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CHRONIC PAIN

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Introduction

Chronic pain is a common and debilitating problem. In the United States, an estimated 16 million adults experience chronic pain, with the most common source being low back pain (28%), followed by severe headache or migraine pain (14%), and neck pain (14%) (National Centers for Health Statistics, 2015). Conditions such as low back pain and migraine rank among the top 10 diseases and injuries that account for the highest number of disability-adjusted life years among adults globally (Vos et al., 2012). The incidence of chronic pain conditions is lower for children and adolescents than is seen in adults, although over the past several decades it has been rising (Haraldstad, Sørum, Eide, Natvig, & Helseth, 2011; King et al., 2011; Stanford, Chambers, Biesanz, & Chen, 2008). Each of these prevalence statistics are likely vast underestimates, as chronic pain is consistently underdiagnosed and undertreated (Institute of Medicine, 2011).

The high prevalence and disease burden associated with chronic pain translates into immense direct and indirect economic costs. Within the United States, chronic pain is estimated to cost between $560 and $635 billion annually in healthcare expenses, disease burden and lost productivity (Gaskin & Richard, 2012). This is a conservative estimate as excluded from these figures are pain-related healthcare costs among nursing home residents, children, military personnel, and persons who are incarcerated (Gaskin & Richard, 2012). To address the public healthcare crisis of chronic pain (Darnall et al., 2016; Institute of Medicine, 2011), it is necessary to advance both scientific understanding as well as treatment options.

In this chapter, chronic pain is first defined, and the prevailing theoretical frameworks for understanding pain discussed. Stemming from this conceptual understanding, the critical biopsychosocial risk and protective factors are outlined, and relevant research summarized. Finally, an overview of approaches to chronic pain management—with a focus on cognitive behavioral therapy (CBT)—is described. In the context of chronic pain, interdisciplinary pain management is the gold standard (Ehde, Dillworth, & Turner, 2014), and within this, health psychologists play a critical role.

Chronic Pain: Definitions and Theory

Pain is defined by the International Association for the Study of Pain (IASP) as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage” (IASP, 1994). Typically, acute pain is distinguished from chronic pain on the
basis of a temporal profile, with chronic pain referring to pain experienced at least half of the days of the past three or six months, depending on the definition (IASP, 1986; National Institutes of Health, 2011). In the context of pain arising from a specific injury (as opposed to arthritis, for example), the three- to six-month demarcation pertains to the time period that extends beyond the expected healing time associated with the initial injury (IASP, 1994). Other approaches to classify the transition from acute to chronic pain have focused on attempting to identify brain maps and biomarkers, with the argument made that it is exceedingly difficult to determine the end of the healing process (Apkarian, Baliki, & Geha, 2009; Apkarian, Hashmi, & Baliki, 2011). Despite the various perspectives and approaches to defining chronic pain, one aspect that is consistently agreed upon in the field is that chronic pain is complex and is inherently biopsychosocial in nature, as opposed to a purely biomedical phenomenon.

The Biomedical Model

Up until the 20th century, the prevailing understanding of pain was a biomedical perspective, which equated the amount of pain experienced with the amount of underlying tissue damage in a 1:1 relationship. This model originated in the 17th century with Descartes’ mind-body dualism philosophy that described pain in reductionistic, mechanistic, physical terms and relegated the brain as a passive recipient of peripherally generated pain signals. Within this framework, psychological and contextual social factors were viewed as irrelevant. However, by the middle of the 20th century, evidence began accumulating that refuted this understanding.

Arguably the most famous first documentation of such evidence was from Beecher’s reports as a physician in the US Army while treating soldiers and civilians during World War II: he noticed that although the injuries between soldiers and civilians were comparable, the civilians reported more pain and required more pain medication than the soldiers (Beecher, 1946). The purely biomedical perspective was inadequate to explain such differences. Beecher reported that a key differentiating factor appeared to be the meaning that was given to the pain: for the civilians, the injury often meant returning to a war-torn homeland with limited capacity to work, whereas for the soldiers, this was their ticket home! An abundance of empirical research has now accumulated to refute the biomedical conceptualization of pain, demonstrating that “verifiable” tissue damage is a poor predictor of the pain experience (e.g., Jensen et al., 1994; Keefe et al., 1987). The central role of multiple brain processes (including cognitive and emotion centers) in pain perception and experience is now well recognized, and the current most widely held conceptualization of pain is biopsychosocial in nature.

