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ACCEPTANCE

This dissertation, THE BIOPSYCHOSOCIAL CORRELATES OF CHRONIC PELVIC PAIN AND QUALITY OF LIFE IN WOMEN ATTENDING A SPECIALTY PELVIC PAIN CLINIC by Elisabeth A. Johnson was prepared under the direction of the candidate's dissertation committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Nursing in the Byrdine F. Lewis School of Nursing and Health Professions, Georgia State University.

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Caitlin Martin BS, **Elisabeth Johnson,** MSN, PhDc, Mary Ellen Wechter, MD, MPH, Jane Leserman, PhD, Denniz Zolnoun, MD, MPH. Catastrophizing: a strong predictor of persistent pain among women with endometriosis at one year. *Human Reproduction, 26* (11), 3078-84.

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ABSTRACT

THE BIOPSYCHOSOCIAL CORRELATES OF CHRONIC PELVIC PAIN AND QUALITY OF LIFE IN WOMEN ATTENDING A SPECIALTY PELVIC PAIN CLINIC

by

ELISABETH A. JOHNSON

Background: Chronic pelvic pain (CPP) in women causes significant disability and distress. Like other chronic pain conditions, psychosocial variables likely play as key a role in the development and maintenance of CPP as physiological ones. The purposes of this study were to use the Biopsychosocial model to determine the predictors of pain and quality of life (QOL) and to specifically examine to effect of baseline catastrophizing on 12-month pain and QOL.

Methods: Secondary analysis of baseline and 12-month data collected from women presenting for CPP treatment (n = 673) at a tertiary referral center was performed. Questionnaires assessed medical symptoms, physical and mental health, abuse, trauma, catastrophizing and the main outcome measures of pain reports (McGill Pain Questionnaire) and QOL scores (adapted version of the Irritable Bowel Syndrome QOL Questionnaire).

Results: Of the 673 enrolled, 401 completed baseline questionnaires. These women were predominantly middle aged (M = 35.68, SD = 9.87), married (66%), Caucasian (78%), and educated (M = 14.83, SD = 2.55). Two hundred seventy-two women completed

questionnaires at baseline and 12 months and were similar in most characteristics but reported fewer incidents of trauma and abuse, improved physical health and fewer medical symptoms. Women experienced a significant reduction in pain (t (261) = 11.23, $p < .001$) and improved QOL (t (257) = 6.78, $p < .001$). Baseline catastrophizing was a predictor of baseline pain ($R^2 = .42$, $p < .001$; $\beta = .46$, $p < .001$) and baseline QOL ($R^2 = .79$, $p < .001$; $\beta = .71$ p < .001) with similar results at 12-month follow-up. While baseline catastrophizing contributed only 3% of the variance it remained a significant predictor of 12-month pain ($R^2 = .39$, $p < .001$; $\beta = .18$, $p = .003$). Unexpectedly, abuse and trauma histories were not significant predictors of pain or QOL.

Conclusions: These findings contribute to the existing body of literature by confirming the complex nature of CPP and suggest that psychological processes such as catastrophizing play a vital role in CPP. Future research in CPP will benefit from the exploration of the contribution of psychological processes to CPP and the application of research from other pain conditions to gynecologic pain disorders.

THE BIOPSYCHOSOCIAL CORRELATES OF CHRONIC PELVIC PAIN AND QUALITY OF LIFE IN WOMEN ATTENDING A SPECIALTY PELVIC PAIN CLINIC

by

ELISABETH A. JOHNSON

A DISSERTATION

Presented in Partial Fulfillment of Requirements for the Degree of Doctor of Philosophy in Nursing in the Byrdine F. Lewis School of Nursing and Health Professions Georgia State University

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LIST OF ABBREVIATIONS

ACOG	American College of Obstetricians and Gynecologists
APS	American Pain Society
CSQ	Coping Strategies Questionnaire
CSQ-CAT	Catastrophizing subscale of the Coping Strategies Questionnaire
CPP	Chronic Pelvic Pain
DNIC	Diffuse Noxious Inhibitory Controls
Ed	Years of Education
fMRI	Functional Magnetic Resonance Imaging
IASP	International Association for the Study of Pain
IC	Interstitial Cystitis
IBS	Irritable Bowel Syndrome
IBS-QOL	IBS Quality of Life Questionnaire
IPV	Intimate Partner Violence
LTSurg	Number of Lifetime Surgeries
MCS	Mental Component Summary of the Rand 12-Item Health Survey
MDOV	Number of Doctor Office Visits in Past 3 Months
MedSx	Medical Symptoms Questionnaire
MH	Mental Health Summary Score of the Rand 12-Item Health Survey
MOS	Medical Outcomes Study
PASS	Power Analysis and Sample Size
PBS	Painful Bladder Syndrome
PCS	Physical Component Summary of the Rand 12-Item Health Survey

PH	Physical Health Summary Score of the Rand 12-Item Health Survey
PMDOV	Number of Office Visits in the Past 3 Months for Pelvic Pain
PPI	Present Pain Intensity on Short-Form McGill Pain Questionnaire
PPSurg	Number of Surgeries for Pelvic Pain
PsychTx	History of Psych Treatment
PTSD	Post-Traumatic Stress Disorder
QOL	Quality of Life
RA	Research Assistant
SF-12	Rand 12-Item Health Survey
SF-36	36 Item Health Survey
SF-MPQ	Short-Form McGill Pain Questionnaire
SPSS	Statistical Package for the Social Sciences
TMJD	Temporomandibular Joint Disorder
TPRI	McGill Pain Questionnaire Total Pain Report Index
UNC	University of North Carolina
VAS	Visual Analog Scale

CHAPTER I

INTRODUCTION

This chapter will provide an overview of the significance of chronic pelvic pain in women and current knowledge in the field. The importance of psychological factors, specifically coping strategies, will be described. Lastly, the use of the Biopsychosocial model as applied in the context of women with chronic pelvic pain will be proposed.

Introduction

Chronic pelvic pain (CPP), a common condition in women, is a major public health problem that has a negative impact on both physical functioning and quality of life. The American College of Obstetrics and Gynecology (ACOG) defines CPP as non-cyclic pain of at least six months duration that is severe enough to cause disability and possibly warrant medical intervention (ACOG, 2004). Among the general reproductive aged gynecologic population, CPP accounts for 10% of gynecologic consultations, 40% of diagnostic laparoscopies, and is the indication for 12% of all hysterectomies (Howard & Sanchez, 1993; Reiter & Gambone, 1990; Zondervan et al., 2001). The first large-scale population based study of the prevalence of CPP in the United States estimated that in 1994, 9.2 million women suffered from CPP (Mathias, Kuppermann, Liberman, Lipschutz, & Steege, 1996). Compared to women without pain, the study found that women with CPP utilized more healthcare services and missed more time from work. The women with pain were significantly more likely to have seen a health care provider

in the previous 3 months and of the 71 % who were employed, 15% missed one or more hours of work per week and reported a mean of 14.8 hours of missed work per month. Mathias and colleagues (1996) calculated that these consequences translated to an estimated direct health care cost of 880 million dollars a year, and total of 1.9 billion dollars in annual patient out-of-pocket expenses and an indirect cost of 555.3 million dollars a year due to time lost from work. Using a standard inflation calendar to adjust for present day value, this would be the equivalent to approximately $1.3 billion in direct health care costs, 2.8 billion dollars in out-of-pocket expenses and 822 million in time lost from work (United States Department of Labor, 2010). When comparing these numbers to those of other diseases, it must be acknowledged that the methods used for measurement often vary between diseases as well as across individual studies. However, the process remains useful. Like CPP, Crohn's disease often involves the use of expensive medications and multiple surgical interventions. In 2002, Sandler and colleagues estimated that the annual cost of Crohn's disease was 865 million dollars, translating to a present day value of 1 trillion dollars. Goldberg (2005) estimated that migraine headaches accounted for 13 to 17 billion dollars in annual costs and a present day value of 14 to 19 billion dollars. Thus, CPP has an economic impact similar to other more commonly recognized chronic health conditions.

CPP can occur in various locations including the pelvis, the anterior abdominal wall, at or below the umbilicus, the lower back or the buttocks (ACOG, 2004). While recognized as a serious issue for women, CPP continues to be difficult to treat. Often, the etiology of CPP is unclear. There are numerous disorders that may be associated with

CPP including those of the reproductive tract, the gastrointestinal system, the urologic organs, the musculoskeletal system and the nervous system (Howard, 2003).

Surgical intervention is the traditional gold standard for the treatment for CPP; however, identifiable pathologies found during laparoscopy such as endometriosis and adhesions are often incidental rather than causal with no demonstrable direct relationship between severity of pathology and intensity of pain (Howard, 2009). Thus, current surgical interventions such as the excision or ablation of endometrial implants and lysis of adhesions, lack long-term effectiveness in pain relief and available medical interventions remain limited (Lamvu et al., 2006; Stones, Cheong, Howard, & Singh, 2005). More radical surgical interventions such as hysterectomy have been demonstrated to have a mixed impact on CPP. Findings among women who have undergone a hysterectomy for benign pain conditions range from little to no relief to a substantial change in daily pain with few consistent findings (Hartmann et al 2004; Hillis, Marchbanks, & Peterson, 1995; Kjerulff, Langenberg et al, 2000). Unfortunately, it has also been shown that women who undergo a hysterectomy specifically for the treatment of their pain are at a higher risk of not experiencing relief and may instead have exacerbation of their symptoms (Brandsborg, Nikolajsen, Hansen, Kehlet& Jensen, 2007).

With the lack of a consistent biological cause and the varying efficacy of available treatments for CPP, researchers have turned to other explanations. Women with CPP have been found to have higher rates of childhood physical and sexual abuse as well as neglect compared to women without CPP (Golding, 1999; Romans, Belaise, Martin, Morris & Raffi, 2002; Walker et al., 1999). Meltzer-Brody and colleagues (2007)

reported that 50% of the women in their cohort with CPP reported a history of physical or sexual abuse. One in three of these same women had a positive screen for post-traumatic stress disorder (PTSD) and were more likely to report their pain as severe. The association between abuse and CPP has also been observed in women experiencing abuse in their adult years. A 2008 review of the literature reported that intimate partner violence (IPV) has been identified as contributing to CPP. The type of violence occurring during IPV appears to play an important role with a stronger association between CPP and IPV involving rape than CPP and IPV involving only physical assault (Romans & Cohen, 2008). The association between trauma history and CPP, however, does not appear to be equivalent across the differing types and sources of pain. Leserman Zolnoun, Meltzer-Brody, Lamvu, and Steege (2006) compared the health and trauma histories of women across identified subtypes of CPP and found that women reporting diffuse abdominal and pelvic pain had histories of more lifetime trauma than those with vulvovaginal pain or cyclic pain

The complex nature of CPP is similar to that of other pain conditions such as fibromyalgia, headache, temporomandibular joint disease, irritable bowel disease and chronic back pain. The International Association for the Study of Pain (IASP) defines pain as "An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage" (IASP, 2010). While this is a rather broad definition, it is generally agreed upon that there are several specific biologic mechanisms that may cause pain including peripheral sensitization after inflammation, stimulation of nociceptive fibers after injury and nerve injury or irritation after a lesion or disease (IASP, 2010). Following this path in CPP and more specifically

in the study of endometriosis-associated pain, it has been asserted that pain is the result of a combination of nociceptive, inflammatory and neuropathic mechanisms (Howard, 2009). In addition to the complex biological systems involved, pain perception is not a passive process and thus the intensity of a painful stimulus does not always correspond with a patient's response (Edwards, Campbell, Jamison, & Wiech, 2009). Sensory information is modulated at all levels of the nervous system. It has been demonstrated that through the activation of multiple modulatory networks within the brain, pain-coping processes play a key role in the inhibition or facilitation of pain perception. Individual differences in coping play a key role in the variability of the pain experience with cognitive, affective and behavioral efforts creating neurobiological effects (Wiech, Ploner, & Tracey, 2008).

Catastrophizing is a pain-coping response that within the broader field of the study of pain has garnered attention. It is defined as a negative emotional and cognitive response to pain and includes the tendency to amplify and focus on pain symptoms as well as the expression of feelings of helplessness and pessimism (Sullivan et al., 2001). Catastrophizing has been found to be a critically important risk factor for pain related outcomes with higher rates being associated with increased levels of reported pain (Edwards, Bingham, Bathon, & Haythorthwaite, 2006). This trend has been illustrated in a variety of pain-related conditions including neuropathic pain, back pain, spinal cord injuries and scleroderma (Buer & Linton, 2002; Edwards, Bingham, Bathon, & Haythornwaithe, 2006; Hanley, Raichle, Jensen, & Cardenas, 2008; Turner, Jensen, Warms, & Cardenas, 2002). Across both non-patient and chronic pain populations, individuals with high levels of catastrophizing appear to be at greater risk for developing

post-surgical pain, as well as musculoskeletal and other persistent pain syndromes (Granot, 2005; Severijns, Van Den Hout, & Weber, 2001; Severijns, Vlaylen, & van den Hou, 2004; Turner 2004).

The exact mechanism through which catastrophizing has an influence upon pain is not entirely understood. Functional magnetic imaging resonance (fMRI) studies have demonstrated that higher levels of catastrophizing in patients are associated with an increase in brain activity in brain regions that are involved in the emotional processing of pain (Gracely et al., 2004; Strigo, Simmons, Matthews, Craig, & Paulus, 2008). Among otherwise healthy individuals, higher catastrophizing levels have been associated with a reduction in activity in brain areas involved in pain-inhibitory systems during periods of more intense pain stimulation (Seminowicz & Davis, 2006). In addition to changes noted during neuroimaging, catastrophizing has been linked to an enhanced inflammatory response among rheumatoid arthritis patients and elevations in pro-inflammatory cytokines during acute pain processes (Edwards, Bingham, Bathon, & Haythornthwaite, 2006; Edwards, Kronfli, Haythornthwaite, Smith, McGuire, & Page, 2008).

Statement of the Problem

While it is generally accepted that CPP is a common and costly gynecologic problem, available statistics on prevalence and cost to the US health care system are outdated. The most commonly cited are those from a 1994 Gallup poll surveying 17,927 households (Howard, 2003; Mathias et al., 1996; Meltzer-Brody et al., 2007). Thus, the current scope and magnitude of the issue may be larger than previous numbers indicate. Depending upon the chosen definition, CPP has been estimated to have a prevalence from 3.8% to 25 % among women between the ages of 15 and 73 (Howard & Sanchez, 1993;

Pitts, Ferris, Smith, Shelley, & Richters, 2008; Zondervan et al., 2001). This is a similar prevalence rate to that of migraine headaches (18%).

Two uncontrolled follow up studies have investigated the clinical course of CPP in secondary care centers and have illustrated that medical and surgical interventions for CPP have proven to have varying levels of success (Lamvu et al., 2006; Weijenborg, Greeven, Dekker, Peters, & Ter Kuile, 2007). Given this, it is evident that more needs to be understood about CPP so that more effective intervention strategies may be developed. Studies of other pain conditions such as fibromyalgia, chronic back pain and headaches suggest that pain appraisal and coping strategies may be as important an indicator of symptom improvement as traditional medical interventions (Edwards et al., 2009; Turk, 2003). The same may be true in CPP. It is imperative that importance of coping strategies in CPP be determined so that the repertoire of interventions may be expanded and increase the chances of women experiencing daily pain being able to live more productive lives.

Purpose/Significance

There are currently very few studies that have evaluated the links between CPP and psychosocial variables and to date, there are no studies that evaluate these links over time. The purposes of this study were to use the Biopsychosocial model to determine the predictors of pain and quality of life (QOL) in a group of women with CPP and to specifically examine to effect of baseline (BL) catastrophizing on BL and 12-month pain and QOL. The expansion of the current knowledge base in CPP will aid in the development of more effective interventions and allow women diagnosed with CPP to have more options in the treatment of this disorder.

