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Jessica Ann Lohnberg  
*University of Iowa*

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AN EXAMINATION OF THE PSYCHOSOCIAL PROFILE OF INDIVIDUALS WITH  
COMPLEX REGIONAL PAIN SYNDROME

by

Jessica Ann Lohnberg

An Abstract

Of a thesis submitted in partial fulfillment  
of the requirements for the Doctor of  
Philosophy degree in Psychological and Quantitative Foundations  
in the Graduate College of  
The University of Iowa

July 2011

Thesis Supervisor: Professor Elizabeth M. Altmaier

## ABSTRACT

This study sought to provide a description of the psychosocial profile of persons with complex regional pain syndrome (CRPS). CRPS is an excruciatingly painful and debilitating condition that is poorly understood by medical professionals. Its profound impact on an individual's quality of life prompts a closer examination of the psychosocial profile of individuals suffering from CRPS. The extant literature examining psychological variables associated with CRPS is inconclusive with regard to the role that these factors play in the course of the syndrome. It has been shown, however, that CRPS patients suffer tremendous physical discomfort and this is often reflected in increased emotional distress. The present study assesses level of pain, anxiety, depression, disability, intrusive thoughts, quality of life, and demographic variables utilizing a national sample obtained from an online survey distributed to members of an organization that provides resources to CRPS patients. Descriptive data are presented for all data gathered and specific correlates of quality of life were examined. Results of the study demonstrated that this sample endorsed high levels of anxiety and depression and reported low levels of both physical and mental quality of life. When compared to normative data, this sample endorsed more pain and anxiety than other pain populations and also endorsed lower mental and physical quality of life than other pain conditions. The psychosocial profile of individuals with CRPS type I did not vary significantly from individuals with type II. Intrusive thoughts were uniquely predictive of disability, physical quality of life, and mental quality of life after controlling for age, gender, and pain level. The role of intrusive thoughts in predicting disability and quality of life suggests a potential mechanism by which clinicians can target psychotherapeutic

treatment. Understanding the psychosocial profile and psychological sequelae of this disorder will help both physicians and psychologists understand the impact of CRPS on patients and provide a pathway for improved comprehensive interdisciplinary treatments.

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Graduate College  
The University of Iowa  
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CERTIFICATE OF APPROVAL

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PH.D. THESIS

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This is to certify that the Ph.D. thesis of

Jessica Ann Lohnberg

has been approved by the Examining Committee  
for the thesis requirement for the Doctor of Philosophy  
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To my family—Esty, Michael, Carrie, and Lauren



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This study sought to provide a description of the psychosocial profile of persons with complex regional pain syndrome (CRPS). CRPS is an excruciatingly painful and debilitating condition that is poorly understood by medical professionals. Its profound impact on an individual's quality of life prompts a closer examination of the psychosocial profile of individuals suffering from CRPS. The extant literature examining psychological variables associated with CRPS is inconclusive with regard to the role that these factors play in the course of the syndrome. It has been shown, however, that CRPS patients suffer tremendous physical discomfort and this is often reflected in increased emotional distress. The present study assesses level of pain, anxiety, depression, disability, intrusive thoughts, quality of life, and demographic variables utilizing a national sample obtained from an online survey distributed to members of an organization that provides resources to CRPS patients. Descriptive data are presented for all data gathered and specific correlates of quality of life were examined. Results of the study demonstrated that this sample endorsed high levels of anxiety and depression and reported low levels of both physical and mental quality of life. When compared to normative data, this sample endorsed more pain and anxiety than other pain populations and also endorsed lower mental and physical quality of life than other pain conditions. The psychosocial profile of individuals with CRPS type I did not vary significantly from individuals with type II. Intrusive thoughts were uniquely predictive of disability, physical quality of life, and mental quality of life after controlling for age, gender, and pain level. The role of intrusive thoughts in predicting disability and quality of life suggests a potential mechanism by which clinicians can target psychotherapeutic

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## CHAPTER I

### INTRODUCTION

Complex regional pain syndrome (CRPS) has repeatedly been described as one of the most puzzling and enigmatic of the chronic pain disorders (Janig, 1996; Nelson & Novy, 1996). The dearth of information on its epidemiology, the lack of understanding of its pathophysiology, and the lack of agreement on its definition and diagnostic criteria (Nelson, 2002) make this syndrome difficult to study. Unfortunately, patients with CRPS suffer tremendously and, consequently, researchers have been working to gain a better understanding of this condition. Because CRPS is so poorly understood, combined with the observed psychological differences seen in these patients as compared with other pain patients, researchers have implicated psychological processes as potentially causing, maintaining, and/or exacerbating this condition.

Psychological factors have long been associated with chronic pain conditions, both as predispositional factors as well as outcome effects. The biopsychosocial model of illness (Engel, 1977) and, more specifically, the gate control theory of pain (Melzack & Wall, 1965) both provide explanations for how psychological factors can affect the experience and perception of pain. For that reason, psychosocial factors are often studied in chronic pain populations. Researchers have shown how chronic stress (Van Houdenhove, 2000) and personality traits (Gatchel & Weisberg, 2000) may contribute to the development of chronic pain. Additionally, the experience of chronic pain itself has been associated with psychological effects such as depression (for a review, see Romano & Turner, 1985), anxiety (e.g., Fishbain, Goldberg, Meagher, Steele, & Rosomoff, 1986), physical disability (Gatchel, 2001), and reduced quality of life (Latham & Davis, 1994). To make sense of these contradicting theories, researchers have proposed that a diathesis-stress model best explains the increased psychopathology among chronic pain

populations (Dersh, Polatin, & Gatchel, 2002) to the extent that patients may have preexisting characteristics that become activated by the stress of pain.

Complex regional pain syndrome (CRPS) is a chronic condition first described during the American Civil War (Borg, 1996). CRPS has a complex history characterized by multiple name changes in an effort to capture a poorly understood pathophysiology. This syndrome has had labels such as causalgia, Sudeck's atrophy, osteodystrophy, shoulder-hand syndrome, algodystrophy, reflex sympathetic dystrophy, and sympathetically-maintained pain, among others (Borg, 1996; Turner-Stokes, 2002). In addition, there has been disagreement on a universally accepted set of diagnostic criteria, making the condition difficult to study.

The currently accepted set of criteria, according to the International Association for the Study of Pain (IASP), includes the following: (1) the presence of an initiating noxious event or cause of immobilization; (2) continuing pain, allodynia, or hyperalgesia in which the pain is disproportionate to any known inciting event; (3) evidence at some time of edema, changes in skin blood flow, or abnormal sudomotor activity in the region of pain; and (4) the diagnosis is excluded by the existence of other conditions that would account for the degree of pain and dysfunction (Merskey & Bogduk, 1994). CRPS represents two syndromes, type I and type II. CRPS type I was previously known as reflex sympathetic dystrophy (RSD; Stanton-Hicks et al., 1995) whereas type II was known as causalgia (Baron & Wasner, 2001). Both share the same signs and symptoms, but type II has an identifiable nerve injury whereas type I does not (Merskey & Bogduk, 1994).

Though early interventions result in the best outcomes, many individuals with CRPS continue to suffer intractable pain for years and undergo many failed treatments (Allen, Galer, & Schwartz, 1999). CRPS usually develops following a seemingly innocuous injury or incident such as a fracture, soft tissue damage, low-grade infection, frostbite, burns, or in the aftermath of stroke or myocardial infarction (Baron, Levine, &



Fields, 1999). The pain that subsequently develops is disproportionate to the tissue damage sustained during the injury, thus suggesting a disruption of the normal healing process.

Because CRPS is so poorly understood, many researchers have implicated psychological factors in its etiology and pathophysiology. Consequently, numerous studies have investigated such ideas, and, interestingly, they have failed to come to a consensus on this matter. After thorough reviews of the literature, some authors (Beerthuis, Van't Spijker, Huygen, Klein, & de Wit, 2009; Bruehl & Carlson, 1992; Covington, 1996; Feliu & Edwards, 2010; Haddox, 1990; Lynch, 1992; Steger, Bruehl, & Harden, 1999) contend that there is not sufficient evidence to conclude that CRPS patients have preexisting psychological characteristics or personality traits that lead to the development of the syndrome. By contrast, some researchers (Ochoa, 1992; Van Houdenhove et al., 1992; W. U. Weiss, 1994) still maintain that psychological factors indeed are related to the initiation and etiopathogenesis of CRPS. This lack of consensus has spawned additional studies aimed at identifying potential psychological predictors of the disorder, comparing CRPS patients to other chronic pain patients, and describing the common psychological effects of having CRPS.

Several studies have attempted to identify whether certain conditions or characteristics might predispose an individual to develop CRPS. de Mos et al. (2008) conducted a study investigating whether medical factors before diagnosis may predict development of CRPS. They determined that migraine, osteoporosis, and asthma were associated with CRPS, but psychological factors were not. One study showed that depressed mood predicts the following day's pain in CRPS patients (Feldman, Downey, & Shaffer-Neitz 1999) and another study found alleviation of depression via electroconvulsive therapy (ECT) also resulted in relief from CRPS symptoms (McDaniel, 2003). Another study has shown that CRPS patients tend to have experienced more stressful life events, potentially implying stress may be involved in its pathogenesis

(Geertzen, de Bruijn-Kofman, de Bruijn, van de Wiel, and Dijkstra, 1998). One prospective study found no psychological differences or higher incidence of life events between one patient who developed CRPS following fracture of the distal radius compared to other fracture patients who did not (Dijkstra, Groothoff, ten Duis, and Geertzen, 2003). Similarly, another study also showed no difference in personality characteristics or symptoms of depression between patients who did versus those who did not develop CRPS following surgery to repair fractures of the distal radius (Puchalski & Zyluk, 2005). Another study, however, showed that distress and pain level predicted the development of CRPS following a total knee arthroplasty surgery (Harden et al., 2003); anxiety and depression, on the other hand, were found to be results of the syndrome. Taken together, these studies do not provide sufficient evidence to conclude that psychological characteristics are wholly responsible for the development of CRPS.

Despite the lack of support for psychological factors predicting the development of CRPS, many physicians anecdotally have reported their CRPS patients behave qualitatively differently than other chronic pain patients (Rauis, 1999). Consequently, other studies have attempted to compare CRPS patients to other chronic pain patients on psychological variables. Results from these studies have also differed, with some claiming CRPS patients are psychologically worse than other chronic pain patients, and others reporting no psychological differences. One study found no difference on psychological variables between CRPS patients and radiculopathy patients (Haddox, Abram, & Hopwood, 1988). Another study found no differences on psychological symptoms between RSD patients, low back pain patients, and headache pain patients (DeGood, Cundiff, Adams, & Shutty, 1993). Similarly, studies comparing CRPS patients to somatic disorder patients found no differences in psychopathology (Van der Laan, van Spaendonck, Horstink, & Goris, 1999). Another study also found no differences, but CRPS patients were compared to a psychiatric group of conversion disorder patients instead of a chronic pain group (Shiri, Tsenter, Livai, Schwartz, & Vatine, 2003),

suggesting there is a psychiatric component since CRPS patients looked similar to psychiatric patients.

Many studies, by contrast, did find psychological differences between CRPS patients and chronic pain comparison groups. Some studies noted greater depression among CRPS patients as compared to brachial plexus lesion patients (Zucchini, Alberti, & Moretti, 1989) and as compared to hand injury patients (Hardy & Merritt, 1988). When compared to chronic low back pain patients, one study (Verbunt, Pernot, & Smeets, 2008) found CRPS patients to be similar while another study found CRPS patients to have more somatization and phobic anxiety (Bruehl, Husfeldt, Lubenow, Nath, & Ivankovich, 1996). Other confounding results occurred in studies comparing CRPS patients to fibromyalgia (FM). One study (Marinus & Van Hilten, 2006) found CRPS and FM to show similar characteristics, signs, and symptoms, but another (Verbunt et al., 2008) found FM patients reporting more psychological distress than CRPS patients. While these studies varied in comparison groups and psychological measures, the contradictory outcomes do not advance our understanding any further.

The comparative studies do not provide a consensus about whether CRPS patients are more psychologically disturbed than other chronic pain patients; therefore, descriptive studies of the psychological effects of CRPS might provide more insight into the experience of those with this puzzling syndrome. CRPS patients report decreased quality of life (Galer, Henderson, Perander, & Jensen, 2000), job inactivity and depression (Rauis, 1999) and reduced physical functioning (Bruehl & Chung, 2006). Often, these patients are depressed, unable to function and work, and consequently suffer a reduced quality of life. The high levels of psychopathology seen within this group of patients could be due to the intense nature of pain and disability associated with this syndrome; learned helplessness after multiple failed treatment attempts may be a contributing factor as well.

While numerous studies of the psychological factors involved in CRPS exist, there are a number of limitations to the extant literature. First, many of the studies use a convenience sample from a single tertiary pain clinic, thus reducing generalizability of their findings. Second, many of the studies include psychological measures as an ancillary component to a medical or treatment outcome study. Of the studies whose primary concentration is psychological, the focus tends to be on how “psychologically disturbed” CRPS patients are compared to other reference groups; little attention is given to understanding their experience of the syndrome and how best to improve patient quality of life. Third, to date, there are no studies that examine the role of posttraumatic stress disorder (PTSD)-like symptoms in patients with CRPS. Though references have been made to individuals suffering from both PTSD and CRPS concomitantly, no study has investigated the role of intrusive thoughts or rumination about the injury or syndrome in the maintenance or exacerbation of CRPS.

Chronic pain has clearly been shown to have a significant socioeconomic impact on both society and the suffering individual. CRPS, as one of the most poorly understood and debilitating of the chronic pain disorders, needs to be a focus for improving treatment and quality of life for individuals who suffer from this syndrome. Therefore, the purpose of this study is to examine the quality of life of individuals suffering from CRPS and describe their psychosocial profile. Because these individuals suffer from a disabling condition, it was suspected that they would report a lower quality of life and increased anxiety and depression compared to physically healthy counterparts. The psychological variables of individuals with CRPS type I versus CRPS type II were compared to investigate whether known presence of a nerve injury affects these variables. Factors associated with quality of life were also examined. Finally, the role of intrusive thoughts in predicting disability and quality of life was investigated. This study augments the current literature of CRPS by providing an increased understanding of how it affects the

individuals who suffer from this syndrome. This information will allow medical professionals and psychologists to tailor interventions to improve quality of life.

## CHAPTER II

### LITERATURE REVIEW

This literature review will begin by discussing chronic pain, its definitions, and the models developed to explain the pathophysiology of pain. The chapter will then examine the psychosocial predictors and effects of chronic pain detailed in the literature. Next, complex regional pain syndrome (CRPS) will be discussed and its definition and diagnostic criteria will be reviewed. Then, studies examining psychosocial factors associated with CRPS, both predictors and resulting effects, will be analyzed. Finally, this paper will provide a summary of the existing literature on the psychological profile of CRPS and discuss the limitations in the existing research before proposing the purpose and hypotheses of the current study.

#### Chronic Pain

Chronic pain is a condition that can affect an individual's functioning and quality of life. There are many conditions that can turn into chronic pain and the mechanism by which acute pain episodes become chronic and disabling is routinely studied and will be presented below. This section will describe the definitions and criteria for chronic pain, followed by a discussion of the various explanatory models of chronic pain.

#### Acute versus chronic pain

Pain is a physiological sensation that typically indicates when something is wrong with the body; it serves as a warning signal about harm or danger such as infection, disease, damage to the system, and other external dangers. Nociception is the term used for the nerve impulses that alert the brain to danger; it is triggered by noxious, or potentially harmful, stimuli and functions to alert the individual to remove or lessen the danger (Zimmerman, 2004). Most pain experiences serve to warn individuals about an internal (e.g., disease) or external (e.g., fire) danger and are acute in nature; the pain is

relieved once the noxious stimuli is removed or avoided. However, in certain patients, various pain conditions can become chronic. In some cases, the pain symptoms continue to exist even after the organic condition has resolved, and in others the pain may be experienced in excess of what one would expect given the level of physical damage. In acute pain, sensations are mediated by the nociceptive neuronal system (Zimmerman, 2004). The noxious stimuli trigger the free-nerve endings in the skin and the impulses then travel to the spinal cord via thick or thin fibers in the peripheral nerves (Merskey & Spear, 1967). The thick fibers can carry the pain signal much faster than the thin fibers resulting in “fast pain” or “slow pain.”

This neuronal system of nociception is also involved in chronic pain, in which case the continued neuronal activation may lead to changes that make the nervous system more sensitive (Zimmerman, 2004). Therefore, less harmful stimuli can still result in an increased perception of pain. This nervous system sensitization thus contributes to the chronicity of certain pain conditions (Zimmerman, 2004). Chronic pain is pain that becomes continuous and persists for more than six months (Almay, 1989).

While this explanation describes the physiological differences between acute and chronic pain, it does not account for other factors that have been implicated by many researchers. The following section will describe the various models that have been developed to explain the pathophysiology of pain, which, over time, have been modified to include additional contributing factors to the sensation and perception of pain.

#### Models of chronic pain

When pain becomes chronic, simple physiological findings often no longer adequately explain the perception of pain. For this reason, researchers have proposed various models of pain in an attempt to identify other contributing factors to pain, particularly when there is a disproportionate ratio of physical damage to perceived pain symptoms.

Biomedical models. The biomedical model was initially used to explain the pathophysiology of pain perception. This model of pain and disease was described as early as the 17<sup>th</sup> century by ancient Greeks and made known by Descartes and posited that reported symptoms reflected a disordered biology (Turk & Monarch, 2002). In relation to pain, this model assumed that each individual's reported pain perception represented some kind of physical pathology and that increased pain reports represented greater physical damage. Rene Descartes viewed pain through a *biomedical reductionist model* whereby the mind and soul were not needed to explain physical function and behavior and instead the body reacted directly to painful stimuli through a direct channel from the skin to the brain (Gatchel & Weisberg, 2000). This explanation of pain was very influential in medicine for some time. Melzack and Wall (1965) noted that in 1894, von Frey expanded upon the biomedical reductionist model to propose the *specificity theory of pain* whereby specific pain receptors were directly responsible for the transmission of pain to the spinal cord via A-delta and C fibers in the peripheral nerves and subsequently to the brain by the lateral spinothalamic tract. This theory, while more detailed than Descartes's description, still followed a biomedical approach positing a direct relationship between exposure to noxious stimuli and pain perception.

Melzack and Wall (1965) also described Goldschneider's opposing *pattern theory of pain* which was developed around 1894 as well. They described how Goldschneider proposed that pain sensations resulted from a pattern of nerve impulses that were coded at the peripheral stimulation site and that different patterns of impulses resulted in different sensations. Therefore, the perception of pain was related to the way the central nervous system coded these patterns as opposed to a simple direct transmission between pain site and pain receptors, as proposed by von Frey. Though these models differed in their explanation of how pain was transmitted and experienced, they both followed the biomedical model, assuming that pain experience was purely mechanistic and resulting from an organic source.



While this model dominated medicine for many years, researchers began to question its accuracy in describing medical illness. Because individual differences were noted in response to similar physical stimuli, researchers began to wonder what additional factors might account for the variation in perception (Turk & Monarch, 2002). In the biomedical model, all symptoms were categorized as either somatogenic or psychogenic (Turk & Monarch, 2002), indicating that when pathology could not account for an individual's reported symptom, that symptom was attributed to purely psychogenic processes.

Chronic pain is one medical condition that is not always adequately explained via the biomedical model. Numerous pain conditions result in significant levels of reported pain and distress even when the observed pathology would suggest otherwise. In 1977, Engel criticized the biomedical model for its failure to account for other variables in the disease process in his seminal article on a new model, the biopsychosocial model.

Biopsychosocial models. Even before Engel's (1977) critical evaluation of the medical model and subsequent proposal of a new biopsychosocial model, Melzack and Wall (1965) proposed their own new theory of pain that accounted for psychological influences in addition to biological pathology. Their new theory, called the *gate control theory of pain*, posited that both the central nervous system and psychological factors were involved in the pain perception process. They hypothesized that certain cells of the dorsal horn in the spinal cord mediated the response between the stimulus and the response, serving as a gate control system. This "gate" controls the amount of input that gets transmitted from the peripheral fibers to the T cells, or dorsal horn transmission cells. The afferent patterns in the dorsal column system serve as a control trigger that can activate certain brain processes which influence the modulating processes of the gate control system. Lastly, Melzack and Wall asserted that the T cells would activate neural mechanisms that were responsible for the response and perception of pain. It was the interaction of all of these systems that determined pain phenomena, according to their

newly proposed theory. The passage of T cells through the dorsal horn is dependent upon whether the inhibitory or excitatory fibers are firing. When the activity of the excitatory fibers exceeds that of the inhibitory fibers, the gate allows the passage of the pain input where it is subsequently perceived by the brain. If, by contrast, the inhibitory fibers are activated, the gate closes and suppresses the perception of pain. In sum, pain response was not a direct, linear pathway from site of trauma to brain. Melzack and Wall proposed a more complex and comprehensive physiological process whereby pain transmission was modulated by internal processes. While this new proposal of pain physiology initially received much criticism and debate, their theory has endured the test of time (Dickenson, 2002) with minor revisions to the initial proposal and still serves as an explanatory model for pain.

Several years later, Melzack and Casey (1968) expanded upon the gate control theory of pain and its physiological explanations of pain transmission to incorporate the influence of motivation and affect. Beyond the gate control system, they asserted that: (a) the sensory-discrimination dimension of pain is partly determined by the selection and modulation of sensory input through the neospinothalamic projection system, (b) the motivational drives and unpleasant affect of pain that influences behavior is triggered by the activation of the reticular and limbic structures of the brain, and (c) the neocortical, or higher central nervous system, processes and evaluates the sensory input in terms of past experience, thus controlling the sensory-discrimination system as well as the motivational-affective system. The interaction of all three of these systems influences the experience of pain and resulting affect and behavior of the individual. Thus, subjective pain experience is determined by sensory, motivational, and cognitive processes. Taken together, the original gate control theory of pain (Melzack & Wall, 1965), along with the addition of motivational and affective processes (Melzack & Casey, 1968), variation of pain experience is explained by both physiological and psychological processes and the gate control theory specifically indicates how each can influence the other.

