME INSTRUCTIONS HERE]. Use the following scale to record your answers.

1 =	2 =	3 =	4 =	5 =
very slightly or not at all	a little	moderately	quite a bit	extremely

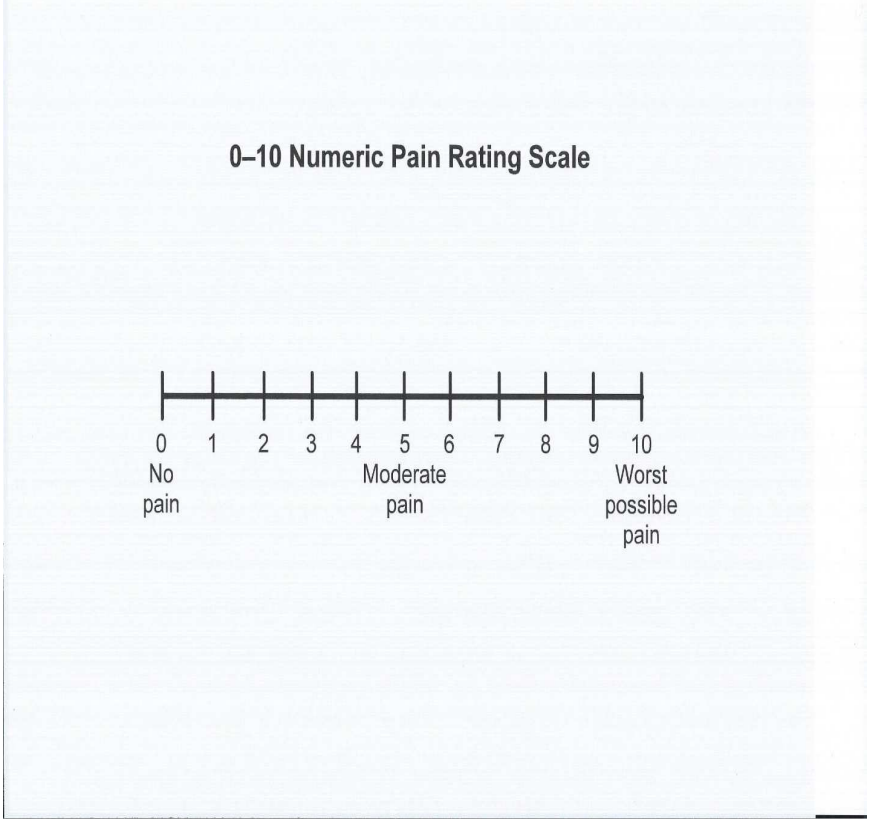
_____ interested	_____ irritable
_____ distressed	_____ alert
_____ excited	_____ ashamed
_____ upset	_____ inspired
_____ strong	_____ nervous
_____ guilty	_____ determined
_____ scared	_____ attentive
_____ hostile	_____ jittery
_____ enthusiastic	_____ active
_____ proud	_____ afraid

We have used PANAS with the following time instructions:

Moment	(you feel this way right now, that is, at the present moment)
Today	(you have felt this way today)
Past few days	(you have felt this way during the past few days)
Week	(you have felt this way during the past week)
Past few weeks	(you have felt this way during the past few weeks)
Year	(you have felt this way during the past year)
General	(you genally feel this way, that is, how you feel on the average)

Appendix E: Pain Intensity—Numeric Rating Scale (PI-NRS)

Retrieved 10 May 2015, from
http://www.painedu.org/downloads/nipc/pain%20assessment%20scales.pdf



Appendix F: DLR

ID#_____

Daily Laughter Record

(Martin & Kuiper, 1999; adapted with permission)

Day____ (1 – 14) **Date**_____

Laughter Occurrence	**Time**	**Stimulus** M= Mass Media S= Spontaneous Situation J= Joke E= Event	**Strength of Laughter** 1 = silent chuckle/forceful exhale or snort 2 = a little bit of laughter 3 = a lot of laughter	**Who Caused the Laughter?** S = Self O = Other (family, friend, pets, etc.)	**Were Others Present?** Y or N.
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

Appendix G: Emergency Guidance

Emergency Guidance

It is unlikely, and not anticipated, that you will experience any increased distress or worsening mood issues due to your participation in this study. However, if your symptoms worsen during the course of the study and you feel as if you are at significant risk of harming yourself or others, please call 911 or go to your nearest emergency room. If the need is less emergent, please contact your primary care physician as soon as possible or schedule an appointment with a local community mental health center. Alternatively, you may consider reaching out to one of the telephone or online chat hotlines listed below, or you may also contact the researcher, Deidre Molchan, at XXX-XXX-XXXX or via email at XXX@waldenu.edu.

Crisis Hotlines:

National Hopeline Network
(800) SUICIDE

National Suicide Prevention Lifeline
(800) 273-TALK (8255)

Online Crisis Hotlines with Chat Function:

http://www.suicidepreventionlifeline.org/GetHelp/LifelineChat.aspx
http://www.crisischat.org/
*Hotline information retrieved from http://psychcentral.com/lib/common-hotline-phone-numbers/

Participants Outside of the United States:

UK or Ireland: http://www.samaritans.org
Other Countries: Befrienders International—Helplines for over 40 countries.
http://www.befrienders.org