Hypotheses and Research Questions

Hypotheses

In a sample of women with CPP:

At baseline

1. Higher lifetime abuse and lifetime trauma will be associated with higher levels of catastrophizing.
2. Less catastrophizing will be associated with better physical and mental health. .
3. More catastrophizing will be associated with higher pain.
4. Catastrophizing will contribute significant variance to pain scores above that contributed by lifetime abuse, lifetime trauma, health status (physical and mental), and medical symptoms.
5. Catastrophizing will contribute significant variance to quality of life above that contributed by lifetime abuse, lifetime trauma, health status (physical and mental), and medical symptoms, and pain.

Research questions exploring factors predicting pain and quality of life at 12 months

In a sample of women with CPP:

1. Is catastrophizing at baseline a predictor of pain scores at 12 months controlling for baseline measures of lifetime abuse, lifetime trauma, health status (physical and mental), pain, and medical symptoms?
2. Is catastrophizing at baseline a predictor of quality of life at 12 months controlling for baseline measures of lifetime abuse, lifetime trauma, health status (physical and mental), pain, and medical symptoms.

Theoretical Framework

Historically, pain was conceptualized as a symptom that developed secondary to tissue damage or pathology (Gatchel, Peng, Peters, Fuchs, & Turk, 2007). Following the traditional medical model of disease, pain was, therefore, a warning sign rather than the focus of treatment. Over time, it became evident that, more often than not, the amount of pain reported by patients did not directly correlate with the location or amount of tissue damage observed and that pain often persisted after the initial insult resolved (Gatchel, 2004; Melzack, 2005; Waddell, 1987). The assessment of pain came to the forefront in 1995 when the American Pain Society published guidelines for the treatment of acute pain and cancer (APS, 1995). These guidelines have permeated other clinical areas and currently, pain is often referred to as the "fifth vital sign". Concurrently, clinical research in pain has led to the acceptance that pain is far more than the resulting experience of sensory mechanisms with newer approaches accounting for cognitive, affective and behavioral components (Gatchel et al., 2007).

The newer approaches to pain have been aligned with the Biopsychosocial model of medicine that was proposed by Engel (1977). This model for medicine focuses upon the interaction and importance of both the objective biological event and the subjective experience of the individual. The assertion is that the essence of health and healing occurs in the overlapping area between the psychological, biological and social realms of the individual's life. This model has been adopted by numerous specialties including cardiology, gastroenterology and anesthesiology. In the field of pain, the Biopsychosocial model is now widely accepted as the most effective perspective in the

understanding and treatment of chronic pain disorders (Gatchel, 2005; Gatchel et al., 2007; Loeser, 1982; Waddell, 1987).

The Biopsychosocial model holds promise in the field of CPP. As previously mentioned, identifiable pathologies such as endometriosis, ovarian cysts and pelvic floor muscle spasm are often incidental rather than causal leaving patients and clinicians alike frustrated when pain fails to respond to conventional treatment. Increasingly, researchers in CPP are asserting that like other pain syndromes, variables such as trauma history, psychological co-morbidities and coping strategies are central to CPP progression and treatment.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

Chronic pelvic pain (CPP) is a common problem and causes significant disability and distress among women. While this disorder has been well documented, there continues to be little information about effective interventions. As with other chronic pain conditions such as fibromyalgia, irritable bowel syndrome and migraine headaches, psychological variables such as catastrophizing may play as key a role in the understanding of CPP as traditionally conceptualized physiological variables. This is congruent with a growing body of knowledge that has revealed the moderate to strong associations between coping responses, pain severity and physical functioning (Dworkin & Breibart, 2004; Eccleston & Crombez, 2007; Edwards et al., 2010; Lowenstein et al., 2009; Tan, Monga, & Thornby, 2000).

Chronic Pelvic Pain in Women

Chronic pelvic pain is generally defined as non-cyclic pain of at least six months duration, severe enough to cause disability and possibly warrant medical intervention (ACOG, 2004). CPP can occur in various locations such as the pelvis, anterior abdominal wall, at or below the umbilicus, lower back or buttocks (ACOG, 2004). Among the general reproductive age gynecologic population, CPP has been estimated to account for 10% of gynecologic consultations and 40% of diagnostic laparoscopies and community based studies have revealed variances in prevalence from 15% to 25% depending on the

definition of CPP used and the measurements used (Grace & Zondervan, 2004; Howard & Sanchez, 1993; Reiter & Gambone, 1990; Zondervan et al., 2001; Pitts et al. 2008). A large US poll found that in the previous six months, 16% of women with CPP experienced constant or intermittent pain (Mathias et al., 1996). Given this, health care providers working in the field of women's health are likely to be confronted with the issue and clinically, this group of patients is often recognized as being difficult to assess and manage (Grace, 2000). Treatment of CPP is often challenging and uses numerous healthcare resources with estimates that the disorder costs the US healthcare system 880 million dollars a year (Mathias et al., 1996; Drossman, 1994). While recognized as a serious issue within the world of gynecology, CPP continues to not be well understood. This is partially due to the wide scope of its definition (Lamvu et al., 2006).

CPP is a difficult and perplexing gynecologic complaint. It has been associated with a variety of gynecological, gastrointestinal, musculoskeletal, neurologic and urologic disorders including endometriosis, irritable bowel syndrome, fibromyalgia, visceral hypersensitivity and interstitial cystitis (Fletcher & Zimmern, 2009). Women who carry the diagnosis, are often followed by physicians from multiple specialties and, unfortunately, the treatment of CPP is challenging and often not satisfactory. Women may undergo multiple imaging studies, surgical interventions, physical therapy and may try a host of medications.

The pathogenesis of CPP is not well understood. Laparoscopy is often viewed as essential in both the diagnosis and treatment of pathology. However, in approximately 40% of laparoscopic surgeries, no obvious cause is found (Fukaya, Hoshiai, &Yajima, 1993; Howard & Sanchez, 1993; Swank et al., 2003). In the event that a pathology such

as endometriosis or adhesions is identified, the association between the site of the insult and the pain complaint is weak (Hammoud, Gago, & Diamond, 2004; Verecellini et al., 2007). For example, endometriosis, defined as the presence of tissue outside of the endometrial cavity that has the histologic appearance of endometrial glands and stroma, is estimated to have a prevalence of 1% to 7% in the general population and as high as 33% among women with CPP (Barbieri, 1990; Guo & Wang 2006; Howard, 2009). Endometriosis has since been the subject of numerous investigations and it has been noted that the severity of the apparent disease is often not directly correlated with severity of symptoms (Whiteside & Falcone, 2003). This is true with other noted causes of CPP such as chronic ovarian cysts, in that similar pathology has been seen in women without any pain complaints and may, in fact, be incidental and be an incidental finding rather than a causal one (Howard, 2009; Howard & Sanchez, 1993; Whiteside & Falcone, 2003).

With the multi-factorial etiology of CPP, comes the concurrent difficulty of treatment. Currently, the mainstays of treatment include laparoscopic surgery to rule out serious pathology, hormonal medications, narcotics and other pain medications, and psychological interventions. Stones, Cheong, Howard and Singh (2005) reviewed 14 studies and concluded that a very limited number of interventions for women with CPP have been rigorously evaluated and most conclusions were based upon the outcomes of single random control trials. Even so, they found evidence to support the use of progesterone based medications, ultrasound and minimally invasive surgeries to aid in counseling and reassurance and a multidisciplinary approach including the use of psychotherapists and physical therapists.

Biopsychosocial model of pain

Psychiatrist George Engel (1977) first described the Biopsychosocial model of medicine. The model posited that illness is a complex interaction of biological, psychological and social factors. Its development accompanied a shift in American medicine away from a primary focus upon biological disease towards one that also encompasses the subjective experience of illness and incorporates the multiple factors that influence the progression of disease (Gatchel, 2005; Smith, 2002).

The delineation between disease and illness is analogous to that between nociception and pain. Nociception is the stimulation of nerves that relay information about potential tissue damage to the brain while pain is the subjective interpretation and perception of sensory information. Based upon these similarities, Loeser (1982) and Waddell (1987) purposed early models that assumed that, like illness, pain must be conceptualized within the larger context of the individual's experience of pain and currently, the Biopsychosocial approach to pain is almost universally supported (Gatchel et al., 2007).

The recognition of chronic pain syndromes such as fibromyalgia, lower back pain, temporal mandibular joint disorder, migraine headache and osteoarthritis coupled with the subsequent growing body of research in these areas has strengthened the argument that the previously assumed relationship between disease severity and pain does not hold true (Quartana, Campbell, & Edwards, 2009). It is thought that coping processes may play a role in this discrepancy as these processes have been shown to activate modulatory networks in the brain (Wiech, Ploner, & Tracey, 2008).

Coping and Chronic Pain

Lazarus and Folkman (1984) were among the first to describe coping as a cognitive process consisting of threat and resource appraisal and the active selection of a response to a perceived stressor. This conceptualization of coping reflects the belief that it is process-oriented rather than trait-oriented and thus can change according to situations and with time. Original formulations of the Transactional Model of Stress and Coping described coping efforts as belonging to one of two dimensions: problem management and emotional regulation (Wenzel, Glanz, & Lerman, 2002). Additional conceptualizations of coping have included active versus passive, approach versus avoidance, problem-focused versus emotion-focused and adaptive versus maladaptive (Peres & Lucchetti, 2010).

Coping strategies have been evaluated in a number of medical populations. In chronic pain patients, coping is an important variable that may influence the adaptation to an on-going process (Cannella Lobel, Glass, Lokshina, & Graham, 2007). Passive coping strategies have been found to be associated with an increased severity of depression, more severe limitation of activity and increased feelings of helplessness (Carroll, Cassidy & Cote, 2006; Mercado, Carroll, Cassidy & Cote, 2005;Wessels et al., 2006). This has held true in several populations including chronic fatigue syndrome, chronic musculoskeletal pain and rheumatoid arthritis and fibromyalgia (Nater et al., 2006; Nijs,Van de Putte, Louckx, Truijen, & De Meirleir, 2008; Sullivan, Bishop, & Pivak, 1995; Turk, Robinson, & Burwinkle, 2004;Vlaeyen & Linton, 2000). In contrast, more active coping strategies have been associated with a decrease in pain and less

disability although this relationship has been inconsistent (Cannella et al., 2007; Roditi Roditi, Waxenberg, & Robinson, 2010; Smith, Strachan, & Buchwald, 2009).

Coping and Chronic Pelvic Pain

Similar to other chronic pain conditions, CPP has a tremendous impact on the daily life activities and the general well-being of women (Grace & Zondervan, 2006). Two recent uncontrolled studies by Lamvu and colleagues (2006) and Weijenborg and colleagues (2007) demonstrated that specific diagnoses and treatments did not have a significant relationship with pain complaints. As has been discussed, coping strategies have been demonstrated to play an important role in other pain conditions and may also influence the experience of CPP, however, there has been little research done in the area of coping and chronic pelvic pain. In a continuation of a larger study Weijenborg and colleagues (2009) evaluated the effect of coping strategies in a population of women with CPP. It was found that while overall, the women in the study reported a decrease in pain severity, the reduction in pain intensity was not associated with pain coping strategies.

Catastrophizing

A specific coping process that has gained attention in the world of chronic pain is catastrophizing. As has been previously discussed, catastrophizing is defined as the tendency towards a negative emotional and cognitive response to pain. It includes the amplification and focus on pain symptoms as well as feelings of helplessness and pessimism (Sullivan et al., 2001). The term was originally used by Beck, Rush, Shaw, and Emery (1979) in reference to a mal-adaptive coping style used by patients with anxiety and depressive disorders. In one of the earlier studies in the field, Spanos, Henderikus and Brazil (1981) interviewed individuals about their pain experience after a

cold pressor task. Catastrophizers were classified as those people who tended to express worry, fear and an inability to divert their attention from the pain. Chaves and Brown (1987) interviewed dental patients and asked them to report the thoughts and images they experienced during a stressful dental procedure. Catastrophizers were defined as those people who had a tendency to exaggerate the possibility of harm or magnify pain sensations. In the development of the Coping Strategies Questionnaire (CSQ) Rosenstiel and Keefe (1983) evaluated coping strategies among 61 people with chronic low back pain. They found that those patients who used passive coping strategies such as catastrophizing were significantly more likely to also report a decrease in physical function. The resulting CSQ has seven identified subscales including one that is exclusively about catastrophizing that includes items reflecting elements of helplessness and pessimism.

Early research in catastrophizing illustrated that it appears to be amenable to intervention. After instructions to not engage in catastrophizing behaviors, undergraduates previously labeled as catastrophizers were no longer categorized as such (Spanos , Henderikus, & Brazil, 1981). This was also shown to be true after a cold pressor stressor (Vallis, 1984). Additional early studies showed that reductions in catastrophizing could be achieved through intensive cognitive-behavioral interventions (Keefe et al., 1991; Parker et al., 1989; Turner & Clancy, 1986). Therefore, catastrophizing appears to not have the fixed character that is often observed in personality traits but it does appear to remain stable in the absence of intervention (Sullivan et al., 2001).

Catastrophizing and pain

Catastrophizing has been consistently associated with an increase in pain reports. The relationship between catastrophizing and higher pain reports holds true across measures and in a variety of clinical populations including those experiencing mixed chronic pain, low back pain, rheumatoid arthritis, headaches, scleroderma, interstitial cystitis, surgery, burn dressing changes and dental procedures (Butler, Damarin, & Beaulieu, 1989; Drahovzal, Stewart, & Sullivan, 2006; Edwards, Haythornthwaite, Sullivan, & Fillingim, 2004; Edwards et al., 2006; Flor, Behle, & Birbaumer, 1993; Haythornwaithe, Lawerence & Fauerbach, 2001; Jacobsen & Butler, 1996; Keefe, Brown, & Wallston, 1989; Sullivan & D'Eon, 1990; Sullivan & Neish, 1998; Tripp et al., 2009).

The relationship between catastrophizing and heightened pain also exists among asymptomatic healthy participants and has been observed in experiments designed to measure pain threshold and tolerance through the use of thermal heat, cold pressor and pressure stimuli (Sullivan, et al., 1995; Sullivan, Martel, Tripp, Savard, & Crombez, 2006; Lefebvre, Lester, & Keefe, 1995; Sullivan & Neish, 1997; Meredith, Strong, & Feeney, 2006; Campbell, Witmer et al., 2010; Beneciuk, Bishop, &George, 2010). Weissman-Fogel and colleagues (2009) examined the relationships between pain perception, pain modulation and catastrophizing in a sample healthy adults ranging in age from 20 to 30 years. The use of pain catastrophizing was associated with increased pain reports during experimental trials using either thermal heat or a hand-grip device to induce muscle pain. In addition, the gender differences that were observed with women reporting more intense pain than men were not significant after controlling for

catastrophizing suggesting that catastrophizing was a stronger predictor of pain reports than gender. The potential mediating relationship of catastrophizing between gender and pain has been demonstrated in previous studies (Keefe et al., 2000; Sullivan et al., 2001). Edwards and colleagues (2004) however found that while catastrophizing did mediate the relationship between gender and pain for recent daily pain reports, it did not explain the larger differences observed in pain threshold and tolerance.

In addition to gender, ethnic differences in pain reports have also been observed in clinical practice (Mailis-Gagnon et al., 2007; Rollman, Abdel-Shaheed, Gillespie, & Jones, 2004). During clinically induced pain procedures, African Americans have been found to report higher pain ratings that non Hispanic White Americans and Indian college students demonstrated greater tolerance to cold pressor pain than Euro-American students (Campbell, Edwards & Fillingim, 2005; Edwards, Sarlani, Wesselmann, & Fillingim, 2005; Nayak, Wheeler, Shiflett, & Agostinelli, 2000). Catastrophizing has received little attention in the research into ethnic differences in pain reports. Hsieh, Tripp, Ji, and Sullivan (2010) published one of the few studies to examine the phenomenon in the understudied Chinese population. The researchers found Chinese undergraduate students reported higher levels of pain after a cold pressor stimulus than their Euro-American counterparts and that this group also reported more pain catastrophizing.