Following this new theory of pain and its incorporation of psychological factors, Engel (1977) challenged the medical community to take a different perspective of medical illnesses beyond the purely biomedical reductionist model. He argued that existence of pathology did not necessarily mean an individual experienced the illness. Similarly, he pointed out that elimination of defective biology or disease did not always lead to restored health. Engel argued that psychological and social factors accounted for these discrepancies between biological observation and human experience. This provocative model forced the medical community to reevaluate their models of disease to include psychological and social influences, including explanatory models of pain. This biopsychosocial model allowed physicians to view pain as a complex, subjective phenomenon whereby psychological, social, and economic factors can affect one's interpretation of nociception as pain (Gatchel & Weisberg, 2000).

An extension of the gate control theory of pain, known as the *neuromatrix theory* has been written about more recently by Melzack (1999). In this theory, he incorporated Selye's theory of stress to propose that nerve impulses are generated by a widely distributed nerve network described as the "body-self neuromatrix" of the brain (Turk & Monarch, 2002). Melzack asserts that this new theory can better explain the discrepancy between physical tissue damage and reported pain perception by proposing that output patterns of this neuromatrix activate perceptual, homeostatic, and behavioral programs following injury or other pathology as a result of multiple other inputs that act on the neuromatrix. The neuromatrix is genetically determined and can be modified by previous sensory experience and creates the pattern output which is influenced by multiple factors. When an injury occurs, the body's homeostatic regulation is disrupted causing stress and an effort to return the body to its previous homeostatic state (Turk & Monarch, 2002). In Melzack's neuromatrix theory, he argues that the resulting stress and attempts to reestablish homeostasis cause a suppressed immune system and activated limbic system (which plays a role in emotional, motivational, homeostatic, and cognitive processes). In

addition, endogenous opioids, or the body's naturally occurring pain relievers, are released. Therefore, the pain can either be experienced or suppressed depending on the systems activated by the body-self neuromatrix. As summarized by Turk and Monarch (2002), prior learning history can shape the neuromatrix by influencing interpretive processes and individual physiological and behavioral response patterns. Therefore, new stressors can augment the stress level and this increased and prolonged stress leads to the body's continued attempts to return to homeostasis. The pain and the interpretation of the pain (e.g., fear, worry about the future, and the meaning of the painful stimuli) can become a stressor itself and consequently cause the body to continually deviate from homeostasis.

In sum, the evidence supporting the biopsychosocial perspective of pain combined with the evidence of the gate control theory of pain and later the neuromatrix theory all point to the considerable role psychological factors play in the experience of pain. While these theories may describe the biological evidence that such factors can influence physiological processes, the next section will discuss the specific psychosocial factors shown to affect the experience of pain.

### Psychosocial Factors Associated with Chronic Pain

It is well known that psychosocial factors have been associated with the presence of chronic pain. Research has implicated psychosocial factors that may predict or predispose an individual to develop chronic pain. Simultaneously, there is substantial literature to support the negative psychosocial effects of chronic pain. This section will review the literature on psychosocial factors that predispose one to develop pain as well as those that occur as a result of the experience of chronic pain.

#### Psychosocial predictors of pain.

Several chronic pain conditions (e.g., complex regional pain syndrome, fibromyalgia, intractable low back pain) currently lack the physiological understanding to

explain the disproportionate experience of pain to organic findings in certain individuals. Recent research has explored psychosocial factors that may play a role in initiating and/or maintaining chronic pain conditions. More specifically, psychosocial stress and certain personality traits have been implicated as predisposing factors to some of these pain conditions.

Van Houdenhove (2000) discussed the role of prolonged stress in chronic pain. He maintained that the well-researched phenomenon of the effects of chronic stress on the immune system can be applied to the understanding of chronic pain as well. Specifically, he proposed a potential pathogenic role for psychosocial stress in “unexplained” chronic pain conditions based on the works of Melzack and his writings on the relationship between stress and pain. Van Houdenhove explained that stress may contribute to chronic pain through the peripheral and central nervous systems, an extension of Melzack’s (1999) physiological explanation of how stress affects pain perception. This theory explains how external sources of stress can have an internal effect on the body, thus exacerbating a pain condition. When pain becomes chronic, the pain itself can also be experienced as a stressor, consequently affecting the maintenance of pain.

While Van Houdenhove focused on the role of external psychosocial stressors because they are less blaming toward the patient, many researchers have discovered individual personality traits to also be linked to chronic pain syndromes. Personality traits are typically assumed to be stable characteristics of a person that define what that person may do in a given situation. According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR; American Psychiatric Association, 2000), personality traits are “enduring patterns of perceiving, relating to, and thinking about the environment and oneself that are exhibited in a wide range of social and personal contexts” (p. 686). Because of the assumed stable nature of traits, research has focused on whether certain personality traits predispose an individual to develop a chronic pain

condition. Personality traits that are maladaptive and interfere with functioning are diagnosed as personality disorders. Because personality disorders occur at a higher rate in the chronic pain population than the population at large (Gatchel & Weisberg, 2000), it might be assumed that those individuals with personality disorders are more likely to develop a chronic pain condition following an injury. However, research has shown that improving one's pain condition can actually change an individual's scores on personality trait inventories (Fishbain et al., 2006). In particular, trait anxiety, MMPI clinical elevations, and personality disorder diagnoses were found to decrease when pain was adequately treated (Fishbain et al., 2006). Such findings would suggest that the high incidence of personality disorders and certain personality traits in the chronic pain population is not a function of simply predisposing factors, but rather a reaction to the chronic pain.

Research has not consistently found a personality profile that can predict the development of chronic pain (Gatchel & Weisberg, 2000); therefore, other theories have been proposed to explain the relationship between personality characteristics, chronic pain, and psychopathology. The following section will review the psychological effects pain can have and other theories that have been developed to explain the relationship between pain and psychological factors.

#### Psychosocial effects of pain.

Many researchers have focused on the associated psychopathology being a resulting factor from having to deal with chronic pain. Many studies have consistently shown that psychological disorders are associated with chronic pain such as depression, substance use, anxiety disorders, somatoform disorders, and personality disorders (for a review, see Gatchel & Dersh, 2002).

Depression. Romano and Turner (1985) reviewed the literature on the relationship between pain and depression and determined that the rates of depressive symptoms were

higher in chronic pain patients than in the general and medical populations. Prior to their review, little evidence existed to support such a relationship with solid controlled studies, so their article spawned an interest in researching the link between chronic pain and depression (Dersh et al., 2002). Since that time, depression has been the most commonly studied psychiatric disorder with chronic pain; however, there is evidence to suggest that many other disorders occur frequently in chronic pain patients (Gureje, 2007).

Anxiety. Along with depression, anxiety is one of the most frequently occurring Axis I diagnoses among chronic pain patients (Fishbain et al., 1986). A study by Fishbain and colleagues evaluated chronic pain patients for psychiatric Axis I and Axis II diagnoses from the DSM-III and found that 62.5 % of the patients met criteria for an anxiety disorder. This exceeded the number of patients found to be suffering from a depressive disorder (56.2%). This suggests that anxiety is a common reaction to persistent, unremitting pain.

Disability. When an individual suffers from persistent pain, physical functioning becomes affected. Depending on the location and severity of the pain, the loss of function can range from activities such as reducing or changing an exercise routine, to limiting household chores, to no longer being able to sustain employment. This loss of function and disability affecting some part of the individual's life can have detrimental psychological effects as well; simultaneously, the psychological effects of chronic pain (e.g., depression and anxiety) can lead to physical disability. A biopsychosocial perspective has been implicated in the development of disability from chronic pain (Gatchel, 2001). Fear and avoidance of physical activity have also been suggested as contributors to the development and maintenance of disability (Lethem, Slade, Troup, & Bentley, 1983). Because the functional losses associated with chronic pain can significantly affect an individual's quality of life and lifestyle, physical disability is important to assess in chronic pain patients.

### Diathesis-stress model.

While the relationship between chronic pain and psychopathology has clearly been established, recent research has focused on explaining the nature of that relationship. Dersh et al. (2002) performed a review of the literature that explored the relationship between chronic pain and psychopathology. While they determined that there was no single theoretical model that could explain the causal relationship between chronic pain and psychopathology, they concluded that the diathesis-stress model appeared to be the most comprehensive and empirically supported model to explain the nature of the relationship, especially with depressive disorders and personality disorders. The diathesis-stress model has been proposed by various researchers (e.g., Gatchel, 1991; Turk, 2002; Weisberg & Keefe, 1999) and asserts that diatheses are preexisting, semidormant characteristics in an individual before the onset of pain that can then be activated and exacerbated by the stress of having chronic pain, which may eventually result in psychopathology and subsequently maintains the disability and pain. This model would best explain why the research has shown both preexisting traits to be related to chronic pain as well as psychopathology being a consequence of chronic pain. The interaction of traits with the stress of the pain creates a cycle of psychopathology development and chronic pain maintenance.

### Complex Regional Pain Syndrome

There are numerous chronic pain conditions that are repeatedly studied in the psychological literature to gain a better understanding of their etiology, predictive factors, and psychological effects. Despite being widely studied, complex regional pain syndrome (CRPS) remains a poorly understood pain condition that can become chronic and significantly affect the quality of life of the individuals it affects. This section will describe CRPS and provide its definition along with a description of the evolution of the diagnostic criteria. The two types of CRPS (type I and type II) will be distinguished and



the etiology of the syndrome discussed. The prevalence and demographics of CRPS patients will be detailed followed by a review of the treatments for CRPS.

### Description

The first documented descriptions of the symptoms of complex regional pain syndrome (CRPS) date back to the descriptions of causalgia during the American Civil War (Borg, 1996). This syndrome has a complex history that includes multiple name changes and constant debate over the most accurate diagnostic criteria. Over the years, the set of signs and symptoms currently known as CRPS have been labeled names such as: causalgia, Sudeck's atrophy, osteodystrophy, shoulder-hand syndrome, algodystrophy, reflex sympathetic dystrophy, and sympathetically-maintained pain, among others (Borg, 1996; Turner-Stokes, 2002). The evolution of names reflects the poorly understood mechanisms underlying the condition as well as the disagreement on a universally accepted set of diagnostic criteria. In 1995, Stanton-Hicks et al. presented a revised taxonomic system for diagnosis along with the proposed name change from RSD and causalgia to CRPS following a special consensus conference to discuss the topic. In general, CRPS can be described as a pain syndrome that develops as a disproportionate consequence of an extremity trauma or nerve lesion (Baron & Wasner, 2001). According to the National Institute of Neurological Disorders and Stroke (NINDS; 2008), the pain is often experienced in excess of what one would expect given the injury that occurred and most often affects an extremity such as an arm, hand, leg or foot. NINDS additionally describes typical features of the disorder as dramatic changes in color and temperature of the skin over the affected body part, intense burning pain, skin sensitivity, sweating, and swelling.

The International Association for the Study of Pain (IASP) developed the following four diagnostic criteria: (1) the presence of an initiating noxious event or cause of immobilization, (2) continuing pain, allodynia, or hyperalgesia in which the pain is

disproportionate to any known inciting event, (3) evidence at some time of edema, changes in skin blood flow, or abnormal sudomotor activity in the region of pain, and (4) the diagnosis is excluded by the existence of other conditions that would account for the degree of pain and dysfunction (Merskey & Bogduk, 1994). In addition, IASP noted that if the condition does not include major nerve damage, the diagnosis of CRPS I is given, whereas the diagnosis of CRPS II includes the presence of major nerve damage.

The most recent set of diagnostic criteria was proposed by Harden, Bruehl, Stanton-Hicks, and Wilson (2007) after determining that the CRPS diagnostic criteria was found to be sensitive (i.e., able to detect actual cases) but not adequately specific, resulting in overdiagnosis of the syndrome. Harden et al. based their newly proposed criteria on the results of a diagnostic criteria workshop held in Budapest, Hungary in 2003 to reevaluate the terminology of CRPS. Based on the outcome of this workshop, the committee in attendance proposed the following definition of CRPS:

CRPS describes an array of painful conditions that are characterized by a continuing (spontaneous and/or evoked) regional pain that is seemingly disproportionate in time or degree to the usual course of any known trauma or other lesion. The pain is regional (not in a specific nerve territory or dermatome) and usually has a distal predominance of abnormal sensory, motor, sudomotor, vasomotor, and/or trophic findings. The syndrome shows variable progression over time. (p. 330)

In order to make a full clinical diagnosis, Harden et al. proposed the following four criteria be met (known as the Budapest criteria): (1) continuing pain that is disproportionate to the inciting event; (2) must report at least one *symptom* in three of the four following categories: (a) sensory: reports of hyperesthesia and/or allodynia, (b) vasomotor: reports of temperature asymmetry and/or skin color changes and/or skin color asymmetry, (c) sudomotor/edema: reports of edema and/or sweating changes and/or sweating asymmetry, (d) motor/trophic: reports of decreased range of motion and/or motor dysfunction and/or trophic changes; (3) must have at least one *sign* in two or more of the following categories: (a) sensory: evidence of hyperalgesia and/or allodynia, (b)

vasomotor: evidence of temperature asymmetry and/or skin color changes and/or sweating asymmetry, (c) sudomotor/edema: evidence of edema and/or sweating changes and/or sweating asymmetry, (d) motor/trophic: evidence of decreased range of motion and/or motor dysfunction and/or trophic changes; (4) there is no other diagnosis that better explains the signs and symptoms. They further note that for research purposes, a diagnosis should be made when there is at least one reported symptom in all four symptom categories and at least one observed sign in two or more sign categories. The Budapest Criteria have been validated compared to IASP criteria as having enhanced specificity with regard to diagnosis of CRPS (Harden et al., 2010).

Though the specifics of what constitutes an official diagnosis have varied (e.g., number of signs or symptoms required, exact temperature difference), certain key signs and symptoms are common among the proposed diagnostic criteria. Brunner, Lienhardt, Kissling, Bachmann, and Weber (2008) surveyed international experts for their opinion on which parameters were most important in determining diagnosis and follow-up of CRPS type I patients. Experts agreed that pain, signs of edema and color change, and decreased mobility were the most relevant diagnostic parameters. The Budapest criteria outlined above have not yet been accepted by the IASP; therefore, a clinically accurate diagnosis can currently be made using the existing IASP criteria.

Complex regional pain syndrome is made up of two types of syndromes, type I and type II. The main distinguishing feature between the two types is the presence or absence of major nerve injury. The description of each type is presented below.

Type I description and definition. CRPS type I is the more common syndrome previously known as Reflex Sympathetic Dystrophy (RSD). Though CRPS has had numerous labels over the years, RSD been the predominant label since 1946 (Nelson, 2002). Previously, it was often known as Sudeck's dystrophy because it was first described by Sudeck in the early 20th century (Baron & Wasner, 2001). Because the name RSD did not accurately reflect the pathophysiology of the disorder, the name was

changed to complex regional pain syndrome to highlight the complex interaction of the somatic, psychological, and behavioral factors along with the regional distribution of symptoms (Turner-Stokes, 2002). CRPS type I is the more poorly understood condition due to its absence of identifiable nerve damage. It can begin with an inciting event such as a fracture, soft tissue damage, low-grade infection, frostbite, burns, or even stroke or myocardial infarction (Baron et al., 1999). Because CRPS type I often responds well to a sympathetic nerve block (administration of an anesthetic to the sympathetic nerve) and shows signs of autonomic nervous system abnormalities, researchers have suggested the syndrome is an exaggerated sympathetic response to post-traumatic inflammatory responses instead of sympathetic damage (Baron et al., 1999; Turner-Stokes, 2002).

Type II description and definition. CRPS type II was previously known as causalgia and has the same signs and symptoms as type I, but is distinguished by the identification of a peripheral nerve injury (Nelson, 2002), usually occurring to large named nerves such as the median or sciatic nerve (Stanton-Hicks et al., 1995). The pain, however, may extend beyond the distribution of the injured nerve to a general region of the body (Baron & Wasner, 2001). Because the other symptoms (swelling, temperature changes, sweating, hypersensitivity to pain) are similar to CRPS type I, the name was changed from causalgia to CRPS type II (Baron & Wasner, 2001).

### Etiology

The etiology of CRPS remains poorly understood. Numerous researchers have attempted to investigate the pathophysiological mechanisms involved and have been able to discredit previously held theories, but the exact pathophysiology of the syndrome remains unknown (Nelson, 2002). However, researchers have proposed various hypotheses of contributing factors in an attempt to explain the etiology of CRPS. These hypotheses include, but are not limited to, disuse of the affected body part following an injury (Galer, Schwartz, & Allen, 2001), myofascial dysfunction (Galer et al., 2001),

psychological factors (Ochoa, 1992), and exaggerated regional inflammatory response to injury (Veldman, Reynan, Arntz, & Goris, 1993). Other explanations of the specific symptoms in CRPS have been linked to sympathetic nervous system dysfunction (Baron & Wasner, 2001). The response of symptoms to sympathetic nerve blocks supports this explanation (Turner-Stokes, 2002); however, it does not explain why certain individuals develop the syndrome and others do not or the striking association and interaction with psychological factors. The central nervous system has also been implicated to better account for these additional factors (Turner-Stokes, 2002).

#### Demographics of CRPS patients

Though CRPS can develop following various common injuries and events, the number of people who develop CRPS is small. For example, it has been shown to occur in 20-90 persons per 100,000 as compared to fibromyalgia which has been shown to occur in 700-3,200 persons per 100,000 (Marinus & Van Hilten, 2006). Furthermore, because the pathophysiology is not yet fully understood, it is hard to determine who is at risk for developing the syndrome. There exist only a few epidemiological studies that have explored the incidence of the condition and the demographics of the individuals who do develop the condition. The existing studies are summarized below.

Allen et al. (1999) performed an epidemiological study by reviewing 134 patient charts for demographic variables, health care utilization, workman's compensation or legal involvement, and other physician recommendations. Demographically, they found that the mean age of the patients reviewed was 41.8 years old and patients reported having CRPS for a mean duration of 30 months prior to coming to the pain center where the charts were reviewed. Seventy percent of the patients were female and most (79% of those who reported ethnicity) were Caucasian. They determined that the three most inciting events were sprain or strain, surgery, and fractures. While they noted that most cases occurred in an extremity, they found lower extremities to be slightly more common

than upper extremities. They found that more than half of the patients reviewed reported that the CRPS was due to an on-the-job injury and 54% had a worker's compensation claim related to their CRPS.

Sandroni, Benrud-Larson, McClelland, and Low (2003) performed the first population based study to determine the incidence, prevalence, natural history, and response to treatment of CRPS type I in Olmsted County, Minnesota. They determined that in Olmsted County, there was an incidence of 5.46 per 100,000 person years and a period prevalence of 20.57 per 100,000. They found that CRPS type I was more likely in females than males (4:1) and the median age at onset was 46 years old. They also found that the upper limb was affected twice as often as the lower limb and a fracture was the most common inciting incident. Limitations of the study include a restricted sample size to a county with a population of only 106,470 people and the retrospective methodology.

Another study (de Mos et al., 2007) that investigated the incidence of the disorder via medical record review in the Netherlands estimated the incidence to be 26.2 per 100,000 persons. They also found that women were affected at least three times more often than men (3.4:1) and that the highest incidence occurred in females in the age category 61-70 years old. Other demographics noted were that the upper extremity was the most affected body part and a fracture was the most common precipitating event. While this study investigated the records of 600,000 patients, the sample was exclusively from the Netherlands and the results differ from other epidemiological studies performed. Of note, this study did not specify which type of CRPS was included while the previous population-based study (Sandroni et al., 2003) limited their investigation to CRPS type I.

More recently, a web-based epidemiological study was conducted in an effort to gain access to a more diverse geographic population. Sharma, Agarwal, Broatch, and Raja (2009) conducted a web-based survey asking individuals with CRPS about the symptoms, demographics, progression, treatments, and psychosocial factors related to CRPS. 888 individuals met inclusion criteria for the study and completed the survey.

They also found women to be significantly more affected than men (5:1). Medical characteristics noted include precipitating event most commonly being trauma, lower extremities (56%) and upper extremities (38%) were most commonly affected, and the syndrome often progressed to other body areas. Many participants were refractory to both pharmacological and nonpharmacological interventions. They noted a disability rate of approximately 62% with significant interference in sleep, mobility, and self-care.

While these studies do not report the same findings, the similarities that do exist include a small incidence, women being more affected than men, and upper or lower extremity being most often affected. Variations in diagnostic criteria to be included in these studies can affect incidence and prevalence estimates when researchers do not all use the same criteria.

#### Treatment for CRPS

Despite the pathophysiology being poorly understood in CRPS, various medical treatments have been used in an attempt to provide relief to patients. In general, treatments for CRPS usually involve a multidisciplinary approach to include neurologists, anesthesiologists, orthopedists, physical therapists, and psychologists (Baron & Wasner, 2001). Certain procedures in particular have been used to definitively diagnose patients with CRPS according to whether the procedure relieves their symptoms. Pappagallo and Rosenberg (2001) detailed the various procedures that can serve both diagnostic and treatment purposes. These procedures include a stellate ganglion block for upper extremity pain and a lumbar sympathetic nerve block for lower extremity pain. These types of procedures are often used in combination with pharmacotherapy. Pappagallo and Rosenberg noted that antiepileptic drugs, opioids, NMDA antagonists, cannabinoids, antidepressants (TCAs and SSRIs), topical analgesics, and bisphosphates have been used for treatment of CRPS. In addition, these medical treatments are often combined with

physical therapy and rehabilitation since immobilization has been hypothesized to be a contributing factor to the development of CRPS (Pappagallo & Rosenberg, 2001).

Borg (1996) additionally discussed the use of sympathetic nervous system blockades, physical therapy, and drugs such as calcitonin, corticosteroids, beta-blockers, nifedipine, and TCAs in the treatment of CRPS. Borg mentioned that studies have shown corticosteroids to be only sometimes effective and the only drug that has shown any lasting benefit is calcitonin.

In reviewing the pharmacologic treatments that have been used for CRPS, Baron and Wasner (2001) noted that only glucocorticoids, transdermal clonidine, intrathecal baclofen, and gabapentin have been shown to provide some relief to CRPS patients. They also mentioned that drugs such as TCAs and systemically administered lidocaine have shown benefit with neuropathic pain. Although there are additional medications that show promise in the treatment of CRPS, there are limited studies on the efficacy of certain drugs. In addition, the ones that have shown benefit often only help with some of the symptoms. Subbarao and Stillwell (1981) evaluated the outcome of 134 cases of RSD that had been treated. They concluded that nearly 60% of the cases reviewed continued to have persistent symptoms despite being treated.

Despite the many treatments available and tried for patients with CRPS, some researchers and clinicians warn of time since diagnosis as being predictive of response to treatment. One study showed that even just one year after diagnosis, signs and symptoms of the syndrome had become well developed and were refractory to most current therapies (Schwartzman, Erwin, & Alexander, 2009). This demonstrates the importance of early detection and intervention for optimal treatment.

The lack of understanding of the pathophysiology of this syndrome combined with poor medical treatment outcome in many cases prompt a further look at the psychological implications involved. The next section will review the literature investigating the potential psychological predisposing factors along with psychological



outcome of this disorder and the implications for a more comprehensive approach to treatment.

### Psychosocial Factors of CRPS

As indicated previously, psychosocial factors have been identified as both precursors and outcome effects of chronic pain conditions. This section will specifically review the literature that has examined the role of psychosocial factors in the course of complex regional pain syndrome. Controversial writings about whether CRPS is a result of a psychiatric condition versus a legitimate organic pain condition have ignited researchers to study psychiatric differences between CRPS and non-CRPS pain patients. Several researchers (Beerthuis et al., 2009; Bruehl & Carlson, 1992; Covington, 1996; Feliu & Edwards, 2010; Haddock, 1990; Lynch, 1992; Steger et al., 1999) have attempted to reconcile this argument by reviewing the literature associated with CRPS and psychological factors; however, each has determined that there is not substantial evidence to support the claim that CRPS patients have predisposing diatheses or personality traits that lead to the development of the disorder. Despite the conclusions arrived at by each of these reviews, some researchers (Ochoa, 1992; W. U. Weiss, 1994) maintain that personality factors play a role in the initiation and maintenance of the syndrome and others (Van Houdenhove et al., 1992) have concluded that psychological factors contribute to the etiopathogenesis based on their own reviews. These reviews, however, predate the current diagnostic criteria for CRPS; therefore, a more current review of the literature is warranted. This section will review that research and identify gaps in the current literature of CRPS. First, studies identifying psychosocial predictors of CRPS will be reviewed followed by studies examining the psychosocial effects of CRPS.

#### Psychosocial predisposition to CRPS

One of the earlier studies investigating psychiatric causes for CRPS was conducted by Van Houdenhove (1986). At the time, CRPS type I was termed neuro-

algodystrophy. He performed a retrospective study of the 32 neuro-algodystrophy patients at a Belgium hospital who had been referred for psychiatric consultation, thus biasing the sample to only those who had been seen by a psychiatrist. After reviewing the psychodynamic interviews conducted with each of the patients, the author found that in all of the cases except one, a direct time-relation could be established between a provoking physical factor and a significant psychological situation (e.g., death of loved one, separation). Based on this evidence, the author concluded that psychological factors may play a role in the etiology of neuro-algodystrophy. The limitations of this study, however, are significant, especially given the biased nature of the sample examined. Nevertheless, such results provide intriguing speculation about a disorder that cannot otherwise be explained.

In examining factors that might predict the development of a disease, multiple medical, demographic, and psychological variables should be considered. de Mos et al. (2008) sought to evaluate prior medical conditions that might serve as risk factors for the development of CRPS. Participants included CRPS patients ( $N = 186$ ) identified by search of the Dutch Health Care System and were compared to age, gender, and injury-type matched controls ( $N = 697$ ). The medical records of each participant were evaluated up to the onset of injury and the associations between the medical history and CRPS were analyzed by conditional logistic regression. They found that a history of migraine headaches or osteoporosis was related to CRPS and that CRPS patients in the past year had reported more menstrual cycle-related problems and neuropathies. Of the medical conditions that have a potentially similar pathogenesis/etiology as CRPS, asthma was found to be associated with CRPS. de Mos et al. also evaluated preexisting psychological factors including depression, anxiety, psychosocial problems, and stress and found none of them to be associated with CRPS onset. They also looked for fibromyalgia associations, but because the prevalence was too low, they were unable to perform meaningful analyses. This study provides important insight into potential medical risk

factors for developing CRPS. Because they investigated medical records, they did not have to rely on self-report of preexisting conditions potentially being affected by recall bias. One limitation of the study was that they determined preexisting conditions by categorizing each general practitioner contact into some type of episode or medical problem. This method might minimize the psychological conditions since each visit was to a physician and if anxiety and depression were not the focus of the physician contact, those conditions would not have been classified even if the patients met criteria for these psychological conditions.

Because the causal relationship between depression and pain is hard to study, there is limited research that prospectively assesses the association between depression and pain, especially in CRPS patients. Feldman et al. (1999) attempted to investigate the relationship between daily pain, negative mood, and social support in a prospective daily diary study. Participants ( $N = 109$ ) with reflex sympathetic dystrophy (now called complex regional pain syndrome, type I) completed 28 daily diaries with responses to questions about pain, mood and social support. Pain was assessed by asking participants to indicate their pain level relative to an average day. Mood was assessed by asking participants to indicate the degree to which they had experienced each of 27 emotions each day. In order to determine the temporal relationship between daily pain and mood, the authors investigated the influence of the previous day's pain on mood and of the previous day's mood on pain. They found that the previous day's pain was a significant predictor of negative mood, depressed mood, anxiety, and anger. They also found that the previous day's negative mood did not significantly predict pain; however, the previous day's depressed mood did significantly predict pain. In sum, their results suggest that pain can predict depressed mood, anxiety, and anger, while depressed mood can predict pain. While the prospective nature of this study design allows one to make predictions about pain and mood, there are several notable limitations. First, because depressed mood was found to be both a predictor and effect of pain, the causal

relationship still cannot be established. Second, the predictions were based solely on the previous day's pain/mood and therefore did not account for more subtle temporal fluctuations. Third, because these assessments were done after the development of a chronic pain condition, the predictions are only relevant to the daily fluctuations of pain and mood and cannot account for whether preexisting depressed mood predicts the development of pain. Despite these limitations, their study does point to the complex interaction of depressed mood and pain in RSD patients and the cyclical effect they have.

Another way to determine whether depression affects pain is to evaluate whether treatment of the depression can alleviate pain symptoms as well. An article (McDaniel, 2003) citing three case reports in which CRPS patients with comorbid depression sought electroconvulsive therapy (ECT) for depression comments on the relationship between pain and depression. In this article, three patients who had developed CRPS following fractures and who had intractable depression sought ECT. In each of the cases, ECT treatments resolved both the depression and the CRPS symptoms completely. Of note, in one of the cases, the depression occasionally recurred over the course of the four years following the ECT treatment, but the CRPS symptoms did not reappear. The results suggest that alleviating the depression resolves CRPS; however, in the absence of a well controlled study with a larger sample size, such results should be interpreted with caution. Because of the previously suggested central nervous system etiology (Turner-Stokes, 2002), these results cannot rule out the idea that the ECT might directly affect CRPS pathology irrespective of the alleviation of depression.

Geertzen et al. (1998) examined the role that stressful life events and psychological dysfunction may play in the pathogenesis of CRPS. The authors compared a study population of CRPS patients in the early phase of the syndrome ( $N = 24$ ) with a control group of preoperative patients with hand pathology ( $N = 42$ ). Both groups were interviewed by a psychologist to assess history of stressful life events 3 months prior to the onset of CRPS or hand pathology. Each stressful life event was rated according to the

Social Readjustment Rating Scale (SRRS) in life change units (LCUs). In addition, patients were administered the Dutch language version of the Symptom Checklist-90 (SCL-90) to assess psychological dysfunction. Results showed that stressful life events were significantly more frequently present in the CRPS group compared to the control group. In addition, female CRPS patients scored higher in depression, feelings of inadequacy, and emotional instability than the control group, and male CRPS patients were higher in anxiety than the control group. Because the CRPS patients were found to have more stressful life events before the onset of pathology, the authors concluded that stressful life events may play a role on the pathogenesis of CRPS, though a causal relationship cannot be established.

Harden et al. (2003) performed an impressive prospective study examining which psychological factors predict the development of CRPS following total knee arthroplasty (TKA). Because this surgery can often result in CRPS, the authors studied a sample of patients ( $N = 77$ ) who were scheduled to undergo TKA and administered several assessments preoperatively, at 1 month follow-up ( $N = 77$ ), at 3 months follow-up ( $N = 69$ ), and at 6 months follow-up ( $N = 55$ ). At each of the assessment periods, patients filled out the McGill Pain Questionnaire (MPQ; Melzack, 1987), the Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961), and the Trait form of the State Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970). Of the patients that participated in the study, prevalence of signs and symptoms meeting criteria for CRPS was 21% at 1 month, 13% at 3 months, and 12.7% at 6 months. Results showed that despite CRPS patients reporting more depression and anxiety at 1 month and 6 months, respectively, pre-TKA anxiety and depression did not predict the development of CRPS, whereas preoperative pain did predict CRPS status at 3-months and 6-months, but not 1-month. This may indicate that preoperative pain is better at predicting those who suffer from a chronic, intractable state of CRPS. Overall, these results suggest that depression and anxiety appear to be results of CRPS and not predispositional factors.

Additionally, this study supports the hypothesis that CRPS patients look psychologically different compared to other pain patients as a result of their condition. The authors cautioned that the inflated type I error rate could have resulted in a number of false positives, thus impacting the reported results.

Another prospective study examining risk factors for the development of CRPS was conducted by Dijkstra et al. (2003). The authors followed patients who reported to an emergency department with a fracture of the distal radius to see who eventually would develop CRPS. Participants ( $N = 88$ ) were asked about risk factors associated with their injury at the time of the fracture, such as cast changes, repositions, and other medical questions. Patients were also asked to participate in a structured interview of social life events (SLEs) and a psychological/psychiatric history was taken along with a self-report measure of psychological distress (SCL-90; Arrindel & Ettema, 1981). Of the patients who participated, one developed CRPS and she did not have any life events or abnormally high pain scores, however she did have a slightly above average score on the SCL-90. Because the results are based on only one patient who developed CRPS, the results do not necessarily suggest psychological factors are responsible for the development of CRPS.

Puchalski and Zyluk (2005) conducted a prospective study investigating whether patients who develop CRPS type I after a fracture of the distal radius display different psychological behaviors and/or depression than those who heal normally. Patients ( $N = 62$ ) who underwent surgical closed reduction and percutaneous fixation with K-wires of a displaced radial fracture were administered psychological questionnaires the day after surgery and ( $N = 50$ ) were subsequently followed two months later to assess for signs and symptoms of CRPS. They assessed personality traits using the EPQ-R and the Adjectives Checklist. Depression was assessed using the Beck Depression Inventory (BDI) for patients age 60 years or less and the Geriatric Depression Scale (GDS) in patients older than 60. They found no significant differences on the EPQ-R or the Adjectives Checklist

between the group that did develop CRPS ( $n = 9$ ) and the group that did not develop CRPS ( $n = 41$ ). There was also no significant difference found between the two groups on symptoms of depression. This study, given its prospective design, had some methodological advantages, but still had limitations. The psychological factors assessed consisted of only a measure of depression and relatively obscure personality inventories. Still, this study supports previous findings that fail to establish a link between preexisting psychological symptoms and a greater likelihood of developing CRPS.

### Psychosocial effects of CRPS

Because of the puzzling etiology of CRPS combined with the observed behavioral differences compared to other pain patients, psychopathology has been implicated as a significant factor in CRPS; consequently, studies have attempted to compare CRPS patients to other pain patients to elucidate whether certain psychological factors are unique to the presentation of CRPS and in excess of what would expect given other pain conditions. Other studies have simply attempted to describe CRPS patients in terms of the psychological factors reported. While the comparative studies show mixed results about whether the CRPS patients differ from other pain conditions, the descriptive studies clearly show that CRPS is associated with psychological factors.

Comparative studies. To assess whether RSD patients differed from other chronic pain patients, Haddox et al. (1988) compared RSD patients ( $N = 21$ ) with non-RSD radiculopathy patients ( $N = 19$ ) on psychological variables. They assessed state and trait anxiety using the State Trait Anxiety Inventory (STAI), pain using the McGill Pain Questionnaire (MPQ), and pain-related dysfunction using the Dartmouth Pain Questionnaire (DPQ). They found no significant statistical differences between the two groups on any of the tests administered. Though they maintain that their results do not support the common notion that RSD patients differ psychologically from other pain patients, they justify their contradictory results by stating that their instruments were not

sensitive enough to detect differences between the two groups. Furthermore, their small sample size may not have provided adequate power to detect such differences.

Another study compared RSD patients to other pain patients on psychological measures. Hardy and Merritt (1988) compared RSD patients ( $N = 9$ ) to hand-injured patients with no autonomic involvement ( $N = 8$ ) on measures of intellectual impairment, body satisfaction, locus of control, pain level, and psychological symptoms. Results showed that the RSD patients showed significantly greater depression, anxiety, and interpersonal sensitivity. This study has significant limitations beginning with the extremely low number of participants. In addition, the authors mentioned that they obtained pain scores, but in fact they only obtained pain scores from about half of the participants. They indicated that there was no difference between groups in level of pain, but such a conclusion is difficult to make given the lack of pain values for nearly half of the sample. Therefore, one cannot determine whether their significant results are related to level of pain or merely the diagnosis.

Zucchini et al. (1989) investigated the personality differences between patients with algodystrophy (also known as RSD or CRPS type I) ( $N = 13$ ) and patients with brachial plexus lesions ( $N = 23$ ) on the Minnesota Multiphasic Personality Inventory (MMPI). They found that the RSD (algodystrophy) patients had higher scores on the Depression, Hysteria, and Hypochondriasis scales of the MMPI. However, statistical significance was only reached when they compared the frequencies of “abnormal scores” in the two groups of patients and not when the psychopathological profiles (T-scores on the MMPI) were compared. While these results may start to point to differences in psychopathology between RSD and non-RSD pain patients, the small sample size and limited statistical significance is not strongly conclusive.

DeGood et al. (1993) compared RSD patients ( $N = 71$ ) to two other groups: low back pain patients ( $N = 66$ ) and headache patients ( $N = 51$ ) on various demographic and psychosocial measures. They noted that while all groups reported elevations on pain,



emotional distress, and behavioral disturbance, the RSD group endorsed the highest level of pain intensity, the most job inactivity, and the greatest amount of financial compensation. Interestingly, the RSD group reported lower distress on the Symptom Checklist-90 (SCL-90), a measure of psychological functioning. While this study did not support the hypothesis that RSD patients are more psychologically disturbed than other pain patients, they noted limitations to their study such as the RSD group having had a shorter pain duration than the other two groups, possibly accounting for difference in psychological distress.

Van der Laan et al. (1999) attempted to compare patients with CRPS-dystonia (a subset of CRPS patients who additionally have fixed abnormal posture of the affected extremity) with typical normal controls and a rehabilitation population on psychological distress. They administered the Dutch adapted version of the Symptom Checklist-90 Revised (SCL-90R) to female CRPS-dystonia patients ( $N = 27$ ) and compared their scores to the normative data from a normal female population (only female patients were used due to the small number of male patients with CRPS-dystonia). The data from the CRPS-dystonia population were then also compared to data obtained from a population of patients suffering from a somatic disorder that required rehabilitation. The authors found that insomnia was higher in the CRPS-dystonia population than in the normal female controls or the rehabilitation group, and that the rehabilitation group had higher somatization scores than the CRPS-dystonia group. They concluded that their results did not suggest a psychogenic factor in the presentation of CRPS-dystonia. Because CRPS-dystonia is an even more severe form of the syndrome, this finding further supports the evidence toward a normal psychological reaction to CRPS consistent with other pain disorders.

In a better controlled study, Bruehl et al. (1996) examined psychological differences between RSD patients ( $N = 34$ ), non-RSD chronic low back pain (LBP) patients ( $N = 165$ ), and non-RSD limb pain patients ( $N = 50$ ). To better isolate the

potential psychological differences among the specific groups, the authors controlled statistically for age and pain duration differences across the diagnostic groups. Patients were administered the McGill Pain Questionnaire—Short Form (SF-MPQ; Melzack, 1987) to measure pain, the Coping Strategies Questionnaire (CSQ; Rosenthal & Keefe, 1983) to measure cognitive coping strategies, and the Brief Symptom Inventory (BSI; Derogatis, 1993), which is a short form of the SCL-90 to assess psychological symptoms. Results showed that RSD patients reported more somatization and phobic anxiety on the BSI than the LBP patients did. RSD patients also tended to cope by diversion of attention more than the LBP patients as measured by the CSQ. The only difference found between the RSD and non-RSD limb pain patients was that the RSD patients reported greater somatization. Both the RSD patients and the limb pain patients showed a stronger relationship between distress and pain severity than the LBP patient group. The authors concluded that these results provide partial support that RSD patients are more psychologically dysfunctional than other chronic pain patients. Interestingly, the RSD patients and limb pain patients were similar on almost all measures given, which confounds the authors' statements about RSD patients looking psychologically worse than other pain patients. They further indicate that such a finding suggests that sympathetic mediation of pain, as is the case in RSD, may not be the source of observed psychological differences if non-RSD limb pain patients exhibit similar psychological profiles. Though the differences observed in RSD patients as compared to LBP patients contradict findings in other studies that do not support RSD being different than other pain patients, this study does identify how RSD patients look like some other pain populations and not others.

Verbunt et al. (2008) conducted a study examining the disability and quality of life in fibromyalgia (FM) patients. Though the purpose of their study was to compare FM patients to other chronic pain patients, one of their comparison groups consisted of CRPS patients. FM patients ( $N = 54$ ) were compared to chronic low back pain (CLBP)

patients ( $N = 35$ ) and CRPS patients ( $N = 22$ ) on psychological distress (using the SCL-90) and quality of life (using the SF-36). Results showed that the FM group reported significantly greater total psychological distress as compared to CRPS and CLBP patients. They also found the FM patients reported a lower quality of life; however, they compared the FM quality of life scores to previous literature and did not report the SF-36 scores of either of their control groups. This study provides some support to the hypothesis that CRPS patients are not psychologically more disturbed than other chronic pain patients, though conclusions from this study must be weighed against the limitations.

Another study attempted to compare CRPS type I patients to Fibromyalgia (FM) and a-specific Repetitive Strain Injury (RSI) patients by evaluating the existing literature on these conditions. Marinus and Van Hilten (2006) performed a literature search looking for studies that examined the clinical manifestations, disease course, risk factors, and demographic characteristics for the three pain groups. They identified 59 studies on CRPS, 73 on FM, and 7 on a-specific RSI. They found that each of the conditions showed similarities in age distribution, male-female ratio, pain characteristics, and sensory signs and symptoms. All three usually start locally and can spread to other regions of the body. CRPS differs from the other two conditions in that there are more frequent reports of motor, autonomic, and trophic changes. The authors found anxiety and depression to be more frequent in these patients as compared to controls, but noted that they likely are not different from patients with other pain conditions or chronic diseases. The authors conclude by saying that though there are obvious differences that make these different conditions, the numerous similarities may suggest a common pathway is involved. Because this study merely compared previous literature and not actual patients, results are limited based on potentially differing methodologies among studies. Though this study did not concentrate on the psychological factors involved in these studies, the noted similarities in pain characteristics, signs, and symptoms may

explain why many other studies find similarities among these various pain conditions with respect to psychological factors.

While the previous study focused on disease characteristics of several conditions, another study by Shiri et al. (2003) compared the psychological profiles of CRPS patients ( $N = 17$ ) and Conversion Disorder (CD) patients ( $N = 20$ ). CRPS and CD patients were recruited from Hadassah University Hospital in Jerusalem, Israel and were interviewed by rehabilitation psychologists. Each patient was administered the Hebrew version of the Minnesota Multiphasic Personality Inventory (MMPI) to assess psychopathology and the visual analog self-report scale (VAS) to assess pain. Results showed no statistical differences between the MMPI profiles of both patient groups. In addition, based on interviews and psychological testing, they found that about one third of patients from both groups suffered from an Axis I disorder, most often depression or posttraumatic stress disorder (PTSD). Consistent with the authors' hypotheses, CRPS patients reported higher pain scores according to the VAS since CRPS is a pain condition and CD is often associated with motor or sensory dysfunction. The authors point out that their study differed from previous studies comparing CRPS patients to other pain groups since they compared the patients to a psychiatric disorder. The significant similarities between the CRPS and the CD groups suggest that CRPS has significant somatoform features. Of note, the majority of the CRPS sample was male (94%) compared to the CD sample (30% male). Given previous studies that report higher incidence of CRPS among females, these results should be tempered against potential gender differences. Despite the limitations of the study, these results show an intriguing similarity between an organic pain condition and a psychiatric condition on psychological profile, prompting a closer look at the psychological experience of CRPS patients.

Because signs and symptoms can continue to affect an individual after supposed successful treatment of CRPS, Savaş, Baloğlu, Ay, & Cerçi (2008) performed a study to examine the effect of these continued signs and symptoms on disability and quality of

life. The authors compared CRPS type 1 patients ( $N = 30$ ) who had been discharged with good outcome to healthy controls ( $N = 38$ ). Participants were given the Turkish version of the Disability of the arm, shoulder, and hand questionnaire (DASH; Hudak, Amadio, & Bombardier, 1996) to assess disability, the Turkish version of the Short Form 36 (SF-36; Ware & Sherbourne, 1992) to assess health-related quality of life, and several physical measures to assess range of motion (ROM), touch perception threshold, and manual dexterity. Of the CRPS patients, none met full criteria at the time of the study, but only 3 were completely symptom free. The authors found decreased grip strength, increased disability, and increased touch perception threshold in CRPS patients as compared to controls. Of the quality of life subscales, CRPS patients reported significantly lower physical function, greater physical role limitation, increased bodily pain, lower general health, lower social function, and emotional role limitation as compared to controls. There were no significant differences between the groups on mental health and vitality. While these patients no longer met criteria for CRPS, their sequel symptoms continued to cause pain, disability, and reduced quality of life in physical functioning. Interestingly, several other areas of quality of life were not different than the control group, suggesting that some of the other signs and symptoms associated with CRPS may be what is responsible for the increased pathology and decreased quality of life noted in other studies of the psychological effects of CRPS.