Mechanism of action

The exact mechanism through which catastrophizing is related to pain is not entirely understood. Eccelston and Crombez (1999) proposed that similar to what has been observed in depression and anxiety, attention and information processing biases might be important contributors to catastrophizing. From a biological perspective, the

experience of physical pain is often indicative of the threat of physical harm. Therefore, it is important to note that the attention that pain demands is initially adaptive (Crombez, Vlaeyen, Heuts, & Lysens, 1999). If the original attention needed to move towards safety continues, may result in the cognitive and behavior immobilization that is observed in catastrophizing. It is this ongoing process that allows a once adaptive coping strategy to become maladaptive (Quartana et al., 2009)

From a biological perspective, recent work has suggested that the emotional and cognitive changes that characterize catastrophizing may disrupt endogenous descending pain-inhibitory pathways (Sullivan et al., 2001). Through the use of functional magnetic resonance imaging (fMRI) Gracely and colleagues (2004) found that among people with fibromyalgia, higher levels of catastrophizing were associated with an increased pain-related hemodynamic response in the dorsolateral prefrontal cortex, dorsal anterior cingulate cortex and the medial frontal cortex. These brain regions all contribute to the mediation of the emotional and motivational response to pain. Similar findings have been demonstrated among healthy individuals (Seminowicz & Davis, 2006). In patients with spinal pain who experienced a non-painful stimulus applied to a painful body region, higher levels of catastrophizing were associated with reduced activation in the normal sensory processing channels in the posterior cingulated cortex and the parietal cortices (Lloyd, Findlay, Roberts, & Nurmikko, 2008). These findings suggest that catastrophizing is associated with enhanced activity in the pain processing regions of the brain and may be involved in maladaptive responses to non-painful stimuli.

Edwards et al. (2005) applied three sequences of 10 rapid heat pulsations to the ventral forearm of a sample of 38 healthy women. This procedure induced what is

referred to as temporal summation; a frequently used index of central pain facilitation that involves the activation of neurons in the spinal cord as a result of sustained C-fiber input (Herrero, Laird, & Lopez-Garcia, 2000; Li, Simone & Larson, 1999; Melzack, Coderre, Katz, & Vaccarino, 2001). The authors found that in this population greater pain catastrophizing was associated with greater temporal summation. While the exact mechanism is not known, it is suggested that catastrophizing involves cortical regions of the brain. Additional support for this theory came from a functional magnetic resonance imaging (fMRI) study that revealed that during noxious stimuli intended to produce moderate to severe pain, healthy participants with higher catastrophizing scores had less activity in cortical regions that are dedicated to pain-inhibitory pathways than those participants with low catastrophizing scores (Seminowicz & Davis, 2006).

Goodin et al. (2009) examined if diffuse noxious inhibitory controls (DNIC), a measure of endogenous pain inhibition, mediated the relationship between catastrophizing and pain in healthy adults and, if gender moderated this effect. Using pressure pain thresholds applied during a cold pressor task, the authors found that among women the relationship between catastrophizing and pain scores was partially mediated by DNIC such that higher catastrophizing scores were associated with lower activation of the descending pain-inhibitory pathways and higher pain ratings. Campbell, Witmer and colleagues (2010) demonstrated further support for the disruption in endogenous pain inhibitory pathways when they found that among healthy individuals experiencing thermally induced pain, higher levels of catastrophizing were associated with a delay in the experience of the pain-reducing effects of distraction.

The inflammatory process is another possible method by which catastrophizing influences pain. The experience of pain appears to be associated with an increase in the release of pro-inflammatory cytokines that in turn, sensitize the central nervous system and promote an amplification of pain (Beilin et al., 2003; De Jongh et al., 2003; Sommer & Kress, 2004). Several studies of participants with rheumatoid arthritis (RA) have found a positive relationship between catastrophizing and indices of disease severity and inflammation (Parker et al., 1992; Schoenfield-Smith et al., 1996; Yin et al., 2005). In a review of the literature on the influence of catastrophizing on rheumatic diseases, Edwards, Bingham and colleagues (2006) found evidence that suggested that catastrophizing was either directly or indirectly associated with the inflammatory process. While most of the research is cross-sectional, catastrophizing has been positively associated with elevated erythrocyte sedimentation rates (Evers, Kraaimaat, Geenen, Jacobs, & Bijlsma, 2003). In a group of healthy adults, Edwards and colleagues (2008) found that higher levels of catastrophizing predicted greater interleukin 6 reactivity thus offering support of the potential effect on the pro-inflammatory response.

Trait versus state

There continues to be a debate over whether catastrophizing is a cause or result of chronic pain. Catastrophizing has most typically been conceptualized as a trait or dispositional variable; however, there have been several studies that have assessed it in a more situation-specific manner resulting from a painful stimulus (Quartana, Campbell, & Edwards, 2009). The latter approach is supported by initial theoretical assertions suggested that maladaptive thoughts and patterns of behavior were latent parts of the personality in need of a specific cue to be expressed (Beck et al., 1979). To date, there are

no longitudinal studies that determine if measures of catastrophizing change after the development of chronic pain. There is, however, evidence that in both healthy adults and those with chronic pain, catastrophizing reports remains stable over weeks and months (Keefe et al., 1989; Sullivan, Bishop. & Pivik, 1995). In a sample of dental patients experiencing pain as a result of acute pulpitis, Edwards, Fillingim and colleagues (2004) found that catastrophizing did not change after their pain resolved.

To compound the state versus trait argument surrounding catastrophizing, there continues to be questions about the best method by which to detail its assessment. In numerous experimental pain studies, catastrophizing has been measured with respect to the noxious stimuli experienced by the participants (Dixon, Thorn, & Ward, 2004; Edwards, Campbell, & Fillingim, 2005). This phenomenon has come to be known as situational or state catastrophizing and is in contrast to dispositional or trait catastrophizing, a construct that appears to remain stable over time (Turner, Mancl, & Aaron, 2004). Interestingly, only moderate correlations have been found between situational and dispositional catastrophizing (Dixon, Thorn, & Ward, 2004; Edwards, Campbell, & Fillingim, 2005). To evaluate situation and dispositional catastrophizing in multiple samples, Campbell, Kronfli and colleagues (2010) pooled data from studies including participants with temporal-mandibular joint disorder (TMJD) and arthritis and a group of healthy adults. They found that for all participants, situational catastrophizing was more strongly associated with increased pain responses than dispositional catastrophizing. In addition, the participants with persistent pain had higher dispositional catastrophizing compared to healthy adults. The authors hypothesized that there would be evidence of significant inter-correlations between situational and

dispositional catastrophizing in both groups of participants with chronic pain although this only held true for those with TMJD.

Measurement considerations

Catastrophizing is one of several constructs that reflect a maladaptive pain response and it shares elements in common with pain anxiety, fear of pain and pain helplessness (Quartana, Campbell, & Edwards, 2009). Catastrophizing has also been shown to share significant variance with broader constructs related to negative affect such as depression and anxiety. (Nicholas, Coulston, Asghari, & Malhi, 2009; Sullivan, Bishop & Pivik, 1995). In the literature, there has been some debate about whether or not catastrophizing is a conceptually distinct from these other measures and to date, the research findings have been mixed. Hirsch, George, Riley, and Robinson (2007) found that catastrophizing was strongly associated with a number of negative mood states and that depression, anxiety and anger accounted for 69% of the variance in catastrophizing and 19% of the variance in pain while George, Dannecker and Robinson (2006) found moderate correlations between catastrophizing and fear of pain. In contrast, earlier work in the field by Sullivan and colleagues (1995) demonstrated that while catastrophizing is moderately correlated with depression, it measures something distinct. Leeuw and colleagues (2007) echoed this finding and asserted that catastrophizing is an entirely separate entity from depression. In a comparison of two clinical samples, Linton and colleagues (2011) found a small to moderate correlation between catastrophizing and depression and that both had small to moderate correlations with pain reports. Perhaps more interesting was the finding that catastrophizing and depression had an additive and adverse effect on pain reports that exceeded the impact of either construct alone.

Catastrophizing and CPP

There is little evidence about the relationship between catastrophizing and chronic pelvic pain. In a three year follow-up study, Weijenborg and colleagues (2009) found that among a cohort of 84 women with CPP, decreased catastrophizing was associated with an improvement in pain scores and that catastrophizing mediated the relationship between internal pain control and pain reports. Similar to Lamvu and colleagues (2006), it was also found that baseline demographic variables, pain related variables and clinical variables such as treatment and surgery were not significantly associated with pain outcomes. Goldfinger, Pukall, Gentilcore-Saulnier, McLean, and Chamberlain (2009) examined the effectiveness of a comprehensive pelvic floor physical therapy intervention in treating the pain and psychological functioning of women with provoked vestibular pain. They found that while overall levels of catastrophizing decreased with the intervention, women who reported higher catastrophizing also reported more pain with intercourse before, during and after the physical therapy intervention.

Interstitial cystitis (IC) and painful bladder syndrome (PBS) are among the myriad of conditions associated with CPP in women and it is the only subgroup of CPP that has been studied in regards to catastrophizing. Tripp and colleagues (2009) found that in women with IC/PBS, catastrophizing was more strongly associated with diminished quality of life reports than depression and sexual functioning. Women with PBS have also been found to have similar responses to painful stimuli as healthy controls but were more likely to demonstrate deficits in their ability to habituate to painful stimuli. These same women were also found to have higher reports of catastrophizing than their healthy counterparts (Lowenstein et al., 2009).

Catastrophizing and Abuse

To date, there are no published studies directly evaluating the relationship between abuse and catastrophizing. In an early study examining the relationship of self-reported physical and sexual abuse and pain complaints among healthy college students, Fillingim, Wilkinson, and Powell (1999) found that those students reporting a history of physical or sexual abuse also reported more catastrophizing. In a group of women with gastrointestinal disorders, Drossman and colleagues (2000) found that both abuse and catastrophizing were each strong predictors of adverse health outcomes but the direct interaction between the two was not examined. In a group of low back pain patients, abuse history and catastrophizing were both associated with moderate levels of spinal pain but again, the interaction between the two variables was not evaluated (Linton, Hellsing, & Bryngelsson, 2000).

The possible association between catastrophizing and abuse may be partially explained by a communal model coping. Sullivan and colleagues (2001) assert that people who catastrophize may engage in exaggerated pain expressions in order to solicit assistance or empathetic responses from those within their social environment. This model has been supported in patients with gastrointestinal cancer pain those with spinal cord injury with the partners of patients who demonstrate catastrophizing being more supportive and solicitous (Giardino, Jensen, Turner, Ehde, & Cardenas, 2003; Keefe et al., 2003). In a study of Canadian undergraduate students, McWilliam and Asmundson (2007) found a positive relationship between reported negative models of self and catastrophizing and the authors posited that those people who perceive others as generally unwilling to provide support may exaggerate their distress in order to obtain the

assistance of others. In an abusive environment, catastrophizing could be adaptive as the individual attempts to avoid further harm and to regain an emotional connection with the abuser. However, catastrophizing has also been associated with exaggerated punishing and critical responses from partners (Boothby, Thorn, Overduin, & Ward, 2004; Buenaver, Edwards, & Haythornthwaite, 2007; Keefe et al., 2003). Therefore in the attempt to attain social goals conducive with survival, catastrophizing may result in an undesirable partner response and become maladaptive by heightening the pain experience.

Chronic pain and Abuse

Multiple studies have suggested that the experience of childhood abuse may be related to the development of pain syndromes in adulthood. In a meta-analysis of the literature, Davis, Luecken, and Zautra (2005) found that individuals who reported childhood abuse or neglect also reported significantly more pain symptoms than people not reporting this history. In addition, among both patient and community samples, people with chronic pain were significantly more likely to report a history of abuse than their healthy counterparts.

General somatic disorders and chronic pain are also more prevalent among women who report a history of intimate partner violence (IPV) (Campbell et al., 2002; Coker et al., 2007). One study of women with a known history of IPV found that 35% reported high levels of disability related to chronic pain (Wuest et al., 2008). The risk for chronic pain is significantly increased among those women who experience an injury secondary to an episode of IPV (Coker et al., 2007). One possible explanation for this phenomenon is that inadequately treated acute pain secondary to injury may ultimately

develop into chronic pain (Carr & Goudas, 1999; Cohen, Christo, & Moroz, 2004). This is troubling considering estimates that fewer than 50% of women will seek healthcare for IPV related injuries (Humphreys, Parker, & Campbell, 2001). The risk of untreated acute injury and the subsequent development of a chronic pain condition may be further exacerbated by the chronic stress which often accompanies IPV (Chapman, Tuckett, & Song, 2008).

Chronic Pelvic Pain and Abuse

A more specific manifestation of a somatic pain syndrome is chronic pelvic pain (CPP). Women with CPP have been found to have significantly higher rates of childhood abuse and neglect and sexual abuse than women without CPP (Golding, 1999; Paras et al., 2009; Roelofs & Spinhoven, 2007; Romans et al., 2002; Walker et al., 1999). The association between trauma history and CPP, however, does not appear to be equivalent across the differing types and sources of pain. Leserman and colleagues (2006) evaluated subtypes of CPP and compared the health and trauma histories of women across the categories. Women reporting diffuse abdominal and pelvic pain had histories of more life-time trauma and worse physical and mental health than those with vulvovaginal pain or cyclic pain. Meltzer-Brody and colleagues (2007) found that 50% of women with CPP reported a history of physical or sexual abuse and one in three of these women also had a positive screen for PTSD. PTSD appears to complicate the picture of CPP with those women with PTSD were more likely to report their pain as severe. A 2008 review of the literature found a stronger association between CPP and sexual IPV than CPP and physical IPV(Romans & Cohen, 2008). Therefore, while there appears to be a

relationship between CPP and abuse, the available literature on the specific association does not allow for definitive conclusions.

Mechanisms of Action

The mechanisms through which childhood abuse and IPV impact physical and sexual health are not well understood. The most overt sequelae are those related to blunt force trauma but the impact extends well beyond contusions, fractures and lacerations. At present, indirect mechanisms are primarily inferred from research in other fields but there is a growing interest in definitively measuring the adverse physical and mental health effects of childhood abuse and IPV.

Throughout the literature, depression, a common consequence of childhood abuse and IPV, is associated with heart disease, chronic pain, premature aging and impaired wound healing (Frasure-Smith & Lesperance, 2006; Frasure-Smith et al., 2009; Rumsfeld et al., 2006; Rutledge et al., 2006). This may be partially explained by evidence suggesting that depressed people have decreased lymphocyte counts, altered immune system functioning that may lead to vascular and other systemic injuries (Robles, Jimenez Nacher, Rubio, Huelmos, & Lopez, 2005). Hostility, including interpersonal mistrust, suspicion and cynicism, another common occurrence in childhood abuse and IPV, has been linked with ischemia and metabolic syndrome (Butterfield, Forneris, Feldman, & Beckham, 2000; Hulme, 2000; Kendall-Tackett, 2007). Finally, the sleep disturbance that often accompanies PTSD may exacerbate the sequelae of both depression and hostility and alone compromises immune, metabolic and neuroendocrine functioning (Hulme, 2000).

The role of chronic stress and its impact upon bodily systems is another possible mechanism for the sequelae of childhood abuse and trauma. Cumulative life-time stress has been linked to disorders characterized by multi-focal pain, fatigue and sleep disturbance such as chronic fatigue syndrome, fibromyalgia, temporomandibular syndrome, irritable bowel syndrome and interstitial cystitis (Afari & Buchwald, 2003; Afari, Wen, Buchwald, Goldberg, & Plesh, 2008; Bertoli, de Leeuw, Schmidt, Okeson, & Carlson, 2007). This process is thought to occur as a result of alterations in the biological stress adaptation systems (Crofford, 2008). Physical and emotional stress often result in disturbed sleep patterns and elevated cortisol level which have grave implications for bodily functioning (Chapotot, Buguet, Gronfier, & Brandenberger, 2001).

As has been discussed, all forms of abuse have been associated with an increased risk of a wide range of serious illness including cardiovascular disease, diabetes, gastrointestinal disorders, cancer and chronic pain (Kendall-Tackett, 2007; Kendall-Tackett, 2009; McFarlane et al., 2004). Kendall-Tackett (2007; 2009) asserts that the field of psychoimmunology holds promise in the search for understanding of the mechanisms directly involved in the physical and health sequelae of abuse.

Kendall Tackett asserts that to understand the connection between abuse and health outcomes, one must understand the human body's response to threat (Kendall-Tackett, 2009). When threatened, the sympathetic nervous system responds with what is commonly known as the fight-or-flight reaction. During this reaction, catecholamine, norepinephrine are all released. The hypothalamic-pituitary-adrenal axis responds with a complex chemical cascade that results in the release of cortisol (Kendall-Tackett, 2009). This process is heightened in the exposure to chronic threat such as that associated with

PTSD (Kendall-Tackett, 2007). The immune system also responds to threat by releasing pro-inflammatory cytokines. While adaptive in the short term in promoting processes such as wound healing, prolonged exposure can result in cardiovascular disease and metabolic syndrome (Suarez, 2006).

Behavioral Interventions in Chronic Pelvic Pain

In a 2005 review of the literature on interventions for CPP, Stones, Cheong Howard and Singh report that the range of proven effective interventions remains limited. The majority of the interventions for CPP described focus upon identified causes of pain that are amenable to treatment with surgery, medicine, physical therapy and chiropractics (BayogluTekin, Dilbaz, Altinbas, & Dilbaz, 2010; Daniels et al., 2010; Hawk, Long, & Azad, 1997; Montenegro, Vasconcelos, Candido Dos Reis, Nogueira, & Poli-Neto, 2008). Haugstad and colleagues (2008) developed a Mensendieck somatocognitive therapy intervention designed to enhance body awareness and reduce psychological distress through the active use of new cognitive and motor patterns. In a study of forty women with CPP, those receiving the therapy reported a significant decrease in pain and less psychological distress than those receiving standard treatment. In a study of thirty women diagnosed with interstitial cystitis and pelvic pain, Carrico, Peters, and Diokno (2008) reported a statistically significant improvement in bladder function and a reduction in pain scores in a group of women exposed to twice daily guided imagery sessions. The guided imagery session included phrases about healing the bladder, relaxing the pelvic floor muscles, and quieting the nerves specifically involved in interstitial cystitis.

Conclusion

To date, little is understood about the role that psychological variables such as catastrophizing play in chronic pelvic pain. When drawing upon the literature available in other pain fields, the importance of coping strategies such as catastrophizing is evident. In addition, there is little available in the literature that evaluates the concept of catastrophizing over time. It is, therefore, not known if this cognitive strategy is a precursor or consequence of chronic pain. The current study is poised in the unique position to add to the body of knowledge in the field of pelvic pain and to perhaps provide insight in the concept of catastrophizing that may be applicable to other pain fields.

CHAPTER III

METHODOLOGY

This chapter describes the methodology involved in the completion of the secondary data analysis. The following sections are included: study design, sample and recruitment, protection of human subjects, data collection and instruments, study procedures, data analysis.

Study Design

Descriptive and hierarchical regression analyses were performed utilizing secondary data to explore the relationships between descriptive and theoretical variables, to test theory-driven hypotheses and to answer research questions about factors predicting pain and quality of life a baseline and 12-months in a group of women with chronic pelvic pain. The data came from the parent study "Trauma and PTSD: Prevalence and Screening in a Pelvic Pain Clinic" that was composed of both a cross-sectional and a longitudinal component. The stated aims of the original research were:

1. To determine the prevalence rates of past trauma (including type) and PTSD symptoms in a specialized pelvic pain clinic at UNCs Women's Hospital
2. To measure functional status and degree of somatic complaint in this population
3. To determine the effects of abuse/trauma and PTSD symptoms on pain, health related dysfunction, and medical symptoms among patients with pelvic pain
4. To assess the change in psychometric measure, medical symptoms, pain level and quality of life at 3, 6, 9 and 12-month intervals after a baseline assessment.

In the original study, participants were recruited from a pelvic pain clinic. For those completing the baseline assessment, they were given the option of completing the study materials in clinic or mailing them back in a stamped addressed envelope. For those in the longitudinal portion, the study materials were mailed with return stamped addressed envelopes at 3, 6, 9, and 12 months time points. For this secondary analysis, baseline data and data at 12 months were used.

Sample

The parent study had two components. For the purposes of the cross-sectional portion, all adult, English speaking and reading women between the ages of 18 and 65 who presented for evaluation of pelvic pain at the UNC Pelvic Pain Clinic were eligible for participation. Of the women who consented for the cross-sectional portion, only those who were new patients to the clinic were asked about their interest in participating in the longitudinal component. At the time of check in, consecutive patients were approached by the research assistant (RA). In the privacy of the clinic, the RA asked the patient if she was willing to complete a research survey and if so, written informed consent was obtained.

The original recruitment goal for the cross-sectional portion was 1500 patients. 722 women were approached and 628 (87%) agreed to participate and completed the questionnaires. Of the 628 women in the cross-sectional portion, 387 were eligible and consented for the longitudinal portion. Of these women, 235 (60.5%) completed follow up questionnaires at 4 time points. 76 of the 387 withdrew voluntarily for personal issues, 55 withdrew by not returning their questionnaires, 18 stated that they had a personal conflict that interfered with returning the questionnaires, 3 expressed that they believed

that they could not answer the questionnaires in a way that accurately reflected their pain experience. For the current secondary data analysis, the 235 participants who completed follow up questionnaires at 4 time points were included. Original power analysis performed determined that sufficient power was present for cross sectional analysis and that 500 patients would be needed to insure adequate power for longitudinal analysis. According to the Power Analysis and Sample Size (PASS) software, a sample size of 211 was necessary to achieve 85% power to detect an R-Squared of 0.05 for the most complex analysis. The available sample size for longitudinal analysis was 235 and provided sufficient power for the most complex hypothesis and research question in the current study.

Protection of Human Subjects

Approval of the "Trauma and PTSD: Prevalence and Screening in a Pelvic Pain Clinic" study procedures and the verification of the protection of human subjects for the participants of the study was performed by the Research Ethics Review Board at the University of North Carolina at Chapel Hill. Selected individuals who agreed to participate in the study were asked to sign a consent form before beginning the surveys. Approval of the use of the "Trauma and PTSD: Prevalence and Screening in a Pelvic Pain Clinic" data for this study was obtained from the Georgia State University IRB, as noted in Appendix A.

Instruments

Abuse.

In order to obtain information about physical and sexual abuse history and categorize women into either history of abuse or no history of abuse, the Abuse

Questionnaire was adapted from one used in previous research in women with gastrointestinal disorders (Leserman & Drossman, 1995; Leserman, Drossman, Li, Toomey, Nachman, & Glogau, 1996). The original Abuse Questionnaire was first described by Drossman and colleagues (1990). The instrument consists of seven items with yes/no responses. Two questions assess sexual abuse (1 touch, 1 rape) before the age of 13, two questions assess sexual abuse after the age of 13 (1 touch, 1 rape), one question assesses the occurrence of an attack with the intent to seriously injure or kill, one question assesses the use of a weapon if an attack has occurred and a final question assessing physical abuse. The sexual abuse questions are a modification of an instrument developed for use in a Canadian national population study (Badgley et al., 1984) and the physical abuse questions are a modification of an instrument used by Briere and Runtz (1988) in a population of university women. A participant is considered to have a positive history of physical and/or sexual abuse if she answers yes to any of the seven items.

Reliability and validity of the original instrument were reported by Leserman and colleagues (1996). In a sample of 139 female patients attending a gastroenterology clinic, the questionnaire demonstrated adequate test-retest reliability of the sexual abuse instrument of 81% and 81% agreement between the questionnaire and an interview about the history of any sexual abuse. A 77% test-retest reliability of the physical abuse instrument was found with a 70% agreement between the questionnaire and an interview about any history of physical abuse. Subsequent research has demonstrated that the instrument is highly correlated with indicators of poor health such as the experience of

daily pain, frequent headaches, frequent fatigue, number of days spent in bed and life-time surgeries. (Leserman et al., 1996: Leserman et al., 1997).

Other Lifetime Trauma.

Other Lifetime Trauma was defined as childhood and adult traumas and losses that are different than those related to physical and sexual abuse (e.g. death of friend or family member, placement in foster care, witnessing serious injury or violent death) and was measured by the Other Lifetime Trauma instrument. This instrument consists of 11dichotomous yes/no items in response to a list of childhood and adult traumas and losses that are different from physical and sexual abuse. These questions were derived for the parent study from lists developed by other researchers (Breslau, Davis, Andreski, & Peterson, 1991; Felitti et al., 1998). The 11 items are summed to create a total score ranging from 0-11. Previous research has indicated that when the number of traumatic exposures is summed, an increased number of traumas are associated with a higher risk of adverse health outcomes such as diabetes, asthma, hypertension, drug abuse and ischemic heart disease (Dong, Anda, et al., 2004; Dube**,** Anda, Felitti, Edwards, & Williamson, 2002; Dube et al., 2003).

Physical and Mental Health Status.

Women's physical and mental health statuses were measured by the physical and mental health components of the Rand 12-Item Health Survey (SF-12). The Rand 12-Item Health Survey [Short Form (SF-12)] (Ware, Kosinski, & Keller, 1995) is a shortened version of the 36 Item Short-Form Health Survey (SF 36) that measures health status from the respondent's point of view using a four-week recall. The SF 36 arose from the Medical Outcomes Study (MOS) and was constructed to meet one of the

primary goals of the MOS to create a multipurpose health survey used to monitor patient outcomes in both clinical and research settings (McHomey, Ware, & Raczek, 1993).

The SF 12 is made up of eight scales and two summary scores; the Physical Component Summary (PCS) and the Mental Component Summary (MCS). For the proposed study only the component scores will be used. The physical functioning items are scored with a Likert Scale of 1 to 3 with 1 being "limited a lot", 2 being "limited a little" and 3 being "not limited at all". For the mental health items, the scale is 1 to 6 with 1 being "all of the time" and 6 being "none of the time". Norm based scoring is used and higher summary scores on both scales represent better health.

Original psychometric testing was performed in large population of adults with chronic diseases with a test-retest reliability of 0.89 for the PCS and 0.76 for the MCS (Ware, Kosinski, & Keller, 1995). While the relative validity coefficients were less than had been demonstrated with the SF 36, the authors asserted that analysis led to similar statistical conclusions. Since the original testing, the psychometric properties of the SF 12 have been studied in a number of populations in including a primary care population, individuals with chronic low back pain, individuals with severe mental illness, and prisoners of war (Amir, Lewin-Epstein, Becker, & Buskila, 2002; Holmboe, Wang, & Brass, 2002; Riddle, Lee, & Stratford, 2001; Salyers, Bosworth, Swanson, Lamb-Pagone, & Osher, 2000). More recently, the SF 12 has been shown be a valid and reliable measure in older African-American adults, and individuals with a stroke history (Cernin, Cresci, Jankowski, & Lichtenberg, 2010; Okonkwo, Roth, Pulley, & Howard, 2010). In addition to demonstrating reliability across populations, the SF-12 has been shown to discriminate between types and severity of disease between patients with medical

disorders alone and those with both medical and psychological disorders (McHorney, Ware, Lu, & Sherbourne, 1994; McHorney, Ware, & Raczek, 1993).

Non Pelvic Pain Symptoms.

Women's non-pelvic symptoms (e.g. blurred vision, shortness of breath, frequent backaches, infections) were measured by the Medical Symptom Checklist. The Medical Symptom Checklist (Leserman et al., 1996) was adapted from previous research with patients with gastrointestinal disorders. The original instrument was developed for studies among patients with gastrointestinal disorders to assess the number of medical symptoms and the participant's rating of the frequency of those symptoms (Leserman et al., 1996; Leserman et al., 1997). To provide content validity, the original list of symptoms was compiled from several symptoms lists and chosen to include those that based upon the National Ambulatory Medical Care survey have been frequent reasons for physician visits (Schneider, Appleton, & McLemore, 1979).

In the parent study, the number and frequency of non-pelvic pain symptoms was assessed. Participants were asked to report the occurrence in the previous six months of eighteen medical symptoms including blurred or double vision, numbness, shortness of breath, irritation or pain in the eyes or ears, frequent headaches, palpitations, chest pain, frequent backaches, muscle aches in the shoulders or neck, diarrhea or constipation or nausea, indigestion, difficulty swallowing and pain with urination. Each item was assigned a value between 0 (never/almost never) to 3 (often). Overall scores could range from 0 to 54 with higher scores indicating increased frequency of symptoms as well as an increased number of symptoms.

Pelvic Pain.

Pelvic pain was measured using the Short-Form McGill Pain Questionnaire (SF-MPQ). The development of the Short-Form McGill Pain Questionnaire (SF-MPQ) was inspired by the identified need to have a shorter and yet equally valid instrument to use in pain research that required more information than that which is provided by the Visual Analog Scale (VAS) but less than the full 28-item McGill Pain Questionnaire (MPQ) (Melzack,2005). A representative set of words chosen by 33% or more of patients to describe pain from the sensory and affective categories of the MPQ was chosen. These words were combined with the Visual Analog Scale (VAS) and Present Pain Intensity (PPI) to provide indices of overall intensity.

The SF-MPQ consists of 15 descriptors of pain, 11 from the sensory and 4 from the affective categories of the MPQ. Participants are asked to rate if the pelvic pain that they have experienced in the past two weeks is consistent with the quality of each word and, if it is present, to rate it as mild, moderate or severe. In addition, the participants rate the overall intensity of their pain on a visual analog scale rated from 0 to 10 and then choose one of five words to describe the intensity of the pain.

The SF-MPQ has been developed in multiple languages including Czech, Swedish, Greek, Korean, Thai and Norwegian (Burckhardt and Bjelle, 1994; Georgoudis, Watson, & Oldham, 2000; Kitisomprayoonkul, Klaphajone, & Kovindha, 2006; Lee et al, 2006; Ljunggren, Strand, & Johnsen, 2007; Solcova, Jakoubek, Sýkora, & Hník, 1990). It has been used to assess the pain experience of several different types of pain including cancer pain, chronic low back pain, fibromyalgia syndrome, rheumatoid arthritis, and pain before and during labor (Burckhardt et al, 1997; Dudgeon, Raubertas, & Rosenthal,

1993; Gronbald, Lukinmaa, Konttinen, 1990; Melzack & Belanger, 1989; Walters, Morrell, & Dixon, 1999). In addition, statistically significant changes in SF-MPQ scores have been demonstrated to occur with the use of pain relieving strategies suggesting that the measure may be sensitive to changes in pain (Melzack & Katz, 2006). To date, the only direct analysis of test-retest reliability has been on the Norwegian version of the SF-MPQ that demonstrated acceptable reliability in groups of patient with musculoskeletal and rheumatic pain but staunch conclusions were limited by large variability within subjects (Strand, Ljunggren, Bogen, Ask, & Johnsen, 2008).

Catastrophizing.

Catastrophizing is defined as the tendency towards a negative emotional and cognitive response to pain and includes the amplification and focus on pain symptoms as well as feelings of helplessness and pessimism (Sullivan et al., 2001). Catastrophizing will be measured by the Catastrophizing subscale of the Coping Skills Questionnaire (CSQ). The Coping Strategies Questionnaire (CSQ) (Rosenstiel & Keefe 1983) is one of the most widely used instruments to measure of pain coping strategies. It was originally developed in response to observations that people with chronic pain developed cognitive and behavioral strategies to deal with their pain. In the initial testing of the instrument, Rosenstiel and Keefe (1983) assessed the extent to which 61 chronic low back pain patients reported using specific coping strategies. Participants were also asked to rate the effectiveness of the strategy based upon how much control they felt over their pain and how much their pain decreased as a result of using the strategy. The instrument was found to be internally reliable with Cronbach's alpha ranging from 0.71 for the

behavioral strategy “Increasing Activity Level” to 0.85 for both cognitive strategies “Diverting Attention” and “Reinterpreting Pain Sensations”.