Descriptive studies. Due to the limited research investigating the effect of CRPS on quality of life, Galer et al. (2000) performed a small ( $N = 31$ ) pilot/survey study to assess the course of symptoms and quality of life in CRPS patients. Patients who had been given a diagnosis of CRPS were mailed surveys about their CRPS symptoms. Quality of life was assessed using a modified version of the Brief Pain Inventory (mBPI; Cleeland, 1990), which assesses the degree to which pain interferes with daily activities, such as general activity, mood, mobility, work, relationships, sleep, enjoyment of life, self-care, recreational activities, and social activities. Galer et al. found that patients

reported significant interference with functional activities and more than 50% of the patients reported substantial interference with all daily activities except self-care. While this study provides important preliminary information regarding the effect of CRPS on quality of life, the small sample size and the fact that all patients were recruited from a tertiary pain clinic limits the generalizability of its findings. However, since a majority of the patients reported significant interference with most daily activities, these results underscore the importance of assessing quality of life in CRPS patients.

While preparing a drug-effectiveness study for RSD, Rauis (1999) became aware of anecdotal evidence from surgeons that patients with RSD were “psychically peculiar” compared to other patients and therefore decided to add a psychiatric examination and socioprofessional evaluation to the study protocol. Patients who met criteria for RSD ( $N = 104$ ) and were being followed by the same physician underwent a psychiatric examination and study of socioprofessional context. Of the 100 patients who agreed to the examination, 96 showed signs of chronic depression. The results of the socioprofessional study showed that patients were either in a state of inactivity (e.g., jobless, disabled, housewives) or had the opportunity for inactivity (e.g., work injury, bankrupt self-employed people). In addition, it was noted that half of the patients showed biological tests suggestive of alcohol abuse. Assessment of treatments added revealed that antidepressant agents greatly improved the RSD condition, though it is unknown whether that was due to the antidepressant effects or the simultaneous effect of the antidepressant on peripheral neurological pain. The author also noted that there was no relationship between the severity of the initial trauma and the severity of the dystrophy. The author concluded that these results suggest a strong relationship between the psychological condition and the physical symptoms, providing further support for evidence of a psychosomatic disease. Though this study does provide some compelling evidence toward significant psychological effects, the study design cannot implicate a causal relationship or make any inferences beyond that of a descriptive nature.

Loss of or limited physical functioning is another common effect of chronic pain disorders. A review of the psychological and behavioral aspects of CRPS (Bruehl & Chung, 2006) emphasized the motor aspects of the syndrome in making treatment suggestions. Specifically, they indicated that treatment of CRPS should include a multidisciplinary and comprehensive approach based on previously identified successful interventions with pain that incorporate the unique characteristics of CRPS such as learned disuse. Bruehl and Chung also argue that the disuse associated with CRPS may be a significant contributor to the psychological reactions that are typically seen. They posit that the disuse is provoked by pain and subsequently leads to emotional arousal, thus exacerbating the pain and maintaining the CRPS. This suggests that the physical disability associated with CRPS may account for variations in mood and quality of life in affected individuals.

#### Summary and Conclusions

Complex regional pain syndrome is a complex, poorly understood syndrome that has been frequently associated with psychological factors. Given our current understanding of chronic pain models, it is clear that psychological factors can influence pain perception. For that reason, psychopathology has been the focus of many chronic pain condition studies. According to Gatchel and Weisberg (2000), research has not consistently shown that certain personality factors predict the development of chronic pain. Based on this review of studies that have attempted to determine whether psychosocial factors predict the development of CRPS, there is no evidence to support a psychological predisposition to CRPS either. There have been a greater number of studies that have examined how CRPS affects an individual psychologically and whether those effects are typical of all chronic pain conditions.

Despite the number of studies that have attempted to characterize the role of psychopathology in CRPS, results remain mixed and inconclusive. Several studies have

compared CRPS patients to other chronic pain patients while others have attempted to describe the various psychological effects seen in CRPS. The comparative studies do not provide a consensus about whether CRPS patients are psychologically more disturbed than other patients. Of the literature reviewed, some of the studies (Bruehl et al., 1996; Hardy & Merritt, 1988; Zucchini et al., 1989) argue their results point to qualitative and quantitative differences and more severe psychological reactions in CRPS patients than other pain conditions. By contrast, other studies did not find evidence to support the often hypothesized notion that these patients are psychologically different (Haddox et al., 1988; Marinus & Van Hilten, 2006; Van der Laan et al., 1999; Verbunt et al.; 2008).

Many of the comparative studies used different chronic pain conditions for their comparison groups ranging from other neuropathic pain, to limb pain, to low back pain, to fibromyalgia. Even studies that used a similar comparison group (e.g., Bruehl et al., 1996; Verbunt et al., 2008) did not report congruent results. Some researchers have noted that CRPS tends to have a similar psychological profile to other “perplexing” pain and psychiatric conditions such as chronic fatigue syndrome, fibromyalgia, and conversion disorder (Shiri et al., 2003; Van Houdenhove, 2003). What is common to all of these studies is that psychological phenomena are frequently present in CRPS patients, specifically depression, anxiety, and PTSD-like symptoms. The descriptive studies reviewed showed CRPS patients report significant depression, job inactivity, decreased quality of life, and decreased physical functioning (Bruehl & Chung, 2006; Galer et al., 2000; Rauis, 1999). The severity of pain experienced in this condition and the resulting disability combined with the anxiety, depression, and emotional stress often reported can significantly impact an individual’s quality of life. Whether or not their quality of life looks different compared to other pain patients, it is important to describe what is affected and how it is affected.

Bruehl (2001) points out that although the specific medical pathogenic mechanisms of CRPS remain unclear, “absence of definitive evidence for the disorder



may be incorrectly assumed to be evidence of absence of the disorder” (p. 279). Physicians often look for psychological explanations when organic causes and mechanisms of disease cannot be determined. The literature investigating associations between CRPS and psychological processes suggest that: (a) researchers are attempting to investigate non-organic causes, (b) CRPS patients qualitatively behave differently than other pain patients prompting the investigation of premorbid and postmorbid psychological differences, or (c) CRPS causes such an intense and debilitating pain that the psychological effects are greater than those seen in other pain conditions. While a and b are important investigations to be done, the literature points away from premorbid psychological causes, thus lending more support for c. As such, this study will provide a description of the psychosocial profile of individuals with CRPS.

Because CRPS has undergone numerous name changes and disagreement on diagnostic criteria over the years, it is difficult to compare studies whose definitions of the disorder vary. Therefore, it is important to not make conclusions based on studies using outdated information. For that reason, this study will comply with current standards of the field and examine patients who meet current diagnostic criteria according to self-report.

#### Purpose of study

The first purpose of this study was to provide a description of the psychosocial profile of CRPS patients from a broad, national sample. Though the role of psychopathology in this syndrome has yet to be determined, it is clear that chronic pain patients, and CRPS patients in particular, suffer from increased levels of emotional distress. It is important to characterize the distress experienced by these patients from a psychological perspective in order to determine the best treatment modalities possible. Because most of the previous studies have used a small, selective sample only representative of one treating hospital or clinic and limited to specific geographic regions,

this study expands upon current understandings of this syndrome by examining a diverse sample across the United States. In addition, it has been noted that many of the previous studies addressing psychological factors in CRPS have been conducted by medical physicians as an ancillary component of a larger study (Haddock, 1990). This study investigates the emotional distress and quality of life of CRPS patients as its primary focus using psychometrically sound instruments. Studying the psychosocial profile and psychological impacts of this disorder can help both physicians and psychologists understand the impact of this disorder on patients and provide a pathway for improved comprehensive multidisciplinary treatments.

Secondly, this study examines the correlates of quality of life interference by examining physical, demographic, and psychological variables associated with quality of life. While some studies have examined the impact of CRPS on quality of life (Galer et al., 2000), this study furthers our understanding of that impact by examining the factors associated with quality of life, thus potentially providing insight to protective factors and how psychologists might intervene to improve CRPS patients' quality of life.

Third, this study compares the psychosocial profiles of patients with CRPS type I with those who have CRPS type II to help us better understand whether differences exist in the way these syndromes affect individuals psychologically. The only known difference between the two types is that type II has an identifiable nerve injury whereas type I does not. Other than this objective difference, the signs and symptoms are the same, but CRPS type II is rarely studied in terms of psychological factors. Presumably, researchers are more interested in the implication of psychological factors in CRPS type I since there is not identifiable nerve injury to explain the signs and symptoms observed, thus leading to psychological conclusions.

Lastly, this study examines PTSD-like symptoms among CRPS patients. Though not explicitly studied in the extant literature, some authors have hypothesized a potential link based on anecdotal evidence (Grande, Loeser, Ozuna, Ashleigh, & Samii, 2004;

Lebovits, Yarmush, & Lefkowitz, 1990). In addition, it has been noted that CRPS patients often have a comorbid diagnosis of PTSD (Shiri et al., 2003), sometimes from an unrelated incident. Though the inciting incident associated with the development of CRPS is often minimally traumatic (e.g., sprain, fracture, surgery), the disproportionate pain and disability associated with that incident may result in a PTSD-like response.

This study furthers our understanding of this puzzling syndrome by examining the experience of the patients it affects. The next chapter will detail the methods and procedures of the study.

## CHAPTER III

### METHODS

This chapter will discuss the methods and procedures used for this study. It will begin by describing the participants and procedure followed by a description of the measures that are used. Finally, the statistical analyses will be discussed along with the author's specific hypotheses.

#### Participants

Participants were adults over the age of 18 who had been diagnosed with complex regional pain syndrome (CRPS). Participants were recruited via an email sent to a listserv distributed by the Reflex Sympathetic Dystrophy Syndrome Association (RSDSA) administrator. The listserv administrator of the Canadian division also requested to post the study to their listserv through the website Promoting Awareness of RSD/CRPS in Canada (PARC). Patients with CRPS and family members of patients voluntarily join these national organizations as a source of support and resources for managing their syndrome. The RSDSA has over 6,000 active members that access the website and receive emails via the listserv. The PARC association has approximately 500 listserv subscribers and nonmembers can also access the website. Members of both organizations include CRPS patients, family members, physicians, and researchers. Only actual patients were able to participate in this survey; therefore, participants had to meet the following inclusion criteria before they were allowed to proceed with the online survey. To be eligible to participate in this study, participants had to meet the following inclusion criteria:

- 1) At least 18 years of age.
- 2) Ability to read and write for the online survey.
- 3) Had been diagnosed with CRPS (type I or type II) by a physician.

- 4) Meets, or at one time met, IASP criteria for CRPS based on self-reported symptoms.
- 5) Does not have any other comorbid chronic pain conditions other than CRPS.

A power analysis was conducted for the regression analysis; an N of 84 was required for a power of .80 with a moderate effect size.

### Procedure

As mentioned previously, participants were recruited via an email sent to subscribers of the free national organizations RSDSA and PARC. The email contained a link to the online survey where participants were able to access the questions. Participants read information pertaining to informed consent, and if they agreed, were forwarded to the next page. Participants were then asked questions relating to the inclusion criteria and, if they met the eligibility requirements, were directed to the online survey. If members were not eligible, they were told that they did not meet inclusion criteria and thanked for their interest. The online survey contained measures of pain, quality of life, disability, anxiety, depression, trauma, and demographic information.

### Measures

#### Pain

There are numerous instruments created to measure pain, but the McGill Pain Questionnaire (MPQ; Melzack, 1975) has been the most widely used measure by clinicians in assessing pain (Piotrowski, 1998; Piotrowski & Lubin, 1990). The MPQ contains 78 word descriptors from three major classes: sensory, affective, and evaluative. Because previous measures of pain only addressed variations in pain intensity, Melzack created the MPQ to additionally address variations in pain quality. Due to potential time limitations in research and clinical use, a short form of the MPQ was developed (SF-MPQ; Melzack, 1987). The SF-MPQ contains 15 word descriptors that make up the Pain

Rating Index (PRI), 11 sensory words and four affective words. Examples of word descriptors include “Throbbing” or “Punishing-Cruel.” Each word is ranked on an intensity scale from 0 (“None”) to 3 (“Severe”). Scores can range from 0-45 with higher scores indicating greater endorsement of severe pain. In addition, the SF-MPQ contains one Present Pain Intensity (PPI) item where the respondent indicates current level of pain between 0 (“No pain”) and 5 (“Excruciating”). The SF-MPQ total PRI score (out of 45) was used for the present study.

The SF-MPQ correlates highly with the long form of the MPQ (Melzack, 1987) for all types of pain studied (postsurgical pain, labor pain, musculoskeletal pain). Therefore, because the original long form of the MPQ showed acceptable psychometric properties (Melzack, 1975), the SF-MPQ is also a psychometrically sound measure. In addition, the two-factor model (sensory and affective) has been validated by confirmatory factor analysis (Wright, Asmundson, & McCreary, 2001), suggesting the original proposed scoring method is accurate. Test-retest reliability assessed 1-3 days apart of the SF-MPQ total, sensory, and affective scores were shown to be 0.75, 0.76, and 0.62, respectively, in patients with musculoskeletal pain, and 0.93, 0.95, and 0.79 in patients with rheumatic pain (Strand, Ljunggren, Bogen, Ask, & Johnsen, 2008).

Neuropathic pain, like that often seen in patients with CRPS, is characteristically different from other types of pain sensations. As such, it is important to have a measure that adequately represents neuropathic pain sensations. The SF-MPQ has been established as being sensitive enough for neuropathic pain and was even used for the two largest placebo-controlled clinical trials ever conducted for neuropathic pain (Dworkin, Nagasako, & Galer, 2001). For that reason, its use is justified in this study with individuals who experience unique pain sensations.

## Depression

Self-reported depression was assessed using the Centers for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977). The measure is often used with medical populations since many depression symptoms can be confused with effects of a medical condition (e.g., fatigue, loss of appetite). Research has suggested that assessment of depression among chronic pain populations is confounded by the fact that many of the neurovegetative symptoms of depression may actually be representative of the patient's physical condition (i.e., pain) and thus this population is often overdiagnosed with depression (Turk & Okifuji, 1994). Consequently, Turk and Okifuji recommend using the CES-D as opposed to other self-report depression measures when assessing depression among a chronic pain population as it is more sensitive and specific for this population.

The CES-D Scale consists of 20 self-report items that ask the respondent to indicate how often they have felt each symptom during the past week, ranging from 0 ("Rarely or none of the time" or "Less than 1 day") to 3 ("Most or all of the time" or "5-7 days"). An example of an item is "I was bothered by things that usually don't bother me." Four of the items are reverse scored. Total scores represent both the number of symptoms as well as their duration, with 60 being the highest possible score. Though other research studies have suggested a cut-off score of 16 to diagnose depression (Plutchik & Conte, 1989), Turk and Okifuji (1994) recommend using a cut-off score of 19 in chronic pain populations due to their increased neurovegetative symptoms secondary to their pain condition. The total score (out of 60) will be used.

The CES-D has high internal consistency reliability (.85) with a general population and even higher within a patient population (.90) (Radloff, 1977). Test-retest correlations are only moderate (.45 to .70), but this measure is confounded by the potential fluctuation in depressive symptoms and the instructions indicating the respondent should answer according to symptoms experienced in the past week (Radloff,

1977). Studies have confirmed the validity of this instrument in being able to identify depressed individuals (Plutchik & Conte, 1989), even among those with somatic complaints (Foelker & Shewchuk, 1992). Because this measure has been recommended over other self-report depression measures due to its short length, high internal consistency reliability, and sensitivity and specificity data (Plutchik & Conte, 1989) along with the fact that it is valid among medical populations, the CES-D is the most appropriate depression measure for this study.

### Anxiety

Anxiety was measured with the State-Trait Anxiety Inventory (STAI; Spielberger, Gorusch, Lushene, Vagg, & Jacobs, 1983). This measure contains 40 items, 20 of which measure state anxiety, and the other 20 of which measure trait anxiety. Instructions for the state measure (S-Anxiety) ask respondents to indicate how they are feeling “right now” by circling Likert responses that range from 1 (“Not at all”) to 4 (“Very much so”). Examples of items are “I feel calm” or “I am jittery.” For the trait portion of the questionnaire (T-Anxiety), respondents are instructed to circle the statement that best indicates how they “generally feel.” Response choices range from 1 (“Almost never”) to 4 (“Almost always”) and examples of items are “I feel insecure” or “I am a steady person.” Ten of the S-Anxiety items are summed while the remaining 10 items are reverse scored. Eleven of the T-Anxiety items are summed, with nine items being reverse scored. Scores for both the S-Anxiety and the T-Anxiety scales range from 20 to 80 with higher scores indicating higher levels of anxiety. Both the total S-Anxiety and the total T-Anxiety scores were used.

Reliability data for the STAI were presented by Spielberger et al. (1983) using test-retest methods with stability coefficients ranging from .65 to .86 for the T-Anxiety scale. The stability coefficients for the S-Anxiety scale were much lower (.16 to .62), which was expected given the situational nature of state anxiety. Alpha coefficients were



also calculated to account for the transitory nature of anxiety states and showed that all but one of the S-Anxiety alphas were above .90. The median coefficient for the T-Anxiety scale was also high at .90. Construct validity of the T-Anxiety was measured by comparing T-Anxiety scores for normal subjects with those of neuropsychiatric patients for whom anxiety was a major symptom. Results indicated that the neuropsychiatric patients showed higher T-Anxiety scores, providing evidence for the construct validity. Similar comparisons were made for the S-Anxiety scores between military recruits who were tested just after a highly stressful training program and college and high school students tested under nonstressful conditions. S-Anxiety scores for the military recruits were higher than those of the college and high school students, thus confirming the construct validity of the S-Anxiety scale. Studies have also examined concurrent validity of the STAI by comparing it to other well validated anxiety measures (Spielberger et al., 1983).

Normative data for the STAI exist for working adults, college students, high school students, and military recruits (Spielberger et al., 1983). There are additional norms for male neuropsychiatric patients, general medical and surgical patients, and young prisoners.

### Quality of life

The Medical Outcomes Study (MOS) Short-Form Health Survey (SF-36; Ware & Sherbourne, 1992) is a 36-item measure assessing health-related quality of life (HR-QOL). There are eight health concepts measured: physical limitations due to health problems, limitations in social activities due to physical or emotional problems, role limitations due to health problems, bodily pain, general mental health, role limitations due to emotional problems, vitality (energy and fatigue), and general health perceptions. Participants are instructed to respond to each item about their perception of their health status during the previous four weeks on a Likert-style scale, such as indicating “how

much did pain interfere with your normal work (including both work outside the home and housework).” Each of the subscales is scored between 0 and 100 with higher scores indicating better perceived health status for each of the eight areas.

Ware, Snow, Kosinski, and Gandek (2000) present reliability data from 14 studies in the SF-36 manual, most of which used the internal consistency (Cronbach’s coefficient alpha) method. All estimates exceeded the accepted standards for measures when making group comparisons (median reliability coefficients across studies equaled or exceeded 0.80 with the exception of the Social Functioning scale which was 0.76). Two types of validation strategies were used for the SF-36: content validity and construct validity. Content validity was evaluated by comparing the SF-36 to other widely used survey forms. This comparison shows that the SF-36 includes the eight most frequently represented health concepts (Ware et al.). Because it is a general health status measure, symptoms specific to various medical conditions are not included and therefore the SF-36 can be supplemented with disease-specific questionnaires (e.g., pain measures and disability measures for the present study). A factor analysis was conducted to test the construct validity of the instrument. This analysis revealed two major clusters, physical health and mental health. The physical health scale is related to the physical functioning, role limitations due to physical health, and bodily pain subscales whereas the mental health scale is related to the mental health, role limitations due to emotional health, and social functioning scales. The remaining two scales, vitality and general health loaded onto both the mental and physical health factors. The total physical health scale and total mental health scale were used for the present study. To obtain the Physical Component Summary (PCS) and the Mental Component Summary (MCS) from the eight subscales, a multistep process is used (Ware & Kosinski, 2001). First, the eight subscale scores are standardized into z-scores using means and standard deviations from a general U.S. population. Next, aggregate scores for the physical and mental components are computed by using physical and mental factor score coefficients created from the general U.S.

population. Lastly, each component score is transformed to the norm-based scoring by multiplying each aggregate component scale score by 10 and adding the resulting product to 50.

Normative data exist for a general U.S. population ( $N = 2,474$ ) stratified by gender and age (Ware et al., 2000). There are additional norms provided for eight comorbid health conditions including: chronic obstructive pulmonary disease (COPD) ( $N = 85$ ), angina ( $N = 256$ ), back pain/sciatica ( $N = 481$ ), osteoarthritis ( $N = 175$ ), musculoskeletal complaints ( $N = 341$ ), benign prostatic hypertrophy symptoms ( $N = 184$ ), varicosities ( $N = 222$ ), and dermatitis ( $N = 231$ ). Additional studies (e.g., Schlenk et al., 1998) have also compared various medical patient groups (including fibromyalgia) on SF-36 scores, suggesting patients with chronic medical disorders report lower HR-QOL than the general U.S. population.

### Disability

Physical functioning and disability were measured using the Oswestry Low Back Pain Disability Questionnaire (ODQ; Fairbanks, Couper, Davies, & O'Brien, 1980). Though this measure was initially developed for use on chronic low back pain patients, it has been used for assessing disability among other chronic pain conditions (e.g., Wittink, Turk, Carr, Sukiennik, & Rogers, 2004) by rephrasing the questions to ask about "pain" instead of "back pain" as suggested by Roland and Morris (1983) who discuss changing previously validated instruments for a specific disease. The ODQ contains 10 questions about pain intensity, personal care, lifting, walking, sitting, standing, sleeping, sex life, social life, and traveling. Each question has six response options ranging from no limitation to extreme limitation with regard to each activity. Items are scored by assigning a value of zero through five, with higher scores indicating maximum functional limitation. The total score is divided by the number of items answered and then multiplied by 100 to get a percentage of patient perceived disability. Fairbanks et al.

provide interpretations of scores ranging from minimal disability (0%-20%) to bed-bound or exaggerated disability (80%-100%) for every 20-point range.

The ODQ has a high test-retest reliability ( $r = 0.99$ ) over two consecutive days and acceptable internal consistency (Fairbanks et al., 1980). Additional studies (Wittink et al., 2004) have tested the ODQ's psychometric properties and have shown acceptable internal consistency (Cronbach's  $\alpha = 0.86$ ) and low respondent burden. Therefore, the ODQ is an adequate instrument for use in assessing how pain behaviorally affects physical functioning in multiple life domains.

### Trauma

The Impact of Event Scale (IES; Horowitz, Wilner, & Alvarez, 1979) is a measure of subjective distress relating to a specific incident. It measures two constructs often experienced by individuals who have gone through a stressful life event and that are required for a diagnosis of posttraumatic stress disorder (PTSD), intrusion and avoidance. Intrusion is described as thoughts and images about the event that interfere with one's thoughts. Avoidance is described as both behavioral and cognitive avoidance of the thoughts and emotions associated with the event. Because the original version was published before the release of the DSM-III (American Psychiatric Association [APA], 1980) when only a two-symptom model was used to explain PTSD, the IES was subsequently revised (IES-R) to include a third subscale on hyperarousal, the third required symptom category for a current diagnosis of PTSD (D. S. Weiss & Marmar, 1997). The IES-R was used for the present study. It contains 22 items assessing PTSD symptomatology experienced within the past seven days that are measured on a five point Likert scale ranging from 0 ("Not at all") to 4 ("Extremely"), with higher scores indicating greater symptomatology. Sample items include "Pictures about it popped into my mind" and "I tried not to think about it."

D. S. Weiss and Marmar (1997) reported psychometric data on the IES-R to include high internal consistency on the intrusion subscale (coefficient alphas ranged from 0.87 to 0.92), avoidance subscale (0.84 to 0.85) and the hyperarousal subscale (0.59 to 0.92). Test-retest correlation coefficients ranged from 0.57 to 0.94 for intrusion, 0.51 to 0.89 for avoidance, and 0.59 to 0.92 for hyperarousal. An additional study (Creamer, Bell, & Failla, 2003) sought to investigate the psychometric properties of the IES-R with a male Vietnam veteran population and found a high correlation between the IES-R and the PTSD Checklist (0.84) and supports the use of the IES-R in assessing traumatic stress. They also found high internal consistency for the total scale (Cronbach's alpha = 0.96) and for each of the three subscales (intrusion = 0.94, avoidance = 0.87, hyperarousal = 0.91).

#### Demographics

Demographic information was also collected from each participant. The information that was collected included, age, gender, ethnicity, marital status, diagnosis, employment status, educational level, zip code, number of children in the household, site of pain, precipitating event, current and previous symptoms, date of diagnosis, previously tried treatments, comorbid conditions, and trauma/abuse history. Please see Appendix B for the complete questionnaire.

## CHAPTER IV

### RESULTS

The results of the study are presented in this chapter. The first section provides a description of the study sample. Next, descriptive statistics for the measures are reported, including data on norms and reliability. Lastly, the research questions are addressed.

#### Sample Characteristics

A total of 435 participants accessed and completed the online survey distributed through the Reflex Sympathetic Dystrophy Syndrome Association (RSDSA) and the Canadian Promoting Awareness of RSD/CRPS in Canada (PARC). Of the participants who completed the survey, three were excluded because they did not report being diagnosed with CRPS and an additional 36 were excluded because they indicated that they had a co-occurring pain disorder, one of the exclusionary criteria. The remaining 399 participants' responses were examined for missing data. A total of 73 participants had more than 10% of the items missing on at least one of the measures and thus were eliminated from subsequent analyses. The demographic characteristics of this group were compared to the group that was retained with no significant differences noted. Of the participants who had less than 10% of the items missing on a measure, person means for each subscale were calculated and imputed for that measure. A total of 326 participants met inclusionary criteria and did not have more than 10% of the items on any one measure missing. Remaining analyses were conducted with these 326 participants.

Table 1 provides a summary of the demographic characteristics of the patient sample. Of the 326 participants included in the analyses, a majority (85.9%) were female. There were 280 females, 45 males, and one participant did not indicate gender. The ratio of female to male participants is similar to other reports of gender ratios among patients with CRPS (Allen et al., 1999; de Mos et al., 2007; Sandroni et al., 2003). The

Table 1. *Demographic Characteristics of the Patient Sample*

VARIABLES	n	%
Sample size	326	
Age	46.18*	10.8*
Gender		
Male	45	13.8
Female	280	85.9
Ethnicity		
African-American/Black	2	0.6
American Indian/Native American	5	1.5
Asian/Asian-American	5	1.5
Biracial/Multiracial	2	0.6
Caucasian	296	90.8
Hispanic/Latino/a	9	2.8
Other	6	1.8
Marital Status		
Cohabiting	19	5.8
Divorced	44	13.5
Married	193	59.2
Separated	7	2.1
Single or Never Married	53	16.3
Widowed	9	2.8
Education		
Below high school	13	4.0
Graduated high school	47	14.4
Some college	126	38.7
Bachelor's Degree	82	25.2
Graduate/Professional Degree	56	17.2
Employment Status		
Disability	181	55.5
Full time	47	14.4
Homemaker	9	2.8
Not employed	26	8.0
Part time	12	3.7
Retired	10	3.1
Student	19	5.8
Other	21	6.4
Legal/Financial Consequences From CRPS		
Litigation	111	34.0
Worker's Compensation	115	35.3
Disability	220	67.5

*Note.* \* These values are mean and standard deviation, respectively.

sample was mostly Caucasian and married, but varied in level of education. Most participants (55.5%) reported being on disability.

Table 2 lists the medical characteristics of the sample. The final sample included 207 participants with CRPS type I (63.5%), 49 participants with CRPS type II (15%), and 70 participants (21.5%) reporting both type I and type II diagnoses. The most commonly reported inciting incident for CRPS was surgery (36.8%) followed by motor vehicle accident, traumatic accident, or injury (24.2%). A majority (62.9%) of the participants indicated that the injury occurred at work. The average time since diagnosis was approximately six years.

Table 3 shows the most commonly reported site of pain was the left foot (54.3%) and leg (53.7%), followed by the right foot (47.9%) and leg (46%). The arms and hands were also commonly reported with the head/face and torso being less frequent. Reported symptoms are displayed in Table 4. Pain, both burning pain and pain with movement, was the most frequently reported symptom, with more than 90% of the sample reporting pain both currently and at the time of diagnosis. Touch sensitivity, temperature changes, discoloration, swelling, and limited range of motion occurred in more than 85% of the sample at the time of diagnosis. The less frequently reported symptoms included sweating and excessive hair or nail growth, with these symptoms only occurring in approximately half of the sample.

Table 5 provides a summary of the subjective success of various treatments tried for CRPS. Pain medication was the most tried treatment, with its success being reported as providing at least minimal relief to most patients who have used it. Physical therapy was the next most tried treatment, but most patients reported little to no relief (67.2%). The next most frequently tried treatment modality was antidepressant medication followed by nerve blocks, both of which were minimally to moderately successful, if at all.



Table 2. *Medical Characteristics of Patient Sample*

VARIABLES	n	%
Diagnosis		
CRPS type I	207	63.5
CRPS type II	49	15
CRPS types I & II	70	21.5
Inciting Incident*		
Sprain/strain	58	17.8
Surgery	120	36.8
Fracture	67	20.6
MVA/Traumatic accident or injury	79	24.2
IV/Injection	12	3.7
Immobilization	9	2.8
No event	10	3.1
Other	54	16.6
Injury Occurred at Work		
Yes	117	35.9
No	205	62.9
Satisfied with Treatment/Management of CRPS		
Yes	148	45.4
No	174	53.4
Time Since Diagnosis	5.88**	4.97**

*Note.* \*These variables are not mutually exclusive; therefore, individuals could have selected more than one.

\*\* Mean and standard deviation in years, respectively

Table 3. *Pain Location*

Site of Pain	Right n(%)	Left n(%)
Arm	133(40.8)	144(44.2)
Hand	139 (42.6)	147(45.1)
Leg	150(46.0)	175(53.7)
Foot	156(47.9)	177(54.3)
Head/Face	55(16.9)	64(19.6)
Torso	71(21.8)	84(25.8)

*Note.* \*These variables are not mutually exclusive; therefore, individuals could have selected multiple pain sites.

Table 4. *Symptoms Reported*

Symptoms	At Diagnosis n(%)	Currently n(%)	Observed by Physician n(%)
Pain/Burning Pain	310 (95.1)	307 (94.2)	296 (90.8)
Extreme Touch/Temperature sensitivity	303 (92.9)	274 (84.0)	310 (95.1)
Temperature changes at pain site	287 (88.0)	267 (81.9)	297 (91.1)
Discoloration at pain site	292 (89.6)	236 (72.4)	295 (90.5)
Sweating at pain site	176 (54.0)	158 (48.5)	177 (54.3)
Swelling	298 (91.4)	247 (75.8)	298 (91.4)
Pain with movement/Mechanical sensitivity	312 (95.7)	300 (92.0)	309 (94.8)
Limited range of motion	281 (86.2)	256 (78.5)	294 (90.2)
Excessive hair/nail growth	135 (41.4)	152 (46.6)	157 (48.2)

Table 5. *Treatments Tried for CRPS*

Treatment	No Relief (%)	Minimal (%)	Moderate (%)	Successful (%)
Nerve Blocks	30.1	29.8	18.1	9.8
Physical Therapy	34.7	32.5	18.4	11.3
Pain Medication	6.1	27.6	50	13.5
Psychotherapy	16.9	22.1	14.4	4.3
Biofeedback	13.5	16.3	7.1	2.1
Spinal Cord Stimulator	12.3	6.4	11	10.1
TENS Unit	31.9	23.9	14.1	2.5
Acupuncture	17.8	8.3	5.8	2.8
Topical Medication	31.9	30.7	12	2.1
Injectable Medication	16.9	18.4	11.3	4
Antidepressant Medication	22.7	35.3	20.2	9.5

*Note.* \*Participants could have marked more than one treatment; adding across treatments indicates percentage of participants who tried each method.

Table 6 summarizes the psychological experiences reported by participants. More than half (59.8%) reported being treated for depression. Anxiety was the next most endorsed (29.1%) psychological issue for which participants reported being treated. When asked whether participants had experienced specific traumas before the age of 18, many reported at least some kind of trauma, with death of a close friend or relative being most common (42%). Physical, sexual, or emotional abuse was reported by at least one-fifth of the sample, with emotional abuse being most common (35%).

Table 6. *Psychological Experiences*

VARIABLES	n	%
Treated for Other Diagnoses		
Fibromyalgia	36	11
Chronic Fatigue Syndrome	24	7.4
Anxiety Disorder	95	29.1
Depression	195	59.8
Bipolar Disorder	16	4.9
Emotional Problem	43	13.2
Posttraumatic Stress Disorder	54	16.6
Experiences Trauma Before Age of 18		
Death of a close friend/Relative	137	42
Sexual Abuse	89	27.3
Physical Abuse	66	20.2
Emotional Abuse	114	35
Car Accident	68	20.9
Traumatic Accident/Injury	48	14.7

### Descriptive Statistics

Table 7 provides a summary of the ranges, means, standard deviations, and Cronbach's alpha for all study measures. Overall pain level, as measured by the SF-MPQ, was relatively high ( $M = 31.09$ ,  $SD = 8.77$ ). Participants also endorsed high levels of depression ( $M = 27.6$ ,  $SD = 14.36$ ). Researchers (Plutchik & Conte, 1989) typically consider a score of 16 or more to be a cutoff for clinical depression. When assessing a

Table 7. *Descriptive Data for Psychometric Instruments*

Measure	Range	Mean	SD	Alpha
Pain (SF-MPQ)	0-45	31.09	8.77	.87
Depression (CESD)	0-60	27.60	14.36	.94
Anxiety (STAI)				
State	20-80	50.59	15.49	.95
Trait	20-80	49.40	14.37	.96
Quality of Life (SF-36)				
Physical Functioning	0-100	32.57	25.30	.90
Role-Physical	0-100	13.78	30.03	.90
Bodily Pain	0-100	23.61	18.45	.84
General Health	0-100	38.68	24.92	.84
Vitality	0-100	24.88	20.13	.81
Social Functioning	0-100	37.50	26.49	.85
Role-Emotional	0-100	42.03	44.18	.88
Mental Health	0-100	54.70	24.85	.90
Physical Health Scale (PCS)	0-100	29.43	8.66	.89
Mental Health Scale (MCS)	0-100	39.02	13.45	.91
Disability (ODQ)	0-100	49.98	18.57	.87
Trauma (IES)				
Hyperarousal	0-28	8.95	7.44	.89
Avoidance	0-32	9.69	6.88	.83
Intrusion	0-28	9.42	7.51	.91
Total	0-88	28.06	20.23	.95

medical population such as pain patients, however, a cutoff score of 19 is typically used (Turk & Okifuji, 1994). The mean score of 27.6 for this sample indicates that participants endorsed many depressive symptoms. The state and trait anxiety scores among participants were very similar ( $M = 50.59$  and  $49.4$ , respectively). The quality of life scores, as measured by the SF-36, varied among subscales. The lowest quality of life

was reported in the area of physical roles ( $M = 13.78$ ), a measure of the degree to which participants experience problems with daily activities as a result of physical health. The highest quality of life score was reported in the area of mental health ( $M = 54.7$ ), a subscale that measures feelings such as nervousness and depression. That is, participants found the least amount of quality of life interference in the area of mental health as higher scores indicate greater quality of life. With regard to trauma symptoms, there was a lot of variability among participant scores, but many symptoms were endorsed ( $M = 28.06$ ). A cut score of 33 on the IES-R was determined to be clinically significant for a diagnosis of PTSD (Creamer, Bell, & Failla, 2003). Many participants (28.7%) had a score of 33 or greater on the IES-R, indicating a large percentage of participants who would likely meet criteria for a diagnosis of PTSD. All of the study measures showed satisfactory internal consistency reliability.

Table 8 shows the means and standard deviations comparing data from these participants to normative data that are available. A series of t-tests were used to compare the means of the study sample with those of published norms. Patients in this study reported significantly more pain on the SF-MPQ than those from a musculoskeletal pain population ( $t(334) = 5.41, p < .0001$ ) (Melzack, 1987). It is important to note, however, that the published norms for this measure were based on a small sample size ( $N = 10$ ), making accurate comparisons difficult. Anxiety was also significantly greater than normative data based on a general medical and surgical group for both state anxiety ( $t(434) = 4.76, p < .0001$ ) as well as trait anxiety ( $t(434) = 5.25, p < .0001$ ) (Spielberger et al., 1983). Quality of life was also significantly worse in the study population as compared to normative data. When compared to a back pain/sciatica population, the study sample had lower scores for both physical health and mental health quality of life ([PCS:  $t(843) = 18.41, p < .0001$ ], [MCS:  $t(843) = 8.95, p < .0001$ ]) (Ware & Kosinski, 2001). These findings were expected given the severity of the syndrome.

Table 8. *Scores and Normative Comparisons for Measures*

Measure	n	<u>Sample</u>			<u>Norms</u>			<u>T Test</u>	
		N	M	SD	N	M	SD	T	Sig.
Pain (SF-MPQ)	15	326	31.09	8.77	10	15.7 <sup>1</sup>	11.9	5.41	<.001
Anxiety (STAI)									
State	20	326	50.59	15.49	110	42.68 <sup>2</sup>	13.76	4.76	<.001
Trait	20	326	49.40	14.37	110	41.33 <sup>2</sup>	12.55	5.25	<.001
Quality of Life (SF-36)									
Physical Health Scale (PCS)	21	326	29.43	8.66	519	43.14 <sup>3</sup>	11.56	18.41	<.001
Mental Health Scale (MCS)	14	326	39.02	13.45	519	46.88 <sup>3</sup>	11.73	8.95	<.001

n= Number of items in a scale

N= Sample size

<sup>1</sup>= Norms and standard deviations based on musculoskeletal pain population (N=10) (Melzack, 1987)

<sup>2</sup>= Norms and standard deviations based on Form X administered to General Medical and Surgical (GMS) patients (N=110) (Spielberger et al., 1983)

<sup>3</sup>= Norms and standard deviations based on back pain/sciatica population (N=519) (Ware & Kosinski, 2001)

### Research Questions

The first research question pertained to the psychosocial profile of CRPS patients. As can be seen from the above analyses, participants endorsed high levels of pain, depression, and anxiety. They reported low quality of life, especially with regard to physical quality of life, and have high levels of disability. They also endorsed many symptoms associated with PTSD. In fact, when compared to other pain populations, these CRPS patients endorsed more anxiety, reported lower quality of life, and even reported a greater level of pain. In sum, this sample endorsed a lot of psychosocial distress, both physical and emotional.

The second research question pertained to whether patients with CRPS type I differ from patients with CRPS type II on various psychosocial measures. In order to determine whether these two patient groups differ, a Multivariate Analysis of Variance (MANOVA) was conducted. In the overall model, statistical significance was not demonstrated ( $F(8, 247) = 1.34, p > .05$ ). However, because several measures suggested between group differences, separate MANOVAs and ANOVAs were conducted to examine differences between the two groups. Table 9 shows the mean differences between CRPS type I and type II on each variable.

To examine whether differences exist between CRPS type I and CRPS type II patients on anxiety, a MANOVA was conducted with the STAI state and trait anxiety totals as the dependent variables. CRPS type I and type II patients were not found to differ with regard to state or trait anxiety ( $F(2, 215) = 1.44, p > .05$ ).

To examine whether differences exist between CRPS type I and CRPS type II patients on quality of life, a MANOVA was conducted with the SF-36 PCS and MCS totals as the dependent variables. MANOVA results indicated a significant difference in quality of life between CRPS type I and type II patients ( $F(2, 253) = 3.45, p < .05$ ). A follow-up ANOVA test showed that differences existed on mental health quality of life

Table 9. Mean Differences of CRPS Type I vs. CRPS Type II

Variable	<u>CRPS Type I</u>		<u>CRPS Type II</u>	
	Mean	SD	Mean	SD
STAI				
State	48.94	14.97	53.59	13.92
Trait	48.08	14.07	51.60	12.55
SF-36				
PCS	30.61	8.98	28.72	7.47
MCS*	40.27	13.20	35.97	12.90
SF-MPQ	29.90	8.89	31.27	9.48
CES-D*	26.07	13.82	31.73	14.49
ODQ	47.98	18.57	51.95	18.02
IES Intrusion	8.53	7.20	10.56	7.47

*Note.* SF-MPQ=Short-Form McGill Pain Questionnaire; CES-D= Centers for Epidemiologic Studies Depression Scale; STAI=State-Trait Anxiety Inventory; ODQ=Oswestry Disability Questionnaire; IES=Impact of Event Scale; SF-36 PCS=Short-Form 36 Physical Component Summary; SF-36 MCS=Short-Form 36 Mental Component Summary

\* $p < .05$

(MCS) between CRPS patients ( $F(1, 254) = 4.24, p < .05$ ), but not on physical health quality of life (PCS) between the two groups ( $F(1, 254) = 1.86, p > .05$ ). An examination of the mean differences indicated that patients with CRPS type I patients reported higher mental health quality of life ( $M = 40.27$ ) than CRPS type II patients ( $M = 35.97$ ).

In order to examine difference between CRPS type I and CRPS type II patients on level of pain, an ANOVA was conducted with SF-MPQ total scores as the dependent



variable. There was no significance found between CRPS type on level of pain ( $F(1, 254) = .917, p > .05$ ). An ANOVA was also conducted to determine whether differences exist between CRPS type I and CRPS type II patients with regard to level of depression as measured by the CES-D. ANOVA results showed that differences existed between the two patient groups ( $F(1, 254) = 6.53, p < .05$ ). An examination of the mean differences indicated that the patients with CRPS type II endorsed more depressive symptoms ( $M = 31.73$ ) than CRPS type I patients ( $M = 26.07$ ).

In order to examine differences between CRPS type I and type II patients on level of disability, an ANOVA was conducted with ODQ total as the dependent variable. Significance was not found for disability level between CRPS type I and type II patients ( $F(1,254) = 1.831, p > .05$ ). In order to determine whether differences existed between CRPS type I and CRPS type II patients with regard to intrusive thoughts, an ANOVA was conducted using the IES Intrusion scale as the dependent variable. Significance was not found between the two groups ( $F(1, 254) = 3.11, p > .05$ ).

In general, patients with CRPS type I did not differ from patients with CRPS type II on most psychosocial variables. Because of this finding, the two patient samples were grouped together for the remaining analyses.

The third research question pertained to the quality of life relationships with other variables. Analyses were conducted to examine the relationships between several study variables. Table 10 summarizes selected intercorrelations between the main study measures. Most measures were correlated with each other with few exceptions. The Physical Component Summary of the SF-36 was not significantly correlated with the STAI Trait or IES intrusion scales.

The last research question involved whether intrusive thoughts predict psychological and physical outcomes in patients with CRPS. To address these questions, three separate regression analyses were conducted. In the first regression equation, age and gender were entered into the first step. Level of pain, as measured by the SF-MPQ,

Table 10. *Selected Intercorrelations Among Variables*

Scale	1	2	3	4	5	6	7	8
1. SF-MPQ	1	.48**	.42**	.39**	.55**	.38**	-.41**	-.38**
2. CES-D	.48**	1	.83**	.82**	.50**	.64**	-.12*	-.81**
3. STAI State	.42**	.83**	1	.85**	.46**	.56**	-.11*	-.79**
4. STAI Trait	.39**	.82**	.85**	1	.45**	.60**	-.08	-.80**
5. ODQ	.55**	.50**	.46**	.45**	1	.37**	-.68**	-.34**
6. IES Intrusion	.38**	.64**	.56**	.60**	.37**	1	-.03	-.58**
7. SF-36 PCS	-.41**	-.12*	-.11*	-.08	-.68**	-.03	1	-.12*
8. SF-36 MCS	-.38**	-.81**	-.79**	-.80**	-.34**	-.58**	-.12*	1

*Note.* SF-MPQ=Short-Form McGill Pain Questionnaire; CES-D= Centers for Epidemiologic Studies Depression Scale; STAI=State-Trait Anxiety Inventory; ODQ=Oswestry Disability Questionnaire; IES=Impact of Event Scale; SF-36 PCS=Short-Form 36 Physical Component Summary; SF-36 MCS=Short-Form 36 Mental Component Summary

\* $p < .05$ ; \*\* $p < .001$

was entered into the second step. Intrusive thoughts, measured by the intrusiveness subscale of the IES-R, were entered into the third step. The dependent variable was level of disability, measured by the ODQ. Table 11 summarizes the results from this regression equation. The overall model was significant [ $F(4, 314) = 41.46, R^2 = .35, p < .01$ ]. The variables in Step 1 were not significantly predictive of disability level. After accounting for the variables in Step 1, level of pain was related to greater disability. After accounting for the variables in Steps 1 and 2, intrusive thoughts were uniquely predictive of disability level ( $\beta = .194, sr^2 = .032, p < .05$ ). The  $R^2$  change ( $sr^2$ ) refers to the amount of variance uniquely accounted for by that variable after controlling for the initial variables entered into the equation. That is, greater endorsement of intrusive thoughts accounted for 3% of the variance in level of disability after level of pain had been accounted for in the model. Both age and level of pain were also significant in the final model.