The CSQ has since been shown to be associated with important measures of pain and functioning across a variety of populations (Edwards, Sarlani, et al., 2005; Jensen, Turner, Romano, & Karoly, 1991; Keefe, Smith, Buffington, Gibson, Studts, & Caldwell, 2002). While acknowledged as a valid and reliable instrument across pain populations, the factor structure of the instrument has been less consistent. Early psychometric studies identified a 3-factor solution (Burkhardt et al., 1997; Keefe & Dolan, 1986; Lawson, Reesor, Keefe, & Turner, 1990). Acknowledging that these early studies often had small sample sizes, exploratory factor analysis was conducted on a sample of 965 low back pain participants and revealed a 6-factor solution one of which was catastrophizing (Robinson et al., 1997). Riley and Robinson (1997) further compared five and six factor solutions for the CSQ and recommended a revised version of the CSQ with 27 of the original 44 items that demonstrated less factor variance. The reduction in factor variance has been replicated by Utne and colleagues (2009) among participants with cancer-related pain and thus, provides adequate evidence of construct validity.

The Catastrophizing subscale is a 6-item subscale of the CSQ (CSQ-CAT) and is a widely used measure for catastrophizing and a positive association has been found with pain measures in a variety of populations including those with rheumatoid arthritis, neck pain and chronic low back pain (Keefe et al., 1989; Sullivan & D’Eon, 1990). The items on the CSQ-CAT are scored from 0 to 6 with 0 indicating “never” and 6 indicating “always”. The scores of the items are summed for a possible total score ranging from 0 to 36 with higher scores indicating more catastrophizing. Riley and Robinson (1997)

proposed an alternate scoring system that reports the mean of the total raw score. This system is often used and was chosen in the current analysis to allow for more meaningful comparisons to other pain populations.

The CSQ-CAT has also been associated with disability among patients with fibromyalgia, rheumatoid arthritis and those recovering from knee surgery (Keefe et al., 1991; Martin et al., 1996; Parker et al., 1989). Hirsh and colleagues (2007), however, found that in a population of chronic pain patients including those with low back pain, myofascial pain, neck pain, arthritis, and fibromyalgia, the CSQ-CAT was highly associated with measures of mood and less of a unique predictor of pain although study design did not enable the authors to analyze more complex relationships that may exist between catastrophizing and mood. The CSQ-CAT has been demonstrated to have a Cronbach's alpha of 0.84 (Robinson et al., 1997) and test re-test reliability (r = .91) (Main & Waddell, 1991).

Quality of Life.

Quality of life will be measured by an adapted version of the IBS Quality of Life Questionnaire (IBS-QOL). This 20-item instrument was adapted from one developed for patients with irritable bowel syndrome (IBS). The IBS Quality of Life Questionnaire (IBS-QOL) (Patrick, Drossman, Frederick, DiCesare, & Puder, 1998) was developed using a model that distinguishes bowel symptoms, functional status, perceived quality of life and social disability as unique components. The questionnaire assesses several dimensions of quality of life within the preceding two weeks including dysphoria, interference with activities, health worry and relationships. The items are scaled 1 to 5 with 1 indicating "not at all' and 5 "a great deal". Scores range from 20 to 100 with

lower scores indicating a better quality of life. For the current study, the wording was changed to be relevant to women with pelvic pain.

Validation studies of the original IBS-QOL occurred in a population of 240, predominantly female (89%) adult IBS patients within two major university settings. The questionnaire showed high internal reliability with a Cronbach's alpha of 0.95 and reproducibility that expectedly was stronger in those with no significant changes in their bowel problems during the two time points (Patrick et al., 1998). Since initial development, the IBS-QOL has been evaluated for evidence of predictive validity and has shown to be responsive to treatment with participants responding to a specific treatment having a statistically significant improvement in IBS-QOL scores (Drossman, et al., 2000). More recently, it has been demonstrated along with control over bowel symptoms, confidence in treatment and study coordinators and improvement in maladaptive cognitions to mediate participants' responses to study treatments (Weinland et al., 2010).

Data analysis

The data set for this study was obtained from the Pelvic Pain Research Unit at the University of North Carolina at Chapel Hill. The data set was in an Excel format and was imported to SPSS Version 19

Missing Data

Preliminary analyses were run and degrees of freedom assessed to determine if any subjects were dropped by SPSS for incomplete data. A missing value analysis was run to determine the pattern of missing values. Values were imputed when subjects were

missing no more than 20% of the items on a given scale. If greater than 20% of data was missing on a given scale, the subject was dropped from analysis.

Assessing normality

Prior to analysis, frequency distributions were run on all theoretical independent and dependent variables with means, standard deviations and skewness determined. Parametric and nonparametric tests were run as appropriate.

Baseline descriptive characteristics

Descriptive statistics were used for sample characteristics and to describe major study variables. These included: demographic variables, Abuse, Other Life-time Trauma, SF-12, Medical Symptom Checklist, SFMPQ, CSQ, and QOL.

Hypothesis testing

Hypothesis one (Higher life-time abuse and life-time trauma will be associated with higher levels of catastrophizing), two (Less catastrophizing will be associated with better physical and mental health) and three (More catastrophizing will be associated with higher pain) were tested using correlational analysis. Spearman's rho correlations were used for hypothesis one and Pearson's Product Moment Correlations were used for hypotheses two and three.

Hypothesis four (Catastrophizing will contribute significant variance to baseline pain scores above that contributed by lifetime abuse, lifetime trauma, health status (physical and mental), and medical symptoms) and hypothesis five (Catastrophizing will contribute significant variance to baseline quality of life above that contributed by life-time abuse, life-time trauma, health status (physical and mental), and medical symptoms) were tested using Hierarchical Multiple Linear Regression. Prior to running the

regressions, Pearson's Product Moment Correlations for dependent variables and participant characteristics were examined for potential covariates. If a descriptive variable was significantly related to the dependent variable, it was treated as a covariate and entered in first step of hierarchical regression. Main variables of the study were also examined for multicollinearity with Pearson's Product Moment Correlations. Lifetime abuse and lifetime trauma were dichotomized. All other variables in this hypothesis were continuous.

Research questions

Research questions one (In a sample of women with CPP, is catastrophizing at baseline a predictor of pain scores at 12 months controlling for baseline measures of life-time abuse, life-time trauma, health status (physical and mental), pain, and medical symptoms?) and two (In a sample of women with CPP, is catastrophizing at baseline a predictor of quality of life at 12 months controlling for baseline measures of life-time abuse, life-time trauma, health status (physical and mental), pain, and medical symptoms?) were examined using Hierarchical Multiple Linear Regression. Prior to running the regressions, Pearson's Product Moment Correlations for dependent variables and participant characteristics were examined for potential covariates. If a descriptive variable was significantly related to the dependent variable, it was treated as a covariate and entered in first step of hierarchical regression. Main variables of the study were also examined for multicollinearity with Pearson's Product Moment Correlations. Lifetime abuse and lifetime trauma were dichotomized. All other variables in this hypothesis were continuous

CHAPTER IV

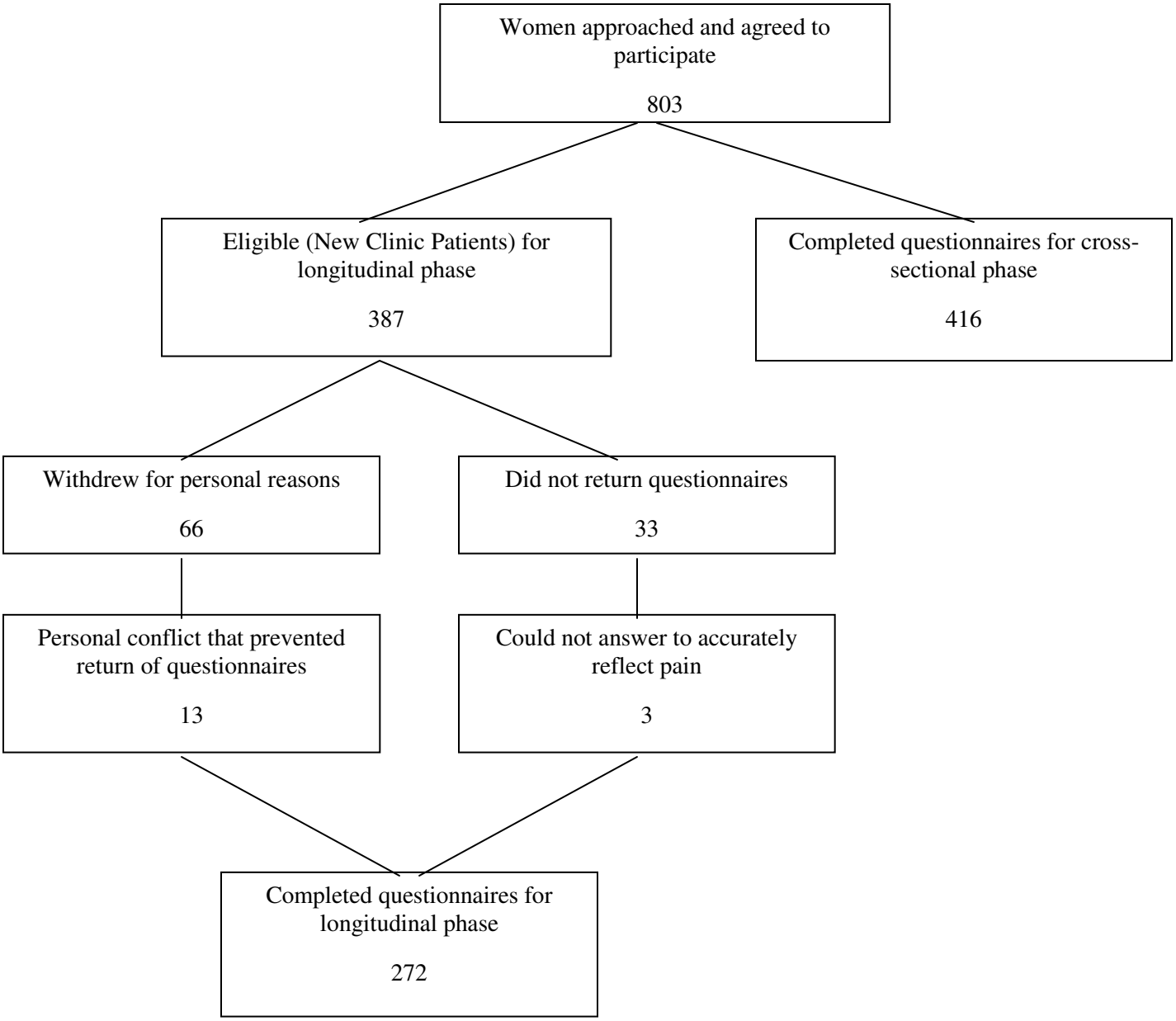
RESULTS

This chapter presents the results of this secondary data analysis from the parent study "Trauma and PTSD: Prevalence and Screening in a Pelvic Pain Clinic" (Meltzer-Brody et al., 2007). Reported are descriptions of the pre-analysis data screening procedures and sample characteristics as well as findings from the questionnaires. In addition results of hypothesis testing and research questions are also reported.

The original target enrollment for the cross-sectional portion of the parent study was 1500 patients. Eight hundred and three consecutive women presenting to the clinic for care were approached and agreed to participate. Four hundred and sixteen completed questionnaires for the cross-sectional phase. Three hundred and eight-seven women were new patients to the practice and therefore eligible for the longitudinal phase. Of these women, 272 completed the baseline and 12-month questionnaires used for the current analysis. Sixty-six of the 387 withdrew voluntarily for personal issues, 33 withdrew by not returning their questionnaires, 13 stated that they had a personal conflict that interfered with returning the questionnaires, 3 expressed that they believed that they could not answer the questionnaires in a way that accurately reflected their pain experience (Figure 1).

Figure 1.

Study Enrollment for Cross Sectional and Longitudinal Portions of the Parent Study



Missing data

Missing data value analysis was run to determine patterns of missing data. The percentage of missing data for the individual items for all of the major theoretical variables was less than 10%. Therefore, imputation was not performed. For all regression analysis list-wise deletion was used to account for any additional missing data.

Sample characteristics

Table 1 summarizes the demographic characteristics of those women who only completed questionnaires for the cross-sectional phase and those who completed questionnaires for the longitudinal phase. Independent samples t tests were run to analyze the difference between interval data and chi square tests were run for categorical data. Overall, the women in both samples were predominantly middle aged, with ages ranging from 18 to 66 years, married and Caucasian. Over half of the women had one or more years of college education. There was a statistically significant difference between the two groups in race with the Cross-sectional group having more African American women and the Longitudinal group having more Caucasian and Other minority women. There were no significant differences between the groups in age and education or marital status.

Table 1

Comparison of Demographic Characteristics of Women in the Cross-Sectional Group With Those in the Longitudinal Group

Variable	Cross-sectional	Longitudinal	pValue
	Mean (SD)	Mean (SD)	
Age in years	n = 416	n = 272	
Education in years	35.68 (9.87)	35.56 (10.51)	.484
	14.83 (2.55)	14.95 (2.44)	.575
Marital status	n (%)	n (%)	
Single, never married	n = 412	n = 271	.467
Living with partner, not	88 (21.40)	55 (20.30)	
married	24 (5.80)	16 (5.90)	
Married			
Divorced/separated/widowed	245 (59.50)	173 (63.80)	
Race/ethnicity	55 (13.30)	27 (10.00)	
White	n = 416	n = 272	
African American	321 (77.20)	215 (79.00)	
Other minorities	74 (17.80)	34 (12.50)	
	21 (5.00)	23 (8.50)	

Table 2 presents the health characteristics of the Cross-sectional and Longitudinal groups. Again, independent samples t tests were run to analyze the difference between

interval data and chi square tests were run for categorical data. Overall, the groups were similar across health characteristics; however, there were statistically significant differences in the average number of pelvic pain surgeries. The cross-sectional group had a higher average number of surgeries for pelvic pain and a higher percentage with a diagnosis related to pelvic pain.

Table 2

Comparison of Health Characteristics of Women in the Baseline only Group and Those in the Longitudinal Group

Variable		**Longitudinal**	**pValue**
	n (%)	n (%)	
	n= 394	n= 255	
Diagnosis related to pelvic pain	268 (68.00)	137 (53.70)	<.001
History of endometriosis	n = 387	n = 244	
	161 (41.60)	99 (40.60)	.804
History of Hysterectomy	n = 392	n = 249	.306
Yes	113 (28.80)	63 (25.30)	
No	279 (71.20)	186 (74.70)	
	M (SD)	M (SD)	
Total number of office visits in past 3 months	4.54 (4.39)	4.73 (4.51)	.401
Number of office visits for pelvic pain	3.05 (3.54)	3.50 (3.91)	.139
Number of lifetime surgeries	4.07 (3.61)	3.69 (3.89)	.423
Number of surgeries for pelvic pain	1.77 (2.49)	1.25 (1.94)	.005

The majority (74.1%) of the women in the longitudinal group were treated during the follow-up year with multiple non-surgical approaches including medications (72.5%) and referrals to physical (32.4%) and psychotherapy (5.9%). Of the women who underwent any type of abdominal surgery during the follow up year, the majority (74.1%) had gynecologic-related surgery. On average women had visited their health care provider once a month.