The next regression equation examined whether intrusive thoughts predicted physical quality of life. Age and gender were entered into the first step. Pain level, as measured by the SF-MPQ, was entered into the second step. Intrusive thoughts, measured by the intrusion subscale of the IES-R, were entered into the third step, with the PCS scale of the SF-36 as the dependent measure. Results are displayed in Table 12. The overall model was significant [ $F(4, 314) = 17.67, R^2 = .18, p < .01$ ]. The variables in Step 1 were not significantly predictive of physical quality of life. After accounting for the variables in Step 1, level of pain significantly predicted lower physical quality of life. After accounting for the variables in Steps 1 and 2, intrusive thoughts uniquely predicted higher physical quality of life ( $\beta = .153, sr^2 = .020, p < .05$ ). Interestingly, after controlling for level of pain, greater intrusive thoughts predicted better physical quality of life, accounting for 2% of the variance.

The last regression equation assessed whether intrusive thoughts predict quality of life, in this case mental health quality of life. Age and gender were entered into the first

Table 11. *Hierarchical Regression Analysis of Intrusive Thoughts Predicting Disability*

Variable	<i>B</i>	<i>B</i>	<i>SE</i>	<i>sr</i> <sup>2</sup>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>p</i>
<b>Step 1</b>				<b>.008</b>	<b>1.20</b>	<b>.008</b>	<b>.302</b>
Age	.067	.115	.098	.004			.243
Gender	-.046	-2.45	3.05	.002			.423
<b>Step 2*</b>				<b>.306</b>	<b>48.0</b>	<b>.314</b>	<b>.000</b>
Age*	.094	.162	.082	.009			.048
Gender	-.023	-1.26	2.54	.001			.621
Pain (SF-MPQ)*	.554	1.17	.099	.306			.000
<b>Step 3*</b>				<b>.032</b>	<b>41.46</b>	<b>.346</b>	<b>.000</b>
Age*	.101	.174	.08	.010			.030
Gender	-.020	-1.08	2.49	.000			.664
Pain (SF-MPQ)*	.479	1.01	.105	.194			.000
Intrusive Thoughts (IES-R)*	.194	.479	.122	.032			.000

Note: \**p*<.05

Table 12. *Hierarchical Regression Analysis of Intrusive Thoughts Predicting Physical Quality of Life*

Variable	$\beta$	<i>B</i>	<i>SE</i>	<i>sr</i> <sup>2</sup>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>p</i>
<b>Step 1</b>				<b>.001</b>	<b>.116</b>	<b>.001</b>	<b>.891</b>
Age	.026	.021	.046	.001			.648
Gender	.013	.322	1.44	.000			.823
<b>Step 2*</b>				<b>.163</b>	<b>20.59</b>	<b>.164</b>	<b>.000</b>
Age	.006	.005	.042	.000			.910
Gender	-.003	-.086	1.32	.000			.948
Pain (SF-MPQ)*	-.405	-.401	.051	.163			.000
<b>Step 3*</b>				<b>.020</b>	<b>17.67</b>	<b>.184</b>	<b>.006</b>
Age	.011	.009	.042	.000			.827
Gender	.000	-.021	1.31	.000			.987
Pain (SF-MPQ)*	-.464	-.459	.055	.182			.000
Intrusive Thoughts (IES-R)*	.153	.177	.064	.020			.006

Note: \**p*<.05

step. Pain level, as measured by the SF-MPQ, was entered into the second step. Intrusive thoughts, measured by the intrusion subscale of the IES-R, were entered into the third step, with the MCS scale of the SF-36 as the dependent measure. Table 13 summarizes the results from this regression equation. The overall model was significant [ $F(4, 314) = 44.1, R^2 = .36, p < .01$ ]. The variables in Step 1 were not significantly predictive of mental health quality of life. After accounting for the variables in Step 1, level of pain significantly predicted poorer mental health quality of life. After accounting for the variables in Steps 1 and 2, intrusive thoughts uniquely predicted lower mental health quality of life ( $\beta = -.501, sr^2 = .213, p < .05$ ). That is, greater endorsement of intrusive thoughts uniquely accounted for 21% of the variance in mental health quality of life above and beyond level of pain.

Table 13. *Hierarchical Regression Analysis of Intrusive Thoughts Predicting Mental Health Quality of Life*

Variable	$\beta$	<i>B</i>	<i>SE</i>	$sr^2$	<i>F</i>	$R^2$	<i>p</i>
<b>Step 1</b>				<b>.006</b>	<b>1.02</b>	<b>.006</b>	<b>.363</b>
Age	.031	.039	.071	.001			.584
Gender	.079	3.10	2.23	.006			.165
<b>Step 2*</b>				<b>.141</b>	<b>18.15</b>	<b>.147</b>	<b>.000</b>
Age	.012	.016	.066	.000			.815
Gender	.064	2.51	2.07	.004			.226
Pain (SF-MPQ)*	-.376	-.578	.080	.141			.000
<b>Step 3*</b>				<b>.212</b>	<b>44.10</b>	<b>.360</b>	<b>.000</b>
Age	-.005	-.007	.058	.000			.909
Gender	.056	2.172	1.793	.003			.227
Pain (SF-MPQ)*	-.182	-.279	.075	.028			.000
Intrusive Thoughts (IES-R)*	-.501	-.900	.088	.213			.000

Note: \* $p < .05$

## CHAPTER V

### DISCUSSION

The results of this study will be discussed and compared to existing literature in the following section. Next, study limitations will be presented. Finally, implications for both research and clinical practice will be presented followed by concluding remarks.

#### Discussion of Results

The purpose of this study was to provide a description of the psychosocial profile of individuals with Complex Regional Pain Syndrome (CRPS). Additionally, this study served to investigate the quality of life issues among that population and specifically identify the role of intrusive thoughts in predicting disability and physical and mental health quality of life. The results of the study show that patients with CRPS are, for the most part, significantly affected by their condition physically, psychologically, and financially.

#### Demographic Characteristics

One purpose of this study was to present the psychosocial profile of individuals with CRPS. Because there are very few epidemiological studies of this population, this study helps to portray the typical demographic characteristics of these individuals. The sample in this study was predominantly female (85.9%). Previous literature has found that females are more commonly affected than males, with gender ratios reported as 2:1 (Allen et al., 1999), 3.4:1 (de Mos et al., 2007), 4:1 (Sandroni et al., 2003), and 5:1 (Sharma et al., 2009). This study showed a ratio just slightly higher than existing epidemiological studies, which could be attributed to the method of data collection. The current sample was also mostly White, married, and educated with some college or more. These findings are also similar to past epidemiological studies. Sandroni et al. (2003) conducted an epidemiological study in Olmstead County, Minnesota, a county that was



95% White. Their sample of CRPS I patients consisted of 73 White individuals and one Asian. The de Mos et al. (2007) population-based study was based on records from the Netherlands, thus restricting the study sample's ethnic background. The Allen et al. (1999) study evaluated charts from patients referred to a University pain center and reported 107 White patients (90.6%) from the 118 who disclosed ethnic data. A retrospective questionnaire study (Schwartzman et al., 2009) of pain clinic patients at Drexel University College of Medicine also found a majority of White patients (96%). Another web-based epidemiological study (Sharma et al., 2009) also showed a sample that was majority White (93.2%). The sample used for the current study is more representative of the general population than single facility/county studies given the dissemination to a national and international listserv. Of the epidemiological studies of CRPS that exist, this syndrome appears to affect White individuals more than other ethnicities. This conclusion is cautiously stated given the dearth of epidemiological studies and limitations to existing study designs. Better epidemiological studies are needed to ascertain whether this finding underrepresents the ethnic makeup of individuals that suffer from CRPS.

One of the most striking findings was the number of participants experiencing legal and financial consequences from CRPS. More than 67% reported being on disability as a result of this syndrome, and over 55% reported disability as their source of income. Approximately one-third reported being involved in litigation and more than 35% were involved in a worker's compensation claim related to CRPS. These findings suggest that this syndrome not only has significant physical and psychological consequences, but also financial implications as well. Other studies have assessed involvement in litigation and have found ranges from 12% of the sample to 95% (Nelson, 2002). The high rates of litigation and disability among this population is likely related to the significant psychological distress and physical disability experienced from the syndrome and the failed efforts to provide relief from medical intervention. These

findings underscore the importance of finding satisfactory treatment to improve function in order to allay the economic impact of this syndrome.

### Medical Characteristics

Currently, the diagnostic criteria for complex regional pain syndrome are undergoing a proposed shift from the International Association for the Study of Pain (IASP) criteria to the Budapest criteria. As such, identification of a standard set of criteria for research studies is difficult. Because this study was conducted online, it relied on reports of physician diagnosis along with self-reported signs and symptoms. Many of the reported medical characteristics of the syndrome, however, were consistent with studies using physician examination. Most participants reported having CRPS type I. A good number of the participants, however, reported having been diagnosed with both type I and type II (21.5%). Given that one subtype excludes the other, this would suggest that these participants had separate injuries or inciting incidents that led to the development of CRPS on more than one occasion. This finding prompts the question as to whether certain people are more vulnerable to the condition. Future research should assess whether individuals who have had one diagnosis of CRPS are at risk for developing a secondary diagnosis following a separate inciting event.

Of the current sample, the most affected body parts were the limbs. This is consistent with other studies of CRPS in which the extremities are the most commonly affected body parts. Some studies have noted upper extremities to be slightly more affected (de Mos et al., 2007; Sandroni et al., 2003) while others have reported lower extremities to be slightly more affected (Allen et al., 1999; Sharma et al., 2009). The current sample reported the left side being slightly more affected than the right and the lower extremities being slightly more affected than the upper extremities. Because the syndrome has a tendency to spread to various regions of the body, multiple body parts could have been affected. Also reported but less common are CRPS affecting the torso,

head, and face. Extremities are likely more often affected due to the type of incidents that lead to CRPS. Because it most often follows surgeries, sprains, and fractures, extremities are more likely to suffer those types of injuries as opposed to the torso, head, and face.

In this sample, surgery was the most common inciting incident, followed by MVA or traumatic injury and a fracture. One study found a fracture to be the most common inciting incident (de Mos et al., 2007), while another found strain, surgery, or fracture to be the precipitating event (Allen et al., 2009). Overall, research has found that the most common precipitating event is a minor trauma such as a fracture, sprain, or strain that requires immobilization (Nelson, 2002). It is the relatively benign nature of the precipitating event resulting in such significant symptoms that makes this such a puzzling syndrome.

Participants in this study have tried many treatments for their condition with varying success. Pain medication and physical therapy were reported to be the most successful treatments by some of the participants. Antidepressant medication was found to be moderately successful. Of the treatments tried, no single treatment stood out as successful by a majority of the respondents. Notably, the treatments showed extreme variation in their benefit to participants. This suggests that the field of medicine has yet to identify a universally effective treatment for this condition. Some treatments work well for some people. Because this syndrome is so difficult to treat, symptoms can persist for many years.

The participants in this study reported a mean time since diagnosis of almost six years. More than half of the sample was dissatisfied with the medical management of their syndrome. This suggests that the physical and psychological symptoms experienced are maintained after years of attempted treatment without success. It is important that clinicians continue working to identify better treatments for this condition.

### Psychological Characteristics

Another main purpose of this study was to demonstrate the psychological characteristics associated with CRPS. As noted previously, psychological sequelae are a common finding among chronic pain populations. Specifically, chronic pain patients are found to exhibit more depression (Romano & Turner, 1985) and anxiety (Fishbain et al., 1986) than the general population. As such, it was expected that the current sample would report significant levels of depression and anxiety, but this study also sought to investigate how those rates compared to other pain populations.

First, participants reported levels of pain significantly higher than even a musculoskeletal pain group. This would suggest that CRPS is associated with severe pain. Because the SF-MPQ uses adjective descriptors of pain, conditions associated with several types of pain may score higher on this measure. For example, individuals with CRPS tend to experience allodynia, dull mechanical pain, and neuropathic type pain. Given the diversity of the pain sensations, scores would be elevated on this particular measure. It would be interesting to compare single pain intensity measures to other pain groups to determine how the level of pain actually compares. By contrast, pain is a poor outcome measure on its own given the subjective nature of self-report. Other measures are more indicative of how pain actually affects functioning. Despite this limitation, it is important to note that these individuals are suffering incredible pain, which could also relate to the elevated findings below.

Participants in the study endorsed high levels of depression, anxiety, and disability, and reported low levels of mental and physical quality of life. Consistent with many pain patients, it was expected that these participants would experience depression, anxiety, disability, and poor quality of life. What was surprising, however, is the extent to which they did. Participants endorsed high levels of depression ( $M = 27.6$ ,  $SD = 14.36$ ). Researchers (Plutchik & Conte, 1989) typically consider a score of 16 or more to be a cutoff for clinical depression, but a cutoff score of 19 is typically used (Turk &

Okifuji, 1994) for medical populations. This sample reported clinically significant levels of depression above what is considered clinical depression. Research has shown that pain patients endorse greater depression than general and medical populations (Romano & Turner, 1985), so this finding was expected.

Anxiety is also commonly associated with chronic pain conditions (Fishbain et al., 1986). Participants in this study reported high levels of both state and trait anxiety. Trait anxiety is the way a person typically or generally feels, indicative of a more characterological way of being. State anxiety, by contrast, is the way a person feels at a particular moment, in this case when the participants filled out the survey. The current sample endorsed high levels of both trait and state anxiety. While this is expected in a chronic pain population, the amount of anxiety endorsed was statistically significantly greater than normative data based on a general medical and surgical group for both state and trait anxiety (Spielberger et al., 1983). There are two possible explanations for why these patients endorse such high levels of anxiety. First, as is suggested by the predisposing personality trait theories of pain, these individuals may have had a higher premorbid baseline level of anxiety. This would be consistent with the reports of high levels of trait anxiety. As a result, individuals with anxiety are often more attuned to physiological sensations and tend to catastrophize interpretations of those sensations. Individuals with high levels of baseline anxiety might be at greater risk for developing a chronic pain condition from an acute injury. The other explanation could be that this condition creates greater anxiety in individuals given its mysterious etiology, failure to respond to conventional pain interventions, and difficulty in receiving a diagnosis. Researchers have theorized that greater uncertainty about medical illness is related to greater anxiety (Mishel, 1988).

It was expected that individuals with CRPS would experience lower quality of life than the general population. Interestingly, they also reported mental health and physical quality of life lower than a back pain/sciatica sample. The lowest domain of quality of

life was in the area of ability to fulfill physical roles. This represents the physical disability experienced by this population.

On a measure of disability, this sample reported on average approximately a 50% level of disability. This score falls into the category of severe disability, suggesting that pain affects multiple areas of their life including travel, personal care, social life, and sexual activity (Fairbanks et al., 1980). This finding is consistent with the high reports of financial disability compensation sought by this population.

Similar to studies that compare CRPS patients to other pain patients, the present study showed that individuals with CRPS experience greater distress than those suffering from other pain conditions. There are studies that have directly compared CRPS to another pain condition and have demonstrated greater distress among CRPS patients (Bruehl et al., 1996; Hardy & Merritt, 1988; Zucchini et al., 1989). The results of this study support those findings. Of note, this study did not directly compare individuals from different pain conditions, but rather assessed individuals with CRPS and made comparisons to published norms on psychological data. This study also supported previous findings from descriptive studies of patients with CRPS. Past descriptive studies have shown that individuals with CRPS report high levels of depression, frequent job inactivity, poorer quality of life, and reduced physical functioning (Bruehl & Chung, 2006; Galer et al., 2000; Rauis, 1999). The current sample reported findings consistent with those studies. This supports a growing body of evidence of the significant psychological impact this condition can have on the individual and the need to both understand that impact and to treat the effects, both physical and psychological.

The cross-sectional design of the present study precludes determination of causal relationships between pain and psychopathology. The review of the pain literature as a whole, however, is not conclusive with regard to the relationship between chronic pain and psychological symptoms. More recent theories have proposed a diathesis-stress model of chronic pain in which preexisting characteristics are triggered by the stress of a

chronic pain condition and may subsequently result in psychopathology or psychological symptoms (Dersh et al., 2002). This could explain the findings established from this study, but without a prospective design, it is impossible to determine if psychological characteristics were preexisting.

Based on a study by de Mos et al. (2009) that assessed long-term outcomes of patients with CRPS, Bruehl (2009) concluded that there is likely a subset of patients who develop a severe, progressive form of CRPS who may be overrepresented in specialty pain clinics. This could be another explanation for the severity of psychological symptoms reported in this study. Those individuals who are using online resources and looking to help with research studies may be the individuals most affected by the syndrome. Additionally, there are theories that psychological characteristics may contribute to the maintenance of CRPS rather than the etiology or onset (Bruehl & Carlson, 1992; de Mos, Sturkenboom, & Huygen, 2010). Based on this hypothesis, individuals with preexisting psychological characteristics would continue to experience CRPS symptoms longer than those without psychological characteristics.

This study represents a significant effort to describe the psychological experiences of individuals with CRPS. Very few descriptive studies exist of the psychological sequelae of CRPS. One study attempted to describe quality of life among individuals with CRPS (Galer et al., 2000), but used an extremely small sample size limiting generalizability of the findings. This study furthered the efforts made by Galer and colleagues to access a larger, more geographically diverse sample and found similar results.

#### Type I vs. Type II

Very few studies have examined differences between the two subtypes of CRPS. The only difference for diagnosis relates to the existence of an identifiable nerve injury. All other signs and symptoms are the same. One of the questions addressed by this study

was whether participants from each subtype differ from each other with regard to psychosocial variables. Overall, there was no significant difference detected between the two groups. Upon closer examination, some minimal differences were noted. For example, type II participants reported slightly more depression and lower levels of mental health quality of life. Given the lack of research focusing on this subtype, it is hard to determine the reason for this finding. One might suspect that the presence of a definitive nerve injury, as opposed to enigmatic symptoms from a seemingly benign injury, might make an individual more frustrated by the lack of satisfactory treatment. There is more research needed comparing the two subtypes and of type II specifically. CRPS is a relatively low incidence syndrome and type II represent only a fraction of those individuals, making studies of this nature very difficult.

#### The Role of Intrusive Thoughts

There are no studies that examine the role of posttraumatic stress disorder (PTSD)-like symptoms in CRPS. Though references have been made to individuals suffering from both PTSD and CRPS concomitantly (e.g., Grande et al., 2004; Shiri et al., 2003), no study has investigated the role of intrusive thoughts or rumination about the injury or syndrome in the maintenance or exacerbation of CRPS specifically. Shiri et al. (2003) noted that approximately one-third of patients with CRPS had a comorbid Axis I diagnosis, most commonly depression or PTSD. Of the current sample, almost 29% received scores on the IES that would meet criteria for PTSD. As described earlier, depression is directly related to pain conditions (Romano & Turner, 1985) and to CRPS specifically (Rauis, 1999). However, PTSD may be an unrelated comorbidity or it could interact with CRPS. The limited research on the relationship between PTSD and CRPS prevents conclusions from being drawn. One study, however, attempted to hypothesize this relationship. Grande et al. (2004) described a case study in which an individual developed CRPS symptoms during an exacerbation of his preexisting PTSD. The authors



of this study proposed a supraspinal mechanism which could explain the role of emotional stress in producing CRPS symptoms.

One of the theories proposed to assist in the understanding of psychosocial factors in chronic pain was that of Van Houdenhove (2000) who posited that psychosocial stress from the pain experience itself could affect the immune system and consequently interact with the peripheral and central nervous systems to maintain pain. Even before that, he proposed a theory specific to CRPS in which hyperarousal, one of the symptoms of PTSD, contributed to the disrupted healing process (Van Houdenhove et al., 1992). This theory would begin to support a relationship between PTSD and CRPS, but limitations to the theory and lack of subsequent evidence prevented further development of this theory. There remains an uninvestigated issue about whether noted similarities between PTSD and CRPS have a relationship.

One of the symptoms of PTSD is intrusive thoughts, or reexperiencing of the traumatic event. This study sought to investigate how intrusive thoughts related to the inciting injury or the pain experience contribute to the physical disability and quality of life of these individuals. Because thoughts can be a target for psychotherapeutic change, demonstrating their function as important for quality of life outcomes would identify a role for psychology in improving quality of life. After controlling for age, gender, and level of pain, it was found that intrusive thoughts significantly predict disability, physical quality of life, and mental health quality of life. Interestingly, however, it was found that greater intrusion of thoughts led to higher disability, lower mental health quality of life, and higher physical quality of life. Therefore, individuals that endorsed greater intrusive thoughts had greater physical disability and poorer mental health quality of life. One theory to potentially explain this finding proposes that rumination can be a causal and maintaining factor for emotional distress in individuals with chronic physical illness (Soo, Burney, & Basten, 2009). Rumination is described as a maladaptive way of thinking whereby an individual repetitively focuses on unproductive thought content.