Descriptive Statistics for Major Study Variables

Data screening was conducted prior to analysis and included screening for outliers and evaluating for normal distribution. As outlined by Munroe (2005) and Field (2009), normality was assessed for all interval/ratio level variables by analyzing skewness, kurtosis, histograms, and box plots. Following Field (2009), statistical significance was not calculated during normality assessment because sample sizes for all major study variables were greater than 200. Z-scores of skewness and kurtosis were calculated by dividing the skewness and kurtosis values by their standard error values. With the exception of trauma and abuse, all of the skewness z scores were 7 or less and kurtosis z scores were 5 or less. Histograms and boxplots were visually examined and approximated normal distribution. The skewness statistic for Abuse was 1.80 and for Trauma it was 1.31. Evaluation of the histograms for both variables demonstrated an increased number of scores to the left of the distribution indicating lower values for each variable. The decision was made to dichotomize the Abuse variable for the regression analyses because in scoring the instrument, a participant is considered to have a positive history of physical and/or sexual abuse if she answers yes to any of the seven items. A value of 0 was given to those women who reported no incidents of abuse (54%, n = 363)

and a value of 1 was given to those women reporting one or more incidents abuse (46%, n = 310) cases. In contrast, the decision was made to not dichotomize the Trauma variable because the instrument is based upon previous research that indicated that an increased number of traumas rather than presence of absence of trauma are associated with a higher risk of adverse health outcomes. Trauma was maintained as a continuous variable and non-parametric tests were performed as indicated. Following Field (2009), care was also given to evaluate for normality of the residuals in the regression models that included the trauma variable. The descriptive statistics and internal consistency reliability coefficients for the instruments representing the major theoretical concepts, including abuse, lifetime trauma, physical and mental health status, medical symptoms, catastrophizing, pain and QOL are displayed in Table 3. All of the instruments had acceptable Cronbach's alpha reliability coefficients.

Table 3

Descriptive Statistics and Cronbach's Alpha for Theoretical Variables

Variable	M (SD)	Observed Range	Possible Range	Cronbach's Alpha
Abuse	1.09(1.62)	0-7	0-7	.77
Trauma	1.83 (1.73)	0-10	0-10	.73
PH	42.48(12.86)	11.83-72.50	0-100	.87
MH	42.73	7.60-75.10	0-100	.82
MedSx	(11.63)	0-50	0-50	.82
TPRI (Baseline)	21.00 (9.30)	0-45	0-45	.90
TPRI (12-Month)	17.53(9.34)	0-45	0-45	.95
CSQ-CAT (Baseline)	10.96	0-6	0-6	.73
CSQ-CAT(12-	(11.15)	0-6	0-6	.73
Month)	2.00 (1.31)	21-104	21-104	.95
QOL (Baseline)	1.33 (1.44)	21-104	21-104	.97
QOL (12-Month)	51.81			
	(19.95)			
	42.21			
	(20.98)			

Note: CSQ-CAT=Catastrophizing Subscale of the Coping Strategies Questionnaire, Trauma = Lifetime Trauma Questionnaire, Abuse = Lifetime Abuse Questionnaire, MedSx= Medical Symptoms Questionnaire, PH=SF12 Physical Health Summary Score, MH = SF12 Mental Health Summary Score, TPRI=McGill Pain Questionnaire Total Pain Report Index, QOL = Quality of Life Questionnaire

Table 4

Comparison of Theoretical Variables Between Cross-Sectional and Longitudinal Groups

Variable	Cross-Sectional n = 353 M (SD)	Longitudinal n= 235 M (SD)	Test Statistic	pValue
Abuse	1.17 (1.68)	0.88 (1.44)	44369.00*	.017
Trauma	1.93 (1.76)	1.62 (1.65)	40961.00*	.018
Physical Health	41.70 (13.08)	44.33 (12.15)	-2.74	.006
Mental Health	42.80 (11.93)	42.60 (10.94)	.23	.819
MedSx	22.26 (9.49)	20.66 (8.91)	2.22	.027
TPRI (Baseline)	16.64 (10.79)	17.58 (10.60)	-1.06	.291
CSQ-CAT (Baseline)	1.97 (1.50)	2.06 (1.52)	-.75	.456
QOL (Baseline)	51.40 (20.19)	52.43 (19.63)	-.60	.550

Note: Mann-Whitney U reported for Abuse and Trauma, all other variables t-test reported, CSQ-CAT=Catastrophizing Subscale of the Coping Strategies Questionnaire, Trauma = Lifetime Trauma Questionnaire, Abuse = Lifetime Abuse Questionnaire, MedSx= Medical Symptoms Questionnaire, PH=SF12 Physical Health Summary Score, MH = SF12 Mental Health Summary Score, TPRI=McGill Pain Questionnaire Total Pain Report Index, QOL = Quality of Life Questionnaire.

Concepts of the Biopsychosocial Model

Mean scores for major theoretical variables are presented in Table 3. Table 4 summarizes the mean scores for the baseline theoretical variables with a comparison between the scores for the Cross-sectional and Longitudinal groups. On average, the

women participants reported high rates of lifetime abuse and trauma with almost half (49.9%) reporting at least one episode of physical or sexual abuse as either a child or an adult. There was a significant difference between the average abuse and trauma scores of the Cross-sectional group and Longitudinal group with the women in the Cross-sectional group reporting higher levels of each.

Average mental and physical health scores indicated poor functioning in both areas. There was a significant difference between the women in the Cross-sectional group and those in the Longitudinal group with the women in the Cross-sectional group reporting poorer physical functioning. On average, both groups reported a high number and frequency of medical symptoms with the Cross-sectional group reporting significantly higher and more symptoms than the Longitudinal group. There was no difference in mental health, general pain, level of catastrophizing and quality of life.

Paired t tests were run to determine the difference between BL and 12-month mean scores for pain, catastrophizing and QOL. Average BL pain reports were less than the midpoint of the McGill Pain Questionnaire and in the 272 women in the Longitudinal group, average pain reports significantly decreased over the 12 month follow up period (BL M = 18.29, SD = 10.65; 12-month M = 10.96, SD= 11.15; $t(261) = 11.23$, $p < .001$). Average BL catastrophizing scores were relatively low and these also significantly decreased over the 12 month follow period (BL M = 2.04, SD = 1.51; 12-month M = 1.33, SD= 1.44; $t (271) = 8.99$, $p<.001$). This significant decrease was also observed in QOL (BL M = 50.11 (19.41), SD = 19.47; 12-month M = 42.21, SD= 20.98; $t (257) = 6.78$, $p<.001$) indicating better quality of life.

Relationships among Theoretical Variables

Bivariate correlations were used to examine the relationships among women's characteristics and the theoretical variables. Pearson product-moment correlation coefficients (r) were calculated for all variables with the exception of Trauma and Abuse for which Spearman's Rho correlation coefficients (r_s) were calculated. Results are reported in Table 5. Greater catastrophizing at BL was associated with worsened BL QOL, a greater number and frequency of associated medical symptoms, and higher pain scores at both BL and 12 months. It was also associated with poorer physical and mental health. Better QOL at BL and 12 months was associated with, fewer incidents of lifetime trauma and abuse, decreased pain reports at BL and 12 months and improved mental and physical health. Women reporting higher pain at BL and 12 months reported worse physical and mental health and a greater number of incidents of lifetime trauma and abuse; however, the associations between 12-month pain scores and both lifetime trauma and lifetime abuse were not significant. Therefore, these variables were not included in the final regression model for 12-month pain scores. The same was true of the associations between 12-month QOL and lifetime abuse and lifetime trauma and these variables were also excluded from regression models for 12-month QOL.

Relationships among Descriptive Characteristics and Major Study Variables

Bivariate correlations were used to examine the relationships among descriptive characteristics and outcome variables. Pearson product-moment correlation coefficients (r) were calculated and results are reported in Table 6. Women with better baseline QOL were significantly more likely to have more years of education, have fewer doctor's visits and doctor's visits for pain in the past 3 months, and fewer lifetime and pain related surgeries. Women reporting better baseline QOL were also significantly less likely to

have a history of psychiatric treatment, a diagnosis of endometriosis, a specific diagnosis related to their pelvic pain or a hysterectomy prior to study entry. Better 12-month QOL was significantly associated with more years of education, fewer doctor's visits and doctor's visits for pain in the past 3 months, and fewer pain related surgeries. Women reporting better 12-month QOL were also significantly less likely to have had a hysterectomy prior to study entry. Women reporting higher baseline and 12-month pain tended to be younger in age although neither of the associations were significant. Higher baseline and 12 month pain scores were significantly associated with fewer years of education, more frequent doctor's visits and doctor's visits for pain in the past 3 months, and an increased number of lifetime and pain related surgeries. Women reporting more baseline and 12-month pain were also significantly more likely to have a diagnosis of endometriosis, and a hysterectomy prior to study entry. While higher baseline and 12-month pain scores were both associated with women having a specific diagnosis related to their pelvic pain, this association was only significant at baseline. Variables significantly associated were included in regression analysis as covariates as warranted.

Table 5

Relationships among Theoretical Predictor Variables (Baseline n = 416, 12-month n = 272)

	CSQ-CAT (T1)	**CSQ-CAT (T2)**	**Trauma**	**Abuse**	**MedSx**	**PH**	**MH**	**TPRI (T1)**	**TPRI (T2)**	**QOL (T1)**	**QOL (T2)**
CSQ-CAT (T1)	--	.61**	.09 **	.16**	.30**	-.29**	-.40**	.53**	.45**	.76**	.51**
CSQ-CAT (T2)		--	.07	.07	.30**	-.27**	-.33**	.27**	.70**	.55**	.79**
Trauma			--	.29**	.24**	-.15**	-.14**	.18*	.11	.19**	.08
Abuse				--	.26**	-.14**	-.19**	.18**	.08	.21**	.13
MedSx					--	-.50**	-.37**	.34**	.36 **	.31**	.36**
PH						--	-.02	-.40**	-.39**	-.28**	-.27**
MH							-	-.22**	-.19**	-.41**	-.34**
TPRI (T1)								--	.53**	.49**	.31**
TPRI (T2)									--	.45**	.77**
QOL (T1)										--	.57**
QOL (T2)											--

Note: ** Correlation is significant at the $p < 0.01$ level (1-tailed), * Correlation is significant at the $p < 0.05$ level (1-tailed), Pearson Correlation Coefficient reported for all correlations except those with Trauma and Abuse that have Spearman's rho reported, CSQ-CAT=Catastrophizing Subscale of the Coping Strategies Questionnaire, Trauma = Lifetime Trauma Questionnaire, Abuse = Lifetime Abuse Questionnaire, MedSx= Medical Symptoms Questionnaire, PH=SF12 Physical Health Summary Score, MH = SF12 Mental Health Summary Score, TPRI=McGill Pain Questionnaire Total Pain Report Index, QOL = Quality of Life Questionnaire, Ed=Years of Education

Table 6

Relationships Between Participant Characteristics and Outcome Variables (Baseline n = 416, 12-month n = 272)

	Age	**Ed**	**MDOV**	**PMDOV**	**LTSurg**	**PPSurg**	**PsychTx**	**Osis**	**Hyst**	**Dx**
QOL(Baseline)	-.07	-.10**	.17**	.22**	.10**	.18**	.24**	.11*	.11**	.11**
QOL(12-Month)	-.01	-.19**	.13*	.16*	.06	.14*	.11	.02	.16**	.04
PRI (Baseline)	-.04	-.20**	.17**	.24**	.18**	.20**	.01	.16**	.09**	.06*
PRI(12-Month)	-.08	-.29**	.14*	.21**	.13*	.21**	.07	.13*	.18**	.10

Note: *Correlation is significant at the p < .05 level (1-tailed), ** Correlation is significant at the p < .01 level (1-tailed), Pearson's Correlation coefficient reported, Age=Age in years**,** Ed=Years of Education, BED=Days in bed over the past 3 months, MDOV= number of doctor office visits in past 3 months, PMDOV= number of office visits in the past 3 months for pelvic pain, LTSurg = number of lifetime surgeries, PPSurg = number of surgeries for pelvic pain, PsychTx = history of psych treatment, TPRI = McGill Pain Questionnaire Total Pain Report Index, QOL = Quality of Life Questionnaire

Hypothesis testing

Hypothesis 1: *Higher lifetime abuse and lifetime trauma will be associated with higher levels of baseline catastrophizing*.

Hypothesis 2: *Less baseline catastrophizing will be associated with better physical and mental health status*.

Hypothesis 3: *More baseline catastrophizing will be associated with higher baseline pain.*

At baseline more catastrophizing was significantly associated with a higher number of lifetime traumas, more lifetime abuse, worse physical health status, decreased mental health status and an increased amount of baseline pain. This supports hypotheses 1, 2 and 3 (Table 5).

Hypothesis 4: *Catastrophizing will contribute significant variance to baseline pain scores above that contributed by lifetime abuse, lifetime trauma, health status (physical and mental), and medical symptoms.*

Table 7

Summary of Final Model for Hierarchical Regression Analysis for the Variables Predicting Baseline Pain Scores (N=408)

	B	SE B	Beta	pValue
Step 1				
Medical symptoms	.20	.05	.17	.000
Physical health status	-.24	.03	-.29	.000
Step 2				
Catastrophizing	2.68	.26	.38	.000

Note: R^2 = .29 (p<.001) for Step 1, Step 2 ΔR^2 = .12 (p<.001); Full model R^2 = .41 (p<.001)

Hierarchical linear regression was conducted to test the hypothesis and the results are reported in Table 7. In the bivariate correlational analysis, baseline catastrophizing, lifetime abuse, lifetime trauma, health status (physical and mental), and medical symptoms were all significantly associated with baseline pain scores and therefore included in the original regression model. Education, the number of doctor's visits for pain in the past three months and lifetime surgeries for pain were also significantly associated with baseline pain reports and included in the original model. Of the variables in the first step only those variables with significant Beta values were included in the final model. In the final model, Step 1 included medical symptoms and physical health status, was significant and accounted for 29% of the variance in baseline pain scores. Step 2 was also significant and catastrophizing added 12% variance to the final model with the full final model being significant. More medical symptoms, worse physical

health status and higher catastrophizing were associated with higher pain scores. Hypothesis 4 was supported.

Hypothesis 5: *Catastrophizing will contribute significant variance to baseline quality of life above that contributed by lifetime abuse, lifetime trauma, health status (physical and mental), and medical symptoms.*

Table 8

Summary of Final Model for Hierarchical Regression Analysis for the Variables Predicting Baseline Quality of Life (N=400)

	B	**SE B**	**Beta**	**pValue**
Step 1				
Office visit for pelvic pain	.51	.17	.10	.002
Past psych tx	3.80	1.31	.10	.004
Mental health status	-.20	.06	-.12	.001
Step 2				
Catastrophizing	8.80	.47	.66	.000

Note: R^2 = .28 for Step 1 (p<.001), Step 2 ΔR^2 = .33 (p<.001); Full model R^2 = .61 (p<.001)

Hierarchical linear regression was conducted to test the hypothesis and the results are in Table 8. In the bivariate correlational analysis, baseline catastrophizing, lifetime abuse, lifetime trauma, health status (physical and mental), and medical symptoms were all associated with baseline QOL scores and therefore included in the original regression model. Education, , the number of doctor's visits for pain in the past

three months and history of previous psychiatric treatment were also significantly associated with baseline QOL scores and included in the first step of the original model. The final model consists of only those variables with significant Beta values in the original model. In the final model, Step 1 included the number of doctor's visits for pain, previous psychiatric treatment and mental health status, was significant and accounted for 28% of the variance in baseline QOL scores. Step 2 was significant and catastrophizing added 33% variance to the final model with the full final model being significant. Those women reporting a higher number of doctor's visits for pain in the past three month, previous psychiatric treatment, poor mental health status, and more catastrophizing had worse QOL. Hypothesis 5 was supported.

Research Questions

Research Question 1: *In a sample of women with chronic pelvic pain, is catastrophizing at baseline a predictor of pain scores at 12 months controlling for baseline measures of lifetime abuse, lifetime trauma, health status (physical and mental), pain, and medical symptoms?*

Table 9

Summary of Final Model for Hierarchical Regression Analysis for the Variables Predicting 12 Month Pain Scores (N=233)

	B	SE B	Beta	pValue
Step 1				
Pain (baseline)	.48	.07	.45	.000
Step 2				
Catastrophizing (baseline)	1.79	.46	.24	.000

Note: R^2 = .32 for Step 1 (p<.001), Step 2 ΔR^2 = .04 (p < .001); Full model R^2 = .36 (p< .001)

Hierarchical linear regression was conducted to test the research question and the results are in Table 9. In the bivariate correlational analysis, baseline catastrophizing, baseline pain scores, health status (physical and mental), and medical symptoms were all associated with 12-month pain scores and therefore included in the original regression model. Education, the number of doctor's visits for pain in the past three months and lifetime surgeries for pain were also significantly associated with 12-month pain reports and included in the original model. The final model consists of only those variables with significant Beta values in the original model. In the final model, Step 1 baseline pain scores, was significant and accounted for 32% of the variance in 12-month pain scores. Step 2 was significant and catastrophizing added 4% variance to the final model with the full final model being significant. Therefore, the answer to research question 1 is that higher baseline pain scores and increased catastrophizing at baseline were independent

predictors of pain at 12 months with higher baseline pain scores being the strongest predictor of increased pain.

Research Question 2: *In a sample of women with chronic pelvic pain, is catastrophizing at baseline a predictor of quality of life scores at 12 months controlling for baseline measures of lifetime abuse, lifetime trauma, health status (physical and mental), pain, and medical symptoms?*

Table 10

Summary of Final Model for Hierarchical Regression Analysis for the Variables Predicting 12 Month Quality of Life Scores (N=225)

	B	**SE B**	**Beta**	**pValue**
Step 1				
Medical symptoms	.46	.15	.19	002
Step 2				
Catastrophizing	6.09	.85	.45	.000

Note: R^2 = .12 (p<.001) for Step 1 Step 2 ΔR^2 = .17 (p<.001); Full model, R^2 = .29 (p<.001)

Hierarchical linear regression was conducted to test the hypothesis and the results are in Table 10. In the bivariate correlational analysis, baseline catastrophizing, baseline pain, health status (physical and mental), and medical symptoms were all associated with 12-month QOL scores and therefore included in the original regression model. Education was also significantly associated with 12-month QOL scores baseline and included in the original model. The final model consists of only those variables with significant Beta values in the original model. In the final model, Step 1 included medical symptoms, was

significant and accounted for 12% of the variance in 12-month QOL scores. Step 2 was significant and catastrophizing added 17% variance to the final model with the full final model being significant. Therefore, an increased number of medical symptoms and more catastrophizing at baseline were both independent predictors of worsened 12-month QOL with baseline catastrophizing being the strongest predictor.

Exploratory analysis

As a part of exploratory analysis the 0 to 6 catastrophizing subscale of the baseline CSQ was divided into four groups defined as none (score of 0), mild (scores of 1 and 2), moderate (scores of 3 and 4) and severe (scores of 5 and 6). Paired t tests for baseline and 12-month pain and QOL scores for each group were calculated. There was a significant difference in the pain scores for those in the none group (Baseline M = 10.73, SD = 6.79; 12-Month M = 4.19, SD = 4.79); $t (19) = 5.49$, $p < .001$, the mild group (Baseline M = 16.75, SD = 8.03; 12-Month M = 9.70, SD = 9.03); $t (74) = 7.27$, $p < .001$ and the moderate group (Baseline M = 23.61, SD = 10.67; 12-Month M = 14.84, SD = 11.99); $t (48) = 4.78$, $p < .001$. Those who exhibited severe catastrophizing at baseline, began and ended the study with higher pain levels and were the only women who did not have a significant pain improvement at 12 months (Baseline M = 31.47, SD = 8.89; 12-MonthM = 28.05, SD = 14.07); $t (10) = .93$, $p = .374$). In parallel, all groups demonstrated a decrease in QOL scores indicating improved QOL at 12 months. There was a difference in the QOL scores for those in the none group (Baseline M = 29.24, SD = 9.34; 12-Month M = 27.10, SD = 10.00); $t (20) = .92$, $p < .368$, the mild group (Baseline M = 44.70, SD = 11.59; 12-Month M = 38.97, SD = 16.88); $t (73) = 3.09$, $p = .003$, the moderate group (Baseline M = 68.85, SD = 15.98; 12-Month M = 49.90, SD =

20.86); t (39) = 5.47, $p < .001$, and severe group (Baseline M = 81.58, SD = 11.33; 12-Month M = 67.33, SD = 21.49); t (11) = 3.214, p = .008. Those women who exhibited severe catastrophizing at baseline began and ended the study with worse QOL; however, there was a statistically significant improvement in QOL for all groups with the exception of those who scored a "0" on the catastrophizing scale (ceiling effect).

Analysis of covariance (ANCOVA) was conducted to determine the effect of catastrophizing group on 12-month pain scores controlling for baseline pain. The covariate, baseline pain, was significantly related to 12-month pain scores F (1, 231) = 62.62 ($p <.001$) $r^2 = .22$. There was also a significant effect of catastrophizing on 12-month pain scores after controlling for baseline pain, F (3, 231) = 5.10 (p = .002) partial $eta^2 = .06$. Follow-up tests were conducted to evaluate pairwise differences among the adjusted means for level of catastrophizing (Table 11). The Bonferroni procedure was used to control for Type I error across the six pairwise comparisons ($\alpha' = .05/6 = .008$). Planned contrasts revealed that those in the high catastrophizing group had significantly higher pain than those in the no catastrophizing group t (231) = -3.37 (p = .001), low catastrophizing group, t (231) = - 3.61 ($p < .001$) and moderate catastrophizing group, t (231) = - 2.59 (p = .010).

Table 11

Pairwise Comparisons of 12-Month Pain Scores by Level of Catastrophizing

			Adjusted Mean Differences			
Group	Mean	Adjusted Mean	1	2	3	4
1. No Catastrophizing	4.19	7.63				
2. Low Catastrophizing	8.18	9.68	2.05			
3. Moderate	13.68	12.08	4.45	2.40		
Catastrophizing	23.30	17.88	10.25 *	8.20 *	5.80 **	
4. High Catastrophizing						

* $p < .008$, ** p = .010

Analysis of covariance (ANCOVA) was also conducted to determine the effect of catastrophizing group on 12-month QOL scores controlling for baseline measure of medical symptoms. The covariate, medical symptoms, was significantly related to 12-month pain scores F (1, 223) = 13.33 (p <.001) r^2 = .06. There was also a significant effect of catastrophizing on 12-month QOL scores after controlling for medical symptoms, F (3, 223) = 12.93 (p < .001) partial eta^2 = .15. Follow-up tests were conducted to evaluate pairwise differences among the adjusted means for level of catastrophizing (Table 12). The Bonferroni procedure was used to control for Type I error across the six pairwise comparisons (α' = .05/6 = .008). Planned contrasts revealed that those in the high catastrophizing group had significantly higher QOL scores than those in the no catastrophizing group t (223) = -5.16 (p < .001), low catastrophizing group, t (223) = - 5.21 (p < .001) and moderate catastrophizing group, t (223) = - 2.87 (p = .005).

Table 12

Pairwise Comparisons of 12-Month Quality of Life Scores by Level of Catastrophizing

			Adjusted Mean Differences			
Group	Mean	Adjusted Mean	1	2	3	4
1. No Catastrophizing	25.95	29.39				
2. Low Catastrophizing	36.35	37.18	7.79			
3. Moderate	48.31	47.03	17.63 *	9.85 *		
Catastrophizing	62.83	59.70	30.31 *	22.52*	12.67 *	
4. High Catastrophizing						

* $p < .008$

Summary

This chapter presented the results of the secondary data analysis of data from the parent study "Trauma and PTSD: Prevalence and Screening in a Pelvic Pain Clinic." The purpose was to determine the relationships between lifetime trauma, lifetime abuse, physical health, mental health, medical symptoms, catastrophizing, QOL and pain. A description of the characteristics of the participant, findings from the questionnaires and the results of hypothesis testing and research questions were reported.

CHAPTER V

DISCUSSION AND CONCLUSIONS

Chapter V presents a discussion of the study results and the conclusions regarding the hypotheses and research questions. This chapter concludes with a discussion of the limitations of the study and implications for practice and future research.

The findings of the current analysis suggest that the Biopsychosocial model provides a useful framework for understanding the clinical course of women with chronic pelvic pain (CPP). Specifically, it was demonstrated that factors such as catastrophizing play a key role in the progression of pain and the quality of life (QOL). These findings are in line with those seen in fibromyalgia, temporomandibular joint disorder (TMJD) and other chronic pain conditions that have demonstrated that pre-existing complex biopsychosocial factors observed in some patients heavily influence pain and QOL outcomes (Gatchel et al., 2007; Quartana, Campbell, & Edwards, 2009).

Biopsychosocial model: psychological domain

The primary construct of interest in the psychological domain of CPP in the current analysis was catastrophizing. Average baseline catastrophizing scores reported in this analysis were relatively low and they significantly decreased over the 12-month follow-up period. While baseline catastrophizing scores in the current analysis were less than those reported in a cross-sectional analysis of a large database of 2,257 people experiencing heterogeneous chronic pain syndromes, they demonstrate a similar wide variability around the mean catastrophizing score (Edwards et al., 2006). In healthy pain-

free adults, catastrophizing scores also exist on a continuum; however, higher levels of catastrophizing in healthy adults do predict the future development of chronic pain conditions (Edwards et al., 2004). To date, there are few studies evaluating the relationship between catastrophizing and pain over time. In a community samples pediatric population, Vervoort, Goubert, and Crombez (2010) examined the predictive ability of baseline catastrophizing on 6-month pain scores and found that baseline catastrophizing had a small but unique contribution to the prediction of pain and disability 6 months. In a sample of temporomandibular joint disorder patients (TMJD), Velly and colleagues (2011) reported that baseline catastrophizing predicted facial pain severity and disability.

In the current analysis, baseline catastrophizing was related to both baseline and 12-month pain reports with baseline catastrophizing having the strongest relationship of all the theoretical and demographic variables with baseline pain. The relationship continued over the 12-month follow up period with both variables demonstrating a significant decrease suggesting that there is a relationship between decreasing negative emotional and cognitive response to pain and pain improvement. Additionally, the strength of the correlations between catastrophizing and pain both within and across time points speaks to the stability of the relationship between the two variables both within and between individual participants. This observed relationship between psychological constructs and CPP has gained attention in the last decade and the relatively high prevalence of psychological distress among women with CPP seeking care in specialty pain clinics is well described (Latthe, Latthe, Say, Gülmezoglu, & Khan, 2006). However, the presence of documented psychological disturbances such as depression,

anxiety and borderline personality disorder does not equate to a causal relationship between these disturbances and the development of CPP. In fact, there is little empiric evidence to support this assertion (Fenton, Durner & Fanning, 2008; Roth, et al., 2000).

While related, the power of baseline catastrophizing to predict pain and QOL scores decreased over time with baseline catastrophizing scores contributing more variance to baseline regression models than those for 12-month outcome measures. This reduction was most dramatic for pain scores with baseline catastrophizing accounting for 19% of the variance in baseline pain and only 2% of the variance in 12-month pain scores. While the absolute value of the variance accounted for in 12-month pain scores was small, it was significant. This again supports the stability of the relationship between the two variables over time. Additionally, the small value may also suggest that other factors contribute to pain scores of women with CPP.

In exploratory analysis evaluating the effect of level of catastrophizing on pain and quality of life reports it was demonstrated that while pain and quality of life reports decreased across time for all women in the current analysis, only those reporting mild and moderate levels of catastrophizing demonstrated significant improvement in quality of life and pain scores. These findings suggest that women who more commonly use maladaptive coping strategies may have a different clinical progression being less likely to experience improvement of their pain or quality of life; therefore requiring alternative interventions. While the interaction between catastrophizing and pain over time was not evaluated, the exploratory analysis is consistent with previous research demonstrating that in both healthy adults and in those with chronic pain, catastrophizing may remain

stable over weeks and months, and, at times, not changing even after the resolution of acute pain (Edwards et al., 2004; Keefe et al., 1989, Sullivan et al., 1995).

From a broader psychological perspective, the women in the current analysis reported poor mental health functioning. Compared to the general population of women in the United States ages 18 to 75, the mean score of the Mental Component Summary Scale (MCS) in the current analysis were below the 50th percentile (50.9) and when compared to other patient populations, the mean score for the MCS was below the 50th percentile for patients with rheumatoid arthritis (49.17) and back pain (49.27) (Ware, Kosinski, & Gandek, 2005). The MCS was only administered at baseline so there is no available information about the evolving relationship between mental health functioning and the clinical progression of pain. However, baseline mental health status did not remain a significant predictor in the regression models for either 12-month pain or QOL.

The poorer physical functioning observed may be the result of several factors. First, the current sample was recruited from the UNC Pelvic Pain Clinic; a tertiary referral center. Often, patients do not have the opportunity to access a specialty center until they have exhausted all other local resources. Therefore, they may have experienced pain for several months to several years with the concurrent frustration of not having a specific reason or plausible explanation for their pain.

Interestingly, while reporting decreased mental health functioning, the women in the current study reported QOL scores that were improved over those seen in patients with functional bowel disorders (Drossman et al., 2007). The IBS-QOL instrument assesses several dimensions of quality of life including dysphoria, interference with activities, health worry and relationships. While there is some overlap in the constructs

measured with the mental health portion of the SF-12 also assessing dysphoria and interference with activities, the SF-12 approaches these issues more generally and with fewer items. The longer QOL scale may be able to better capture the more nuanced experience of chronic pain patients. In the current analysis, item correlation was not performed. Additionally, unlike the norm-based scales of the SF-12, the QOL instrument used in the current analysis has been primarily used in gastroenterology and there is no available information its effectiveness in other populations.

Biopsychosocial model: biological/physical domain

From a biological/physical perspective, the women in the current analysis reported poor physical functioning. This was reflected in their scores on the Physical Component Summary Scale (PCS) of the SF-12. Compared to the general population of women in the United States between the ages of 18 and 75, the mean score of the PCS (M= 42.80, SD = 11.93) in the Cross-sectional only sample was close to the 25th percentile (42.64) (Ware et al., 2005). The Longitudinal group reported better physical functioning, however, when compared to other patient populations, the average the PCS (M= 44.33, SD = 12.15) was below the reported 50th percentile for patients with depression (47.39) and patients with back pain (48.64) (Ware et al., 2005). The difference in the physical functioning between the Cross-sectional only and Longitudinal groups may arise from the selection criteria for participation in the study. All eligible clinic patients were able to participate in the Cross-sectional only portion while only new clinic patients were eligible for the Longitudinal portion. It is not unexpected that established patients in a pelvic pain specialty clinic would experience more pain-related disability. This is also reflected in the finding that the Cross-sectional only group had

more pelvic pain related surgeries and was more likely to have a pain-specific diagnosis. In addition, the individual items on the PCS capture activities that are sometimes limited by the musculoskeletal components of CPP such as climbing stairs and housework (Tu, As-Sanie, & Steege, 2005). Given that the SF-12 was only administered at study enrollment, it is not possible to determine if physical functioning changes concurrently with the change in pain scores.

Also reflective of their poorer physical health, on average, the women in the current analysis reported a high number and frequency of medical symptoms on the Medical Symptoms Checklist. The average scores reported in the Cross-sectional only group (M = 22.26, SD = 9.49) and the Longitudinal group (M= 20.66, SD = 8.91) were greater than those reported in a study of female gastroenterology patients with a history of rape (13.8, SE=0.75) and those with a history of life-threatening physical abuse (13.9, SE=0.72) (Leserman et al., 1996). The observed difference between the Cross-sectional only and Longitudinal groups may parallel the difference on physical functioning with the established pelvic pain patients in the Cross-sectional only group perhaps being refractory to treatment and thus experiencing more pain-related medical symptoms

The higher number and frequency of medical symptoms reported in both groups may be reflective of the individual items measured. The Medical Symptoms Checklist assesses the presence and frequency of eighteen medical symptoms, many of which include pain symptoms in other areas of the body (i.e. frequent headaches, frequent backaches, muscle aches in the shoulders or neck and pain with urination). The higher number of and frequency of symptoms observed suggest that CPP is more like other chronic pain conditions such as fibromyalgia, temporal mandibular joint disorder (TMJD)

and (irritable bowel syndrome) IBS that often have an increased likelihood of the existence of co-morbid pain conditions (Lim, Smith, Bhalang, Slade, Maixner, 2010). While not generally recognized in the gynecologic literature, a recent study reported that in a group of women seeking care for pelvic pain related to endometriosis there was a 1-year prevalence of migraine headaches of 53% and lifetime prevalence rate of 67% (Karp, Sinaii, Nieman, Silberstein, & Stratton, 2011). This observed rate is greater than the 1-year prevalence in the general U.S. female population (18%) and lifetime prevalence (67%) among women of a similar age (Lipton et al., 2002).