Rumination differs from thought intrusion in that it is a process of cognition whereas intrusion is the uninvited experience of thoughts. Intrusion does not necessarily imply repeated focus on that thought content, but high levels of intrusive thoughts would indicate a high frequency of being disturbed by unwanted thought content. The similarities between the two could explain the findings of the current study. Research has shown that cognitive content and biases play a role in the development and maintenance of psychological disorders (Abramson, Metalsky, & Alloy, 1989; Beck, Brown, Steer, Eidelson, & Riskind, 1987). Soo et al., however, extended that theory to posit how the process of thought content (i.e., rumination) can cause and maintain affective distress in individuals with chronic illness. The current study could be seen as supportive of their theory in that the process of intrusive thoughts was predictive of disability and quality of life in CRPS patients.

Another study by Sullivan, Lynch, and Clark (2005) similarly investigated the role of thought content in predicting disability related to pain. They discovered that pain catastrophizing (i.e., rumination, magnification, and helplessness) predicted pain-related disability above the variance predicted by pain severity alone in patients with neuropathic pain conditions. This further supports the idea that there is a significant cognitive component in the maintenance and exacerbation of pain to the point where it affects one's functioning.

Another study conducted by Ramirez-Maestre, Esteve, and Lopez (2008) examined the relationship between patients' cognitive appraisals concerning their pain and the coping strategies they employed. They found that patients who appraised their pain as a threat, harm, or loss used passive coping strategies, while patients who appraised their pain as a challenge used active coping strategies. This study argues for the importance of understanding the content of the thoughts associated with pain. Because active coping strategies are encouraged for pain patients, cognitive restructuring could help facilitate healthier ways of coping. From the current study, it is known that

intrusive thoughts can predict quality of life outcomes. It would be interesting to further assess the predictive value of the content of the thoughts. Given that there was an opposite relationship with regard to intrusive thoughts and physical versus mental health quality of life, the difference could be explained by thought content. Greater intrusion predicted lower mental health quality of life, but higher physical quality of life. Understanding the content of the intrusive thoughts could provide greater insight into this difference. For example, some thoughts can be positive and motivating and thus intrusion of these thoughts would lead to better outcomes. Further investigation in this area is needed to better understand the cognitive experiences in individuals with CRPS.

Cognitive theories of pain have shown the significance of both thought content and thought process. This study adds further evidence to the cognitive models of pain by showing how thought intrusion can significantly affect one's quality of life. This finding lends support to cognitive interventions as a part of multidisciplinary treatment for individuals with CRPS.

#### Study Limitations

As with all studies, there are limitations to the design and methodology of this study. The survey method of data collection poses several potential limitations. First, the survey must be accessed by individuals via a computer. Assumption of technological knowledge and access to a computer may restrict the sample population to a more highly educated, higher income sample. In addition, filling out an online survey requires time, potentially limiting participating individuals to those who have more time. This might skew the sample to include more individuals on disability or out of work than would actually exist in the true population of CRPS individuals. The survey was disseminated via two methods, the Reflex Sympathetic Dystrophy Syndrome Association (RSDSA) listserv and the Canadian Promoting Awareness of RSD/CRPS in Canada (PARC) listserv. These associations exist as online support and resources for individuals

suffering with CRPS. Those most likely to access or seek out such an association are most likely individuals who have failed typical treatments and are seeking additional resources/advice, those who have been most greatly affected by the condition, and those who are greatly invested in advancing knowledge about CRPS. This might restrict the study sample to individuals with more severe and/or less treatable cases of CRPS.

Another significant limitation to this study involved the diagnostic criteria for CRPS. As noted previously, the proposed diagnostic criteria for CRPS has evolved over the years to most accurately capture this syndrome. As a result, past research may rely on different criteria, making comparisons of studies difficult. Furthermore, the design of this study being conducted online precluded access to medical records and physical examination of participants. As such, the study relied on participants' reports of signs and symptoms versus actual observation from a physician. Participants may not accurately recall whether signs were observed by a physician, resulting in overestimation of whether they meet criteria. Studies that use physician examination or confirmation from medical records have a more accurately diagnosed sample with greater specificity and would make comparison to a self-report sample difficult.

Another limitation to the study was the cross-sectional design. Because participants' responses were captured only at one time point, it is difficult to determine if psychological symptoms preexisted the diagnosis or occurred as a result of the pain. This is a longstanding focus of research in the area of pain—which comes first, the pain or the psychological symptoms? Longitudinal prospective studies are best suited to tease apart the causal relationship. That, however, was not the purpose of this study. Instead, the purpose was to portray the psychological phenomena experienced by individuals with CRPS without making assumptions about the causal relationship. As such, the results should be understood as a snapshot of the experience of an individual of CRPS and does not represent the longitudinal trajectory of its course.

This study compared the psychological experiences of individuals with CRPS to normative data published on other pain groups. Conclusions from such comparisons should be taken cautiously. Some of the normative data is not the best example of a representative sample. For example, the normative data for the SF-MPQ is based on a sample of a mere 10 individuals. Such a sample can hardly be representative of an entire musculoskeletal pain population. Similarly, the norms for the STAI are based on a sample of general medical and surgical patients. Further details about that sample, however, are not provided. Clearly, medical patients can vary significantly from pain patients based on the medical condition they have. Therefore, the author cautions against making significant conclusions based on normative comparisons alone; however, the significant elevations on all psychological measures is still meaningful and can be interpreted as at least clinically significant.

#### Implications for Clinical Practice

It is important that psychological research inform clinical practice. There are several implications from this study for clinical practice in both medicine and psychology. First, the importance of early detection and intervention is critical to achieving the best outcome. This study clearly demonstrates the severe psychological sequelae that can result from this unmanaged syndrome. Participants reported psychological distress in excess of what is reported by most other pain conditions. Early medical intervention has the best outcomes for CRPS and multidisciplinary approaches are recommended (Stanton-Hicks et al., 1998), but even so, many treated cases continue to have persistent symptoms (Subbarao & Stillwell, 1981). If the syndrome can be diagnosed and treated early, many of the psychological symptoms may be prevented. However, because this syndrome is misdiagnosed by so many, clinicians need guidelines for assisting those whose symptoms have existed beyond the point of relief from conventional medical intervention.

Second, it is important to understand the psychological distress experienced by these patients. All pain patients experience greater levels of depression and anxiety, but individuals with CRPS suffer even more. Whether it is their attempt to be believed, to cry out for help, or the psychological sequelae of a highly debilitating syndrome, it is important for clinicians to take these reports seriously. In addition, the frequency of psychological factors suggests that medical professionals should assess for depression and anxiety as a routine part of their evaluation. Therefore, appropriate referrals can be made to address the psychological impact of this syndrome in conjunction with the medical intervention. Even better, pain clinics should be interdisciplinary collaborations that can address the holistic experience of a pain condition. Also, chronic pain itself is a risk factor for suicide (Ilgen, Ziven, McCammon, & Valenstein, 2008). Given the high distress experienced by this population, risk assessment should be an important part of a clinical interview with any pain patient and should be routinely incorporated into a pain physician's evaluation.

Third, the role of intrusive thoughts in predicting disability status and both mental and physical quality of life implies an important mechanism for intervention. Psychologists often use behavioral techniques (e.g., relaxation, pacing) to help with self-management of pain. Given the significance of intrusive thoughts in predicting salient outcomes (e.g., quality of life and disability), it is suggested that therapists incorporate a cognitive component to pain management practices. Intrusive thoughts can be a target for change since cognitive therapy can alter the way an individual thinks. Some researchers have suggested that psychologists assess an individual's *appraisal* of pain sensation. It is how the individual interprets a physical pain sensation that determines the consequent affect and behaviors. If a psychologist can assist the individual in reappraising that sensation as less threatening, the affect and behavior will change. Alternatively, behavioral distraction techniques (e.g., engaging in an activity that distracts

the individual from the thoughts) might also prove beneficial to reduce intrusive thoughts since we know it is an effective technique for chronic pain patients.

Last, given Counseling Psychology's focus on the role of vocational psychology, the findings regarding disability and job inactivity in this population are especially important in this field. The findings do not speak to the causal relationship between inability to work and psychological sequelae, but it is known that depression and anxiety, combined with physical pain, can result in inability to work. By contrast, inability to work can lead to depression and anxiety. What is known from these findings is that a significant percentage of individuals receive disability compensation as a result of this syndrome. This provides an important implication for the role of counseling psychologists to examine whether alternate employment may be an option. Vocational counseling might be used to explore career and job options for individuals who have become physically and/or psychologically unable to work in their previous jobs.

#### Implications for Research

There is limited existing research on the psychological implications of CRPS. As such, this study provides a foundation for further exploration of the psychological factors and quality of life issues related to CRPS. Future research can expand upon these findings to further investigate the relationship between psychological distress and CRPS. In addition, future studies should specifically investigate the effectiveness of certain psychotherapeutic treatment modalities for improving quality of life among this population.

The present study demonstrated the severe psychological impact of CRPS on individuals. Past research has failed to determine whether CRPS patients differ from other pain patients on psychological variables through direct comparison. This study did not use a control group or other pain group from which to compare psychological variables. It did, however, find significant differences when those variables were

compared to normative data published on other types of medical or pain patients. Future research could include another pain population for more direct comparisons. This has been done in the past with mixed results. Some studies found CRPS patients have more psychopathology or psychological symptoms (Bruehl et al., 1996; Hardy & Merritt, 1988; Zucchini et al., 1989) while others show no differences when compared to various other pain groups (Haddock et al., 1988; DeGood et al., 1993; Marinus & Van Hilten; Shiri et al., 2003; Van der Laan et al., 1999). Future studies could use both control groups and normative data to make more convincing determinations about the unique psychological profile of CRPS patients and how that profile might be important for clinical understanding of the syndrome.

This study demonstrated that intrusive thoughts play a significant role in predicting disability and mental health quality of life. This finding sets the foundation for future research investigating the role of thoughts in the pain experience. First, the nature and content of the thoughts could be the focus of future research. This study only assessed whether individuals repeatedly think about their pain. How they interpret those thoughts could be investigated. Future research could further examine the appraisal of the pain experience and how those appraisals might be related to disability and quality of life.

Because intrusive thoughts have such a significant role in predicting important outcomes, it is suggested that thoughts be a target of psychotherapy when working with patients with CRPS. Future studies should assess the effectiveness of such an intervention. For example, studies might assess whether cognitive strategies aimed at reducing intrusive thoughts improve quality of life and reduce disability.

Because level of pain is such a subjective outcome measure, behaviorally anchored measures such as the ODQ and the SF-36 might be better targets for change in therapy and for evaluation in research. The ODQ is a behaviorally-based assessment of disability measured according to ability to participate in activities of daily living. The



SF-36 is a quality of life measure that assesses one's ability to engage in activities of life considered to enhance quality, such as social functioning, physical functioning, and role limitations. As mentioned previously, single measures of pain are difficult to compare across different pain conditions due to the varying nature of the pain sensations. The SF-MPQ, for example, is more sensitive to pain conditions that exhibit multiple sensory phenomena such as burning, aching, and throbbing. It is important that research use less subjective outcome measures and instead use ones that are more indicative of actual daily functioning, such as the ODQ or the SF-36.

### Conclusions

This study has demonstrated the significant impact CRPS can have on one's quality of life. It has shown that individuals suffering with this syndrome are not only severely impacted physically as demonstrated by levels of pain and decreased functionality, but also psychologically as demonstrated by significant levels of anxiety, depression, and poor quality of life. Furthermore, the role of intrusive thoughts in predicting both quality of life and physical disability suggests a mechanism by which clinicians may be able to intervene and provide improved quality of life, both mentally and physically. Based on the results presented in this study, it is suggested that early identification of the syndrome and assessment of psychological impact are important factors to consider in this population. These individuals suffer greatly and it is important that clinicians identify, through research and practice, ways to improve quality of life among this population.

## APPENDIX A

### INFORMED CONSENT

#### **Complex Regional Pain Syndrome and Quality of Life**

The following questions will ask you about your experience with complex regional pain syndrome (CRPS). Your answers will help researchers and clinicians better understand the experience of CRPS and how it affects quality of life.

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#### **Project Title: An Examination of the Psychosocial Profile of Patients with Complex Regional Pain Syndrome**

#### **Principal Investigator: Jessica Lohnberg**

We invite you to participate in a research study being conducted by investigators from The University of Iowa. The purpose of the study is to learn about how complex regional pain syndrome affects patients and their quality of life.

We are inviting you to participate in this research study because you have been diagnosed with complex regional pain syndrome (CRPS). Approximately 400 people will take part in this study at the University of Iowa.

If you agree to participate, we would like you to answer an online survey with questions about your health, activities, mood, feelings, and everyday life. You are free to skip any questions that you prefer not to answer. It will take approximately 20 minutes to complete the survey.

We will keep the information you provide confidential, however federal regulatory agencies and the University of Iowa Institutional Review Board (a committee that reviews and approves research studies) may inspect and copy records pertaining to this research. To help protect your confidentiality, we will not collect your name or any identifying information about you in the survey or on the website where you will complete the survey. It will not be possible to link you to your responses on the survey. We will use a secure web site to collect the study information. All responses collected will only be accessible to the research team members and will be stored on a password-protected computer. If we write a report or article about this study or share the study information with others, we will do so in such a way that you cannot be directly identified.

Because the questionnaires ask you about personal and health information, it is possible that you may feel uncomfortable answering some of the items. You are free to skip any questions that you would prefer not to answer. If you have any concerns about your responses to the questions, contact your physician to discuss your concerns.


You will be asked to provide information over the Internet. Information provided via the internet may be viewed by individuals who have access to the computers where the information is collected or stored. It is also possible that your responses could be viewed by unauthorized persons.

You will not benefit personally from being in this study. However we hope that others may benefit in the future from what we learn as a result of this study.

You will not have any costs for being in this research study. You will not be paid for being in this research study.

Taking part in this research study is completely voluntary. If you decide not to be in this study, or if you stop participating at any time, you won't be penalized or lose any benefits for which you otherwise qualify. If you do not wish to participate in this study, you do not have to proceed any further or you may close your web browser at any time without submitting the survey.

Please contact the principal investigator, Jessica Lohnberg, BA, at [jessica-lohnberg@uiowa.edu](mailto:jessica-lohnberg@uiowa.edu) with specific questions about this research or to report any research related problems.

If you have questions about the rights of research subjects, please contact the Human Subjects Office, 300 College of Medicine Administration Building, The University of Iowa, Iowa City, IA 52242,  (319) 335-6564 , or e-mail [irb@uiowa.edu](mailto:irb@uiowa.edu).

Thank you very much for your consideration of this research study. If you agree to complete the survey, please click "next page" which will indicate your consent to participate in this research.

## APPENDIX B

## DEMOGRAPHIC QUESTIONS

1) Are you over the age of 18 years old?

Yes  No

2) Please enter your date of birth:

Format: YYYY-MM-DD

3) Do you have any chronic pain condition other than complex regional pain syndrome?

Yes  No

4) Have you been diagnosed with either of the following by a physician?

	Yes	No
Complex regional pain syndrome - type I (Reflex sympathetic dystrophy)	<input type="radio"/>	<input type="radio"/>
Complex regional pain syndrome - type II (Causalgia)	<input type="radio"/>	<input type="radio"/>

5) What is your gender?

Male  
 Female

6) What is your ethnicity/racial group?

If you selected other, please specify:

7) Please indicate your marital status:

**8) How many children under the age of 18 do you currently have living at home?**

0
  1
  2
  3
  4
  5
  6
  7
  8
  9
  10

**9) Please indicate your employment status:**

If you selected other, please specify:

n:

**11) What is the highest level of education you have attained to date?**

- Below high school  
 Graduated high school  
 Some college  
 Bachelor's Degree  
 Graduate/Professional Degree

**12) What is your zip code?**

**13) Where is the site of your pain?**

	Left	Right
Arm	<input type="checkbox"/>	<input type="checkbox"/>
Hand	<input type="checkbox"/>	<input type="checkbox"/>
Leg	<input type="checkbox"/>	<input type="checkbox"/>
Foot	<input type="checkbox"/>	<input type="checkbox"/>
Head/Face	<input type="checkbox"/>	<input type="checkbox"/>
Torso	<input type="checkbox"/>	<input type="checkbox"/>

Additional comments:

**14) What was the precipitating event to your pain?**

- Sprain/strain
- Surgery
- Fracture
- Motor Vehicle Accident/Traumatic Accident/Injury
- IV/Injection
- Immobilization
- No Event
- Other (please specify)

If you selected other, please specify:

**15) Did the injury occur at work?**

- Yes
- No

**16) What was the approximate date of your diagnosis of complex regional pain syndrome? (If you do not know the day of the month, put 01 for DD)**

Format: YYYY-MM-DD

**17) Symptoms**

	Please indicate which symptoms you experienced following your injury or when you were first diagnosed with CRPS and which you currently experience:		Please indicate which of the following symptoms have been observed by a physician:	
	At Diagnosis	Currently	Yes	No
Pain/Burning Pain	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Extreme touch/Temperature sensitivity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Temperature changes at the pain site	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Discoloration at pain site	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sweating at pain site	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Swelling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pain with movement/Mechanical sensitivity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Limited range of motion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Excessive hair/nail growth	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**18) Which treatments have you tried?**

	Did not work at all	Provided minimal relief	Provided moderate relief	Very successful	Have not tried
Nerve Blocks	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Physical therapy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pain medication	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Psychotherapy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Biofeedback	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Spinal Cord Stimulator	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
TENS unit	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Acupuncture	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Topical Medication	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Injectable Medication	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Antidepressant Medication	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (Please indicate in comments field)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Additional comments:

**19) Have you been treated for any of the following conditions?**



	Yes	No
Fibromyalgia	<input type="radio"/>	<input type="radio"/>
Chronic Fatigue Syndrome	<input type="radio"/>	<input type="radio"/>
Anxiety Disorder	<input type="radio"/>	<input type="radio"/>
Depression	<input type="radio"/>	<input type="radio"/>
Bipolar Disorder	<input type="radio"/>	<input type="radio"/>
Emotional Problem	<input type="radio"/>	<input type="radio"/>
Posttraumatic Stress Disorder (PTSD)	<input type="radio"/>	<input type="radio"/>

**20) Before the age of 18 did you experience any of the following:**

	Yes	No
Death of a close friend/relative	<input type="radio"/>	<input type="radio"/>
Sexual abuse	<input type="radio"/>	<input type="radio"/>
Physical abuse	<input type="radio"/>	<input type="radio"/>
Emotional abuse	<input type="radio"/>	<input type="radio"/>
Car accident	<input type="radio"/>	<input type="radio"/>
Traumatic accident/Injury	<input type="radio"/>	<input type="radio"/>

**21) Have you been involved in any of the following associated with your current CRPS condition?**

	Yes	No
Litigation	<input type="radio"/>	<input type="radio"/>

Worker's Compensation	<input type="radio"/>	<input type="radio"/>
Disability (due to CRPS)	<input type="radio"/>	<input type="radio"/>

**22) Have you been satisfied with the treatment and management of your CRPS?**

Yes  No

Additional comments:

## REFERENCES

- Abramson, L. Y., Metalsky, G. I., & Alloy, L. B. (1989). Hopelessness depression: A theory-based subtype of depression. *Psychological Review*, *96*, 358-372.
- Allen, G., Galer, B. S., & Schwartz, L. (1999). Epidemiology of complex regional pain syndrome: A retrospective chart review of 134 patients. *Pain*, *80*, 539-544.
- Almay, B. G. (1989). Diagnosis of chronic pain syndromes. *Nord Psykiatr Tidsskr*, *43*, 15-23.
- American Psychiatric Association. (2000). Diagnostic and statistical manual of mental disorders: DSM-IV-TR. Washington, DC: Author. American Psychiatric Association. (1980). *Diagnostic and statistical manual of mental disorders*, 3rd. ed. Washington, DC: Author.
- Arrindel, W. A., & Ettema, H. (1981). The Dutch version of the symptom checklist (SCL-90). *Ned Tijdschr Psych*, *36*, 77-108.
- Baron, R., Levine, J. D., & Fields, H. L. (1999). Causalgia and reflex sympathetic dystrophy: Does the sympathetic nervous system contribute to the generation of pain? *Muscle & Nerve*, *22*, 678-695.
- Baron, R. & Wasner, G. (2001). Complex regional pain syndromes. *Current Pain and Headache Reports*, *5*, 114-123.
- Beck, A. T., Brown, G., Steer, R. A., Eidelson, J. I., Riskind, J. H. (1987). Differentiating anxiety and depression: A test of the cognitive content-specificity hypothesis. *Journal of Abnormal Psychology*, *96*, 179-183.
- Beck, A. T., Ward, C. H., Mendelson, M., Mock, J. E., & Erbaugh, J. K. (1961). An inventory for measuring depression. *Archives of General Psychiatry*, *4*, 561-571.
- Beerthuizen, A., van't Spijker, A., Huygen, F. J. P. M., Klein, J., & de Wit, R. (2009). Is there an association between psychological factors and the complex regional pain syndrome type 1 (CRPS1) in adults? A systematic review. *Pain*, *145*, 52-59.
- Borg, A. (1996). Reflex sympathetic dystrophy syndrome: Diagnosis and treatment. *Disability and Rehabilitation: An International Multidisciplinary Journal*, *18*, 174-180.
- Bruehl, S. (2001). Do psychological factors play a role in the onset and maintenance of CRPS-I? In R. N. Harden, R. Baron, & W. Jänig (Eds.), *Complex regional pain syndrome* (pp. 279-290). Seattle: IASP Press.
- Bruehl, S. (2009). Complex regional pain syndrome: Outcomes and subtypes. *Clinical Journal of Pain*, *25*, 598-599.
- Bruehl, S. & Carlson, C. R. (1992). Predisposing psychological factors in the development of reflex sympathetic dystrophy: A review of the empirical evidence. *Clinical Journal of Pain*, *8*, 287-299.