While reporting poorer physical function and a high number and frequency of medical symptoms, the average baseline pain reports in the current sample of women were less than the midpoint of the McGill Pain Questionnaire and similar to those reported by other pain populations including fibromyalgia and low back pain (Harris et al., 2006; Marin, Cyhan, & Miklos, 2006). The current analysis evaluated several theoretical predictors of 12-month pain ratings, with two of the strongest predictors being baseline pain scores and the number of medical symptoms. This pattern is consistent with higher pain and lower physical functioning making it clear that women entering care with increased pain and poorer physical function are likely to have poorer pain-related outcomes.

While baseline measures of pain and physical function play a role in pain-related outcomes, overall, the women who participated at both baseline and 12 months did experience a significant decrease in their pain during the follow-up year. The full explanation for pain reduction is not entirely clear. The parent study did not control for the interventions received during the follow-up year and women who participated in the

12 month follow- up portion were treated based upon the clinical judgment of their individual health care provider. Thus, the women received a variety of medical and surgical interventions including antidepressants, anticonvulsants, muscle relaxants, anxiolytics, sleep aids, narcotics, topical numbing agents, physical therapy, surgical lysis of adhesions and hysterectomy. In recent literature on endometriosis, a recognized cause of CPP, Stratton and Berkely (2011) asserted that the pain is the result of a complex interaction between the disease and the central nervous system. Interestingly, while as a whole pain scores improved, women reporting more baseline and 12-month pain were also significantly more likely to have a diagnosis of endometriosis and a hysterectomy prior to study entry. Therefore it is likely that akin to this and other pain disorders, multiple factors impacted the experience of CPP over time in the women in the current study and that no single intervention accounted for all of the pain reduction (Nicholl et al., 2009; Ramelsberg, LeResche, Dworkin, & Mancl, 2003; Stratton & Berkley, 2011).

Biopsychosocial model: social domain

In the current analysis, CPP demonstrated an impact on the social domain impacting the women directly as well as those involved in their lives. The women in the current analysis reported that they spent a great deal of time attending medical, psychotherapy, physical therapy and pain-related services. This translates to time that they are not be able to participate in work, family or social activities. The potential strain that this places upon women and their families is both emotional and financial with time spent in pain or pursuing treatment options translating into lost wages and increased expenses.

Currently, the literature on the impact of CPP on the social domain of women has focused primarily upon partner relationships and sexual function with evidence that CPP strains marital relationships and can result in social isolation (Bachman et al., 2006; Petersen & Giraldi, 2008). The toll upon intimate relationships is well established in other chronic pain conditions with pain having a negative impact on relationship satisfaction (Cano, Gillis, Heinz, Geisser, & Foran 2004; Turk, Flor & Rudy, 1987). Research on the effect of chronic low back pain on the lives of patients has shown restrictions on parenting time, less satisfying sexual relationships, the inability to participate in leisure activities and decreased support of friends and colleagues (De Souza & Frank, 2011; Strunin & Boden, 2004). Given the interference with daily life that pain has upon the individual, it can be expected that family members are also adversely affected. This has been demonstrated in chronic low back pain with both members of a couple reporting higher levels of psychological distress (Pincus, Vlaeyen, Kendall, Von Korff, Kalauokalani, & Reis, , 2002). In keeping with the interactions in the Biopsychosocial model, psychological variables such as catastrophizing may exacerbate the toll that chronic pain has on relationships. For example, Waxman, Tripp and Flamenbaum (2008) found that catastrophizing and depression mediated the relationship between pain and relationship satisfaction.

An additional aspect of the social context in which women with CPP live was evaluated through trauma and abuse histories. In the literature about CPP, there has been some question about the role of trauma and abuse history in the development and maintenance of pain. In the current sample, women in the Cross-sectional and Longitudinal groups reported an average of one to two episodes of lifetime abuse or

lifetime trauma with the Cross-sectional only group reporting a significantly higher average number of episodes. The difference between the two groups should be interpreted with caution. It is possible that women who have experienced more episodes of trauma and abuse are refractory to treatment and therefore more likely to enter the Cross-sectional only group as an established pelvic pain patient. However, the weak correlations between lifetime abuse, lifetime trauma and pain suggest that this explanation may not be sufficient. It is also plausible that the 115 women (30%) who entered but did not complete the longitudinal portion may have had higher rates of abuse and trauma than those who did complete both time points; however, this analysis was not completed.

While the numbers may appear low, half of the women in both groups reported experiencing at least one incident of lifetime abuse or trauma. These rates of abuse are above many of the national averages estimating that physical and sexual abuse have a prevalence of 20.3% to 26.7% in the general female population. (Breiding, Ziembroski, & Black 2009; McFarlane, 2004; Tjaden, Thoennes & Allison, 2000). This is consistent with other reports that women with CPP have higher than average rates of abuse (Golding, 1999; Paras et al., 2009; Roelofs & Spinhoven, 2007; Romans et al., 2002; Walker et al., 1999). Comparison statistics are not readily available for all of the types of trauma captured by the Lifetime Trauma instrument. However, the National Co-morbidity Survey estimated that 51% of all women in the US had experienced at least one traumatic incident in their lifetime (Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995).

While higher than national averages, abuse and trauma did not have a major impact on pain reports. Relationships between both trauma and abuse variables and initial pain reports were weak and neither variable remained significant in the in the larger sample pain regression model at baseline. When examining 12-month pain reports, the relationships between lifetime abuse and trauma and pelvic pain reports were even weaker. Prior research in gynecology examining abuse and trauma histories in women with CPP has primarily reported associations and there is a scant amount of information available on the role these factors play in the severity of pain or the fluctuation of pain over time. While only captured at one time point, Poleshuck and colleagues (2006) reported that trauma and abuse history had more of an impact on psychological distress than CPP complaints. Within the broader spectrum of chronic pain, it has been reported that women who have experienced abuse and trauma are more likely to report their pain as severe and have a high degree of disability (Wuest et al., 2008).

One explanation for the lack of predictive power of abuse and trauma histories may be that the current study analyzed pain reports across all study participants and did not account for the type of pain for which the women sought treatment. As illustrated previously by Leserman and colleagues (2006), abuse and trauma reports differed across identified subgroups of pelvic pain with women reporting diffuse abdominal and pelvic pain reporting higher rates of abuse and trauma than those women with vulvovaginal pain or cyclic pain. In addition to the type of pain experienced, the nature of the abuse or trauma may also play a role in pain outcomes. A review of the intimate partner violence literature found a stronger association between CPP and sexual abuse than physical abuse (Romans & Cohen, 2008). The current analysis did not distinguish between sexual and

physical abuse nor did it account for the timing of exposure (i.e. childhood versus adulthood). Thus, clinicians need not to assume that the presence of trauma and abuse are the reasons for CPP and must take the time to look at other alternatives.

While the types of CPP experienced may offer insight to pain outcomes, the more likely explanation for the relatively weak relationships between trauma and abuse histories and pain reports arise from the Biopsychosocial theory that asserts that additional factors beyond the social domain complicate these relationships. Meltzer-Brody and colleagues (2007) found that one in three of the women with CPP and a history of abuse or trauma also had a positive screen for PTSD. These same women were more likely to report their pain as severe. PTSD has been demonstrated to have both psychological and biological ramifications in the pain literature (Chapman, Tuckett, & Song, 2008; Otis, Keane, & Kerns, 2003; Woods et al., 2005).

PTSD was not evaluated in the current analysis; however, other psychological measures were taken into account. Baseline reports of catastrophizing were comparable to those demonstrated in other pain populations such as patients with pain related to spinal cord injuries (M=1.57, SD=1.41) (Raichle, Hanley, Jensen, & Cardenas, 2007) and those in a mixed pain population (M=1.2, SD= 1.4) (Arnow et al., 2011). While a positive association was observed, the impact of catastrophizing on the relationship between abuse and trauma reports and pain reports was not directly evaluated in the current analysis. However, the baseline associations between lifetime abuse and lifetime trauma and catastrophizing were not strong and unlike catastrophizing, these variables did not prove to be significant factors in the regression models for baseline or 12-month pain reports.

Limitations

There are potential limitations that are important in the interpretation of the findings of the current analysis. First, the absence of a comparison group of women without CPP does not allow for definitive conclusions regarding the overall influence of catastrophizing on pain. While this study provides support for catastrophizing as an important variable for consideration, it may also be present in varying degrees in pain-free women. In addition, the current analysis did not allow for the comparison of treatment modalities and their potential impact on symptom improvement. The women in the 12-month follow-up portion of the analysis were treated based upon the practice pattern of their health care provider and the consideration of patient preferences. The lack of specific treatment allocation does not allow for the evaluation of the interaction of the observed theoretical and demographic variables with treatment modality.

The limitation with perhaps the greatest potential impact on the interpretation of the results was the measurement of abuse. In the current analysis, the abuse scale was dichotomized with the presence of any item defining the presence of an abuse history. Theoretically, this could result in a positive response to an incident of inappropriate touch during childhood being equated with a positive response to an experience of rape as an adult. While both indicate a positive abuse history, the physical and emotional impacts of these events are likely to be dramatically different. Childhood experiences of inappropriate touch or other forms of child abuse have been associated with a variety of adult adverse health outcomes including obesity and gastrointestinal disorders (Sachs-Ericsson, Medley, Kendall-Tackett, & Taylor, 2011). Similarly, rape and other acts of sexual violence have also been associated with multiple adverse health outcomes

(Amstadter, McCauley, Ruggiero, Resnick, & Kilpatrick, 2011). While most studies evaluating these associations are cross-sectional rather than predictive, it is reasonable to conclude that the health outcomes resulting from the physical trauma of rape may play a larger role in subsequent gynecologic pain conditions than the trauma resulting from inappropriate touch. Future analysis of the predictive ability of abuse history on pain outcomes should differentiate types of abuse.

Implications for Practice

In the present analysis, there was a significant association between psychological measures and CPP. Specifically, psychological distress as measured though catastrophizing was a strong predictor of baseline pain reports and remained a significant predictor for 12-month pain reports. Additionally, exploratory analysis demonstrated that there is a dose response relationship between catastrophizing and pelvic pain with women scoring in the severe category for catastrophizing having less improvement in 12-month pain scores than women in either the mild of moderate groups.

The difference in the improvement in pain reports has important implications for clinicians. The consideration of psychological factors has not traditionally been a strong part of pelvic pain research and has therefore not been incorporated into clinical practice. This pattern has allowed for women who tend to cope via catastrophizing and those who do not to be grouped together when evaluating medical and surgical treatments and has resulted in a knowledge deficit about the true efficacy of either for CPP. The inherent danger of this deficit is that may be considered treatment failure may be a truer reflection of the impact of coping strategies. Effective techniques may be abandoned and there is

the potential for women to be blamed for their non-response to traditional medical and surgical interventions.

The results of the current analysis contribute to the evidence in the literature supporting the consideration of catastrophizing as a risk marker for adverse intermediate and long-term pain outcomes (Quartana et al., 2009). A screening tool would allow clinicians to better identify those women who might not respond to conventional therapies and instead need a more comprehensive approach to pain management. Such an approach might include multidisciplinary interventions, cognitive-behavioral therapy, exercise programs and mindfulness based meditation aimed at reducing catastrophic thinking and aid in the development of alternative coping strategies.

While coping strategies and other psychological constructs are often not assessed in the treatment of CPP, many clinicians do inquire about physical and sexual abuse. While the women in the current analysis did report higher than average rates of abuse and other forms of lifetime trauma, this history did not have a significant impact on the progression of their pelvic pain. This relationship has not been demonstrated previously and warrants further investigation.

Current clinical practice accepts that women with CPP have higher rates of physical and sexual abuse. When such a history is elicited, there is the potential danger of attributing a lack of pain improvement solely to previous experiences of abuse. As demonstrated in the current analysis, the relationship between trauma, abuse and pain is more complicated. Clinicians need to explore issues related to trauma and abuse and ascertain the type of trauma and therefore interventions must be more comprehensive.

Future Research

Gynecology has traditionally been a surgical specialty and much of the research in the field reflects this history. While helpful in many conditions, the traditional end organ approach is not sufficient in the understanding and treatment of CPP. Research in other pain conditions commonly seen in women such as fibromyalgia, temporal-mandibular joint disorder and migraine headache recognizes that certain psychological characteristics may precede or be affected by persistent pain states. Focusing exclusively on potential disease or end organ pathology without recognition of the importance of psychological factors therefore, does not allow for the development of optimal treatment modalities.

The results of the current analysis lend evidence to the need for a greater understanding of the complex nature of CPP. Specifically, additional research is needed to understand the interactions of the psychological and physiological domains of CPP. A more thorough investigation of this process may help to explain unexpected finding that abuse and trauma history did not predict 12-month pain scores. While it is known that women with histories of lifetime abuse and trauma report more somatosensory complaints, the exact mechanism of this association has not been established and indirect mechanisms are inferred from research in other fields. Disordered sleep patterns, cumulative stress, increased inflammatory cytokines and elevated cortisol levels are among the proposed pathways (Afari & Buchwald, 2003; Afari, et al., 2008; Bertoli, et al., 2007; Chapotot, et al., 2001; Kendall-Tackett, 2007). These same pathways have all been implicated in the development and maintenance of chronic pain making the understanding of why this may be different in CPP even more important.

In addition to the need for additional research exploring the connections between abuse and trauma history and CPP, there is a need for a greater understanding of the contribution of psychological processes in the development and maintenance of pelvic pain. The current analysis suggests that this is of paramount importance for those women who the most likely to employ maladaptive coping strategies such a catastrophizing. While catastrophizing in isolation does not appear to be sufficient in explaining the course of pelvic pain, it does seem to play a vital role. Thus, the development and evaluation of future interventions, must take this into consideration and control for the effects of psychological constructs.

Conclusion

The lack of foundation level research in CPP has resulted in inadequate treatment and unnecessary suffering of numerous women. The implications that this carries not only for individual lives but a society that experiences decreased productivity and increased need for health and other services is tremendous. The future of research will benefit most from the adaptation of research in other pain conditions and an understanding of how findings from fields such as dentistry, anesthesiology, rehabilitation and rheumatology may be applicable to gynecologic pain disorders. The current analysis contributes to the existing body of literature by confirming the complex nature of CPP and highlighting the need for additional exploration of the contribution of psychological processes to the development and maintenance of pain.

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Appendix

Institutional Review Board Approval

INSTITUTIONAL REVIEW BOARD

Mail: P.O. Box 3999
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December 13, 2010

Principal Investigator: Clark, Patricia

Student PI: Elisabeth Dinkins

Protocol Department: B.F. Lewis School of Nursing

Protocol Title: Catastrophizing, Abuse, Quality of Life and Pain Reports in Female Patients Attending a Pelvic Pain Clinic

Submission Type: Protocol H11237

Review Type: Exempt Review

Approval Date: December 13, 2010

The Georgia State University Institutional Review Board (IRB) reviewed and approved your IRB protocol entitled Catastrophizing, Abuse, Quality of Life and Pain Reports in Female Patients Attending a Pelvic Pain Clinic. The approval date is listed above.

Exempt protocols do not require yearly renewal. However, if any changes occur in the protocol that would change the category of review, you must re-submit the protocol for IRB review. When the protocol is complete, a Study Closure Form must be submitted to the IRB.

Any adverse reactions or problems resulting from this investigation must be reported immediately to the University Institutional Review Board. For more information, please visit our website at www.gsu.edu/irb.

Sincerely,

Laura Fredrick

Laura D. Fredrick, IRB Vice-Chair

Federal Wide Assurance Number: 00000129