- Bruehl, S., & Chung, O. Y. (2006). Psychological and behavioral aspects of complex regional pain syndrome management. *Clinical Journal of Pain, 22*, 430-437.
- Bruehl, S., Husfeldt, B., Lubenow, T. R., Nath, H., & Ivankovich, A. D. (1996). Psychological differences between reflex sympathetic dystrophy and non-RSD chronic pain patients. *Pain, 67*, 107-114.
- Brunner, F., Lienhardt, S. B., Kissling, R. O., Bachmann, L. M., & Weber, U. (2008). Diagnostic criteria and follow-up parameters in complex regional pain syndrome type I – a Delphi survey. *European Journal of Pain, 12*, 48-52.
- Cleeland, C. S. (1990). Assessment of pain in cancer. *Advances in Pain Research and Therapy, 16*, 47.
- Covington, E. C. (1996). Psychological issues in reflex sympathetic dystrophy. In W. Jänig & M. Stanton-Hicks (Eds.), *Reflex sympathetic dystrophy: A reappraisal* (pp. 191-215). Seattle: IASP Press.
- Creamer, M., Bell, R., & Failla, S. (2003). Psychometric properties of the Impact of Event Scale—Revised. *Behaviour Research and Therapy, 41*, 1489-1496.
- DeGood, D. E., Cundiff, G. W., Adams, L. E., & Shutty, M. S., Jr. (1993). A psychosocial and behavioral comparison of reflex sympathetic dystrophy, low back pain, and headache patients. *Pain, 54*, 317-322.
- Derogatis, L. R. (1993). Brief Symptom Inventory: Administration, scoring, and procedures manual-II. Minneapolis, MN: National Computer Systems.
- Dersh, J., Polatin, P. B., & Gatchel, R. J. (2002). Chronic pain and psychopathology: Research findings and theoretical considerations. *Psychosomatic Medicine, 64*, 773-786.
- de Mos, M., de Bruijn, A. G. J., Huygen, F. J. P. M., Dieleman, J. P., Stricker, B. H. C., & Sturkenboom, M. C. J. M. (2007). The incidence of complex regional pain syndrome: A population-based study. *Pain, 129*, 12-20.
- de Mos, M., Huygen, F. J. P. M., Dieleman, J. P., Koopman, J. S. H. A., Stricker, B. H. Ch., & Sturkenboom, M. C. J. M. (2008). Medical history and the onset of complex regional pain syndrome (CRPS). *Pain, 139*, 458-466.
- de Mos, M., Huygen, F. J. P. M., van der Hoeven-Borgman, M., Dieleman, J. P., Stricker, B. H. Ch., & Sturkenboom, M. C. J. M. (2009). Outcome of the complex regional pain syndrome. *Clinical Journal of Pain, 25*, 590-597.
- de Mos, M., Sturkenboom, M. C. J. M., & Huygen, F. J. P. M. (2010). Current understandings on complex regional pain syndrome. *Pain Practice, 9*, 86-99.
- Dickenson, A. H. (2002). Gate control theory of pain stands the test of time. *British Journal of Anaesthesia, 88*, 755-757.
- Dijkstra, P. U., Groothoff, J. W., ten Duis, H. J., & Geertzen, J. H. B. (2003). Incidence of complex regional pain syndrome type I after fractures of the distal radius. *European Journal of Pain, 7*, 457-462.

- Dworkin, R. H., Nagasako, E. M., & Galer, B. S. (2001). Assessment of neuropathic pain. In D. C. Turk & R. Melzack (Eds.), *Handbook of pain assessment*, 2<sup>nd</sup> ed. (pp. 519-548). New York: Guilford Press.
- Engel, G. L. (1977). The need for a new medical model: A challenge for biomedicine. *Science*, 196, 129-136.
- Fairbanks, J. C. T., Couper, J., Davies, J. B., & O'Brien, J. P. (1980). The Oswestry Low Back Pain Disability Questionnaire, *Physiotherapy*, 66, 271-273.
- Feldman, S. I., Downey, G., & Schaffer-Neitz, R. (1999). Pain, negative mood, and perceived support in chronic pain patients: A daily diary study of people with reflex sympathetic dystrophy syndrome. *Journal of Consulting and Clinical Psychology*, 67, 776-785.
- Feliu, M. H., & Edwards, C. L. (2010). Psychologic factors in the development of complex regional pain syndrome: History, myth, and evidence. *Clinical Journal of Pain*, 26, 258-263.
- Fishbain, D. A., Cole, B., Cutler, R. B., Lewis, J., Rosomoff, H. L., & Rosomoff, R. S. (2006). Chronic pain and the measurement of personality: Do states influence traits? *Pain Medicine*, 7, 509-529.
- Fishbain, D. A., Goldberg, M., Meagher, B. R., Steele, R., & Rosomoff, H. (1986). Male and female chronic pain patients categorized by DSM-III psychiatric diagnostic criteria. *Pain*, 26, 181-197.
- Foelker, G. A., & Shewchuk, R. M. (1992). Somatic complaints and the CES-D. *Journal of the American Geriatrics Society*, 40, 259-262.
- Galer, B. S., Henderson, J., Perander, J., & Jensen, M. P. (2000). Course of symptoms and quality of life measurement in complex regional pain syndrome: A pilot survey. *Journal of Pain and Symptom Management*, 20, 286-292.
- Galer, B. S., Schwartz, L., & Allen, R. J. (2001). Complex regional pain syndromes—Type I: Reflex sympathetic dystrophy, and Type II: Causalgia. In J. D. Loeser, S. H. Butler, C. R. Chapman, & D. C. Turk (Eds.), *Bonica's management of pain* (3<sup>rd</sup> ed., pp. 388-411). Philadelphia: Lippincott Williams & Wilkins.
- Gatchel, R. J. (2001). A biopsychosocial overview of pretreatment screening of patients with pain. *The Clinical Journal of Pain*, 17, 192-199.
- Gatchel, R. J. (1991). Early development of physical and mental deconditioning in painful spinal disorders. In T. G. Mayer, V. Mooney, & R. J. Gatchel (Eds.), *Contemporary conservative care for painful spinal disorders* (pp.278-289). Philadelphia, PA: Lea & Febinger.
- Gatchel, R. J., & Dersh, J. (2002). Psychological disorders and chronic pain: Are there cause-and-effect relationships? In D. C. Turk & R. J. Gatchel (Eds.), *Psychological approaches to pain management: A practitioner's handbook* (2<sup>nd</sup> ed., pp. 30-51). New York: Guilford Press.

- Gatchel, R. J., & Weisberg, J. N. (2000). Introduction. In R. J. Gatchel & J. N. Weisberg (Eds.), *Personality characteristics of patients with pain* (pp. 3-22). Washington, DC: American Psychological Association.
- Geertzen, J. H. B., de Bruijn-Kofman, A. T., de Bruijn, H. P., van de Wiel, H. B. M., & Dijkstra, P. U. (1998). Stressful life events and psychological dysfunction in complex regional pain syndrome type I. *The Clinical Journal of Pain, 14*, 143-147.
- Grande, L. A., Loeser, J. D., Ozuna, J., Ashleigh, A., & Samii, A. (2004). Complex regional pain syndrome as a stress response. *Pain, 110*, 495-498.
- Gureje, O. (2007). Psychiatric aspects of pain. *Current Opinion in Psychiatry, 20*, 42-46.
- Haddox, J. D. (1990). Psychological aspects of reflex sympathetic dystrophy. In M. Stanton-Hicks (Ed.), *Pain and the sympathetic nervous system* (p. 207-224). Boston, MA: Kluwer Academic Publishers.
- Haddox, J. D., Abram, S. E., & Hopwood, M. H. (1988). Comparison of psychometric data in RSD and radiculopathy. *Regional Anesthesia, 13*, 27.
- Harden, R. N., Bruehl, S., Perez, R. S. G. M., Birklein, F., Marinus, J., Maihofner, C.,... Vatine, J. (2010). Validation of proposed diagnostic criteria (the "Budapest Criteria") for complex regional pain syndrome. *Pain, 150*, 268-274.
- Harden, R. N., Bruehl, S., Stanos, S., Brander, V., Chung, O. Y., Saltz, S., et al. (2003). Prospective examination of pain-related and psychological predictors of CRPS-like phenomena following total knee arthroplasty: A preliminary study. *Pain, 106*, 393-400.
- Harden, R. N., Bruehl, S., Stanton-Hicks, M., & Wilson, P. R. (2007). Proposed new diagnostic criteria for complex regional pain syndrome. *Pain Medicine, 8*, 326-331.
- Hardy, M. A., & Merritt, W. H. (1988). Psychological evaluation and pain assessment in patients with reflex sympathetic dystrophy. *Journal of Hand Therapy, 2*, 155-164.
- Horowitz, M., Wilner, N., & Alvarez, W. (1979). Impact of event scale: A measure of subjective stress. *Psychosomatic Medicine, 41*, 209-218.
- Hudak, P. L., Amadio, P. C., & Bombardier, C. (1996). Development of upper extremity outcome measure: The DASH (disabilities of the arm, shoulder, and hand). *American Journal of Industrial Medicine, 29*, 602-608.
- Ilgen, M. A., Zivin, K., McCammon, R. J., & Valenstein, M. (2008). Pain and suicidal thoughts, plans and attempts in the United States. *General Hospital Psychiatry, 30*, 521-527.
- Janig, W. (1996). The puzzle of "reflex sympathetic dystrophy": Mechanisms, hypotheses, open questions. In W. Janig & M. Stanton-Hicks (Eds.), *Reflex sympathetic dystrophy: A reappraisal* (pp. 1-24). Seattle, WA: IASP Press.
- Latham, J., & Davis, B. D. (1994). The socioeconomic impact of chronic pain. *Disability and Rehabilitation, 16*, 39-44.

- Lebovits, A. H., Yarmush, J., & Lefkowitz, M. (1990). Reflex sympathetic dystrophy and posttraumatic stress disorder: Multidisciplinary evaluation and treatment. *The Clinical Journal of Pain, 6*, 153-157.
- Lethem, J., Slade, P. D., Troup, J. D. G., & Bentley, G. (1983). Outline of a fear-avoidance model of exaggerated pain perception—I. *Behaviour Research and Therapy, 21*, 401-408.
- Lynch, M. E. (1992). Psychological aspects of reflex sympathetic dystrophy: A review of the adult and paediatric literature. *Pain, 49*, 337-347.
- Marinus, J., & Van Hilten, J. J. (2006). Clinical expression profiles of Complex Regional Pain Syndrome, Fibromyalgia, and a-specific Repetitive Strain Injury: More common denominators that pain? *Disability and Rehabilitation, 28*, 351-362.
- McDaniel, W. W. (2003). Electroconvulsive therapy in complex regional pain syndromes. *The Journal of ECT, 19*, 226-229.
- Melzack, R. (1975). The McGill Pain Questionnaire: Major properties and scoring methods. *Pain, 1*, 277-299.
- Melzack, R. (1987). The short form of the McGill Pain Questionnaire. *Pain, 30*, 191-197.
- Melzack, R. (1999). Pain and stress: A new perspective. In R. J. Gatchel & D. C. Turk (Eds.), *Psychosocial factors in pain: Critical perspectives* (pp. 89-106). New York: Guilford Press.
- Melzack, R., & Casey, K. L. (1968). Sensory, motivational and central control determinants of pain: A new conceptual model. In D. Kenshalo (Ed.), *The skin senses* (pp. 423-443). Springfield, IL: Thomas.
- Melzack, R., & Wall, P. D. (1965) Pain mechanisms: A new theory. *Science, 150*, 971-979.
- Merskey, H., & Bogduk, N. (Eds.). (1994). Classification of chronic pain: Descriptions of chronic pain syndromes and definitions of pain terms (2<sup>nd</sup> ed.). Seattle, WA: IASP Press.
- Merskey, H., & Spear, F. G. (1967). *Pain: Psychological and psychiatric aspects*. London: Bailliere, Tindall, & Cassell.
- Mishel, M. (1988). Uncertainty in illness. *Journal of Nursing Scholarship, 20*, 225-232.
- National Institute of Neurological Disorders and Stroke. (2008). NINDS complex regional pain syndrome information page. Retrieved November 3, 2008, from [http://www.ninds.nih.gov/disorders/reflex\\_sympathetic\\_dystrophy/reflex\\_sympathetic\\_dystrophy.htm](http://www.ninds.nih.gov/disorders/reflex_sympathetic_dystrophy/reflex_sympathetic_dystrophy.htm).
- Nelson, D. V. (2002). Treating patients with complex regional pain syndrome. In D. C. Turk & R. J. Gatchel (Eds.), *Psychological approaches to pain management: A practitioner's handbook* (2<sup>nd</sup> ed., pp. 470-488). New York: Guilford Press.
- Nelson, D. V., & Novy, D. M. (1996). Psychological characteristics of reflex sympathetic dystrophy versus myofascial pain syndromes. *Regional Anesthesia, 21*, 202-208.

- Ochoa, J. L. (1992). Reflex sympathetic dystrophy: A disease of medical understanding. *The Clinical Journal of Pain, 8*, 363-366.
- Pappagallo, M., & Rosenberg, A. D. (2001). Epidemiology, pathophysiology, and management of complex regional pain syndrome. *Pain Practice, 1*, 11-20.
- Piotrowski, C. (1998). Assessment of pain: A survey of practicing clinicians. *Perceptual and Motor Skills, 86*, 181-182.
- Piotrowski, C., & Lubin, B. (1990). Assessment practices of health psychologists: Survey of APA Division 38 clinicians. *Professional Psychology: Research and Practice, 21*, 99-106.
- Plutchik, R., & Conte, H. R. (1989). Self-report scales for the measurement of depression. *Psychiatric Annals, 19*, 367-371.
- Puchalski, P., & Zyluk, A. (2005). Complex regional pain syndrome type 1 after fractures of the distal radius: A prospective study of the role of psychological factors. *Journal of Hand Surgery [BR], 30*, 574-580.
- Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement, 1*, 385-401.
- Ramirez-Maestre, C., Esteve, R., & Lopez, A. E. (2007). Cognitive appraisal and coping in chronic pain patients. *European Journal of Pain, 12*, 749-756.
- Rauis, A. L. (1999). Psychological aspects: A series of 104 posttraumatic cases of reflex sympathetic dystrophy. *Acta Orthopaedica Belgica, 65*, 86-90.
- Roland, M., & Morris, R. (1983). A study of the natural history of back pain. Part I: Development of a reliable and sensitive measure of disability in low-back pain. *Spine, 8*, 141-144.
- Romano, J. M., & Turner, J. A. (1985). Chronic pain and depression: Does the evidence support a relationship? *Psychological Bulletin, 97*, 18-34.
- Rosenthal, A. K., & Keefe, F. J. (1983). The use of coping strategies in chronic low back pain patients: Relationships to patient characteristics and current adjustment. *Pain, 17*, 33-44.
- Sandroni, P., Benrud-Larson, L. M., McClelland, R. L., & Low, P. (2003). Complex regional pain syndrome type I: Incidence and prevalence in Olmsted county, a population-based study. *Pain, 103*, 199-207.
- Savaş, S., Baloğlu, H. H., Ay, G., & Cerçi, S. S. (2008). The effect of sequel symptoms and signs of Complex Regional Pain Syndrome type 1 on upper extremity disability and quality of life [Electronic version]. *Rheumatology International*. Retrieved November 23, 2008, from <http://www.springerlink.com.proxy.lib.uiowa.edu/content/101577/>
- Schlenk, E. A., Erlen, J. A., Dunbar-Jacob, J., McDowell, J., Engberg, S., Sereika, S. M., et al. (1998). Health-related quality of life in chronic disorders: A comparison across studies using the MOS SF-36. *Quality of Life Research, 7*, 57-65.



- Schwartzman, R. J., Erwin, K. L., & Alexander, G. M. (2009). The natural history of complex regional pain syndrome. *Clinical Journal of Pain, 25*, 273-280.
- Sharma, A., Agarwal, S., Broatch, J., & Raja, S. N. (2009). A web-based cross-sectional epidemiological survey of complex regional pain syndrome. *Regional Anesthesia and Pain, 34*, 110-115.
- Shiri, S., Tsenter, J., Livai, R., Schwartz, I., & Vatine, J. (2003). Similarities between the psychological profiles of complex regional pain syndrome and conversion disorder patients. *Journal of Clinical Psychology in Medical Settings, 10*, 193-199.
- Soo, H., Burney, S., & Basten, C. (2009). The role of rumination in affective distress in people with a chronic physical illness. *Journal of Health Psychology, 14*, 956-966.
- Spielberger, C. D., Gorusch, R. L., & Lushene, R. E. (1970). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press.
- Spielberger, C. D., Gorusch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the State-Trait Anxiety Inventory STAI (Form Y)*. Palo Alto, CA: Consulting Psychologists Press.
- Stanton-Hicks, M., Baron, R., Boas, R., Gordh, T., Harden, N., Hendler, N.,... Wilder, R. (1998). Complex regional pain syndromes: Guidelines for therapy. *Clinical Journal of Pain, 14*, 155-166.
- Stanton-Hicks, M., Jänig, W., Hassenbusch, S., Haddox, J. D., Boas, R., & Wilson, P. (1995). Reflex sympathetic dystrophy: Changing concepts and taxonomy. *Pain, 63*, 127-133.
- Steger, H. G., Bruehl, S., & Harden, R. N. (1999). Complex regional pain syndromes: An interdisciplinary perspective. In A. R. Block, E. F. Kremer, & E. Fernandez (Eds.), *Handbook of pain syndromes: Biopsychosocial perspectives* (pp. 321-347). Mahwah, NJ: Lawrence Erlbaum Associates Publishers.
- Strand, L. I., Ljunggren, A. E., Bogen, B., Ask, T., & Johnsen, T. B. (2008). The Short-Form McGill Pain Questionnaire as an outcome measure: Test-retest reliability and responsiveness to change. *European Journal of Pain, 12*, 917-925.
- Subbarao, J., & Stillwell, G. K. (1981). Reflex sympathetic dystrophy syndrome of the upper extremity: Analysis of total outcome of management of 125 cases. *Archives of Physical Medicine Rehabilitation, 62*, 549-554.
- Sullivan, M. J. L., Lynch, M. E., & Clark, A. J. (2005). Dimensions of catastrophic thinking associated with pain experience and disability in patients with neuropathic pain experience. *Pain, 113*, 310-315.
- Turk, D. C. (2002). A diathesis-stress model of chronic pain and disability following traumatic injury. *Pain Research and Management, 7*, 9-19.
- Turk, D. C., & Monarch, E. S. (2002). Biopsychosocial perspective on chronic pain. In D. C. Turk & R. J. Gatchel (Eds.), *Psychological approaches to pain management: A practitioner's handbook* (2<sup>nd</sup> ed., pp. 3-29). New York: Guilford Press.

- Turk, D. C., & Okifuji, A. (1994). Detecting depression in chronic pain patients: Adequacy of self-reports. *Behaviour Research and Therapy*, *32*, 9-16.
- Turner-Stokes, L. (2002). Reflex sympathetic dystrophy: A complex regional pain syndrome. *Disability and Rehabilitation: An International, Multidisciplinary Journal*, *24*, 939-947.
- Van der Laan, L., van Spaendonck, K., Horstink, M. W. I. M., & Goris, R. J. A. (1999). The symptom checklist-90 revised questionnaire: No psychological profiles in complex regional pain syndrome-dystonia. *Journal of pain and symptom management*, *17*, 357-362.
- Van Houdenhove, B. (1986). Neuro-algodystrophy: A psychiatrist's view. *Clinical Rheumatology*, *5*, 399-406.
- Van Houdenhove, B. (2000). Psychosocial stress and chronic pain. *European Journal of Pain*, *4*, 225-228.
- Van Houdenhove, B. (2003). Chronic fatigue syndrome, fibromyalgia, and complex regional pain syndrome type I. *Psychosomatics*, *44*, 173-174.
- Van Houdenhove, B., Vasquez, G., Onghena, P., Stans, L. Vandeput, C., Vermaut, G., et al. (1992). Etiopathogenesis of reflex sympathetic dystrophy: A review and biopsychosocial hypothesis. *The Clinical Journal of Pain*, *8*, 300-306.
- Veldman, P. H. J. M., Reynen, H. M., Arntz, I. E., & Goris, R. J. A. (1993). Signs and symptoms of reflex sympathetic dystrophy: Prospective study of 829 patients. *Lancet*, *342*, 1012-1016.
- Verbunt, J. A., Pernot, A. H. F. M., & Smeets, R. J. E. M. (2008). Disability and quality of life in patients with fibromyalgia [Electronic version]. *Health and Quality of Life Outcomes*, *6*, 1-8. Retrieved November 23, 2008, from <http://www.hqlo.com/content/6/1/8>
- Ware, J. E., & Kosinski, M. (2001). *SF-36 Physical & Mental Health Summary Scales: A Manual for Users of Version 1*. Second Edition. Lincoln, RI: QualityMetric Incorporated.
- Ware, J. E., & Sherbourne, C. D. (1992). The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Medical Care*, *30*, 473-483.
- Ware, J. E., Snow, K. K., Kosinski, M., & Gandek, B. (2000). *SF-36 Health Survey: Manual and interpretation guide*. Boston, MA: QualityMetric, Inc.
- Weisberg, J. N., & Keefe, F. J. (1999). Personality, individual differences, and psychopathology in chronic pain. In R. J. Gatchel & D. C. Turk (Eds.), *Psychosocial factors in pain: Critical perspectives* (pp. 56-73). New York: Guilford Press.
- Weiss, D. S., & Marmar, C. R. (1997). The Impact of Event Scale—Revised. In J. P. Wilson & T. M. Keane (Eds.), *Assessing psychological trauma and PTSD: A handbook for practitioners* (pp. 399-411). New York: Guilford Press.
- Weiss, W. U. (1994). Psychophysiologic aspects of reflex sympathetic dystrophy syndrome. *American Journal of Pain Management*, *4*, 67-72.

- Wittink, H., Turk, D. C., Carr, D. B., Sukiennik, A., & Rogers, W. (2004). Comparison of the redundancy, reliability, and responsiveness to change among SF-36, Oswestry Disability Index, and Multidimensional Pain Inventory, *Clinical Journal of Pain*, 20, 133-142.
- Wright, K. D., Asmundson, G. J. G., & McCreary, D. R. (2001). Factorial validity of the short-form McGill pain questionnaire (SF-MPQ). *European Journal of Pain*, 5, 279-284.
- Zimmerman, M. (2004). Basic physiology of pain perception. In S. Lautenbacher & R. B. Fillingim (Eds.), *Pathophysiology of pain perception* (pp. 1-24).
- Zucchini, M., Alberti, G., & Moretti, M. P. (1989). Algodystrophy and related psychological features. *Functional Neurology*, 4, 153-156.