The Dynamic, Active Role of the Brain in Pain

Historically, the active role of the brain in pain was first formally recognized in Melzack and Wall’s Gate Control Theory, now known as the Neuromatrix Model of Pain (Melzack, 2001, 2005; Melzack & Wall, 1965, 1982). This framework identified the highly interconnected and dynamic neurological processes involved in the sensory experience of pain, and conceptualized pain from a multi-systems perspective. Specifically, the central tenet of this model theorized that pain was the result of the convergence of a complex interplay of neurophysiological pathways, thoughts, emotions, and behavioral processes. Over the ensuing decades that followed Melzack and Wall’s original Gate Control Theory, and with advancements in brain imaging technology, a large body of research now confirms the central role of the brain in actively processing pain and its perception.

A reliable and consistently documented account of pain has emerged from this scientific inquiry to show that multiple brain regions are most highly connected to the pain experience: (1) primary
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somatosensory cortex, associated with the sensory–discriminative aspects of pain; (2) secondary somatosensory cortex, involved in the recognition, learning, and memory of painful experiences; (3) limbic system, which is linked to the emotional processing of pain; (4) anterior cingulate cortex, responsible for the allocation of attentional resources to pain and processing of pain unpleasantness and motivational–motor aspects of pain; (5) insula, which is involved in processing information about one’s physical condition, autonomic reactions, and also possibly in relation to the affective aspects of pain-related learning and memory; and (6) prefrontal cortex, which governs general executive functions such as planning of complex responses to pain (Bantick et al., 2002; Jensen, 2010; Schnitzler & Ploner, 2000). Not only is pain complex (i.e., is the result of far more than purely the amount of tissue damage, as was proposed in the biomedical model), but also psychological processes have the capacity to actually shape the way painful stimuli are interpreted by the brain. This body of research broadened the points of intervention beyond the biomedical realm, and provided both convincing evidence as well as sound rationale for the application of psychosocial principles in the context of chronic pain.

Risk and Protective Factors

The risk for developing chronic pain, and for experiencing worsening pain-related outcomes over time, is not equivalent across demographic groups. A growing body of research has consistently documented the existence of pervasive health, treatment, and ethnicity disparities across a range of samples, settings, and types of chronic pain (Tait & Chibnall, 2005). Studies have shown that various intervening factors potentially influence the relationship between healthcare access, treatment, and outcome for individuals with pain; however, the most frequently recognized major stratification hierarchies are age, gender, race, rurality, and socioeconomic status (SES) (Day & Thorn, 2010). Further compounding the experience of chronic pain is common comorbid conditions such as depression and anxiety, and a number of other psychosocial factors that also increase the risk for poorer pain-related outcomes. However, a number of protective factors that enhance resiliency and coping have also importantly been identified.

Demographic Factors

Age. Although some research has questioned the linearity of the relationship between age and chronic pain, most population-based research has generally shown that while the risk for acute pain is highest in children, the risk for chronic pain increases with age (Bergman et al., 2001; Blyth et al. 2001; Ng, Tsui, & Chan, 2002; Thorn, 2017). The specific nature of these patterns varies across pain conditions, however, and there are a number of potential biopsychosocial contributing factors that may exacerbate risk, such as age-related changes in neuronal structure/function, sleep quality, and social support (see Fillingim (2017) for a review).

Given many developed countries have both longer life expectancies and an aging population coinciding with the baby boomer generation, this general age-related incidence pattern indicates rates (and costs) of chronic pain are expected to rise exponentially. The proportion of Americans aged ≥65 years is expected to increase by approximately 60% by the year 2035 (USA Social Security, 2017). This trend is mirrored in the most recent Australian Intergenerational Report (Australian Government, 2015) that projected the number of Australians aged ≥85 years will increase from 80,000 in 1974 to nearly 2 million in 2055. Within the context of already limited healthcare resources, these figures are particularly alarming and indicate a crucial need for advancement in the way pain is managed in order to meet the projected increased demand for pain-related intervention.
**Gender**

Across a variety of chronic pain conditions, research has shown that women are at greater risk than men not only in terms of higher incidence rates but also for worse outcomes, with women reporting pain of greater intensity, greater frequency, and longer duration than men (Fillingim, 2017; Nahin, 2015; Unruh, 1996). Some research suggests that women may have a biological vulnerability to pain as well as differential responsivity to pain medications, which is potentially related to sex hormone differences (Picavet, 2010). Although a traditional biomedical model perspective expounds a primarily physiologically focused base to explain sex differences on health outcomes (Hoffman & Tarzian, 2001), this perspective often minimizes the influence of potential mediating factors, which may include the psychosocial and cultural differences between men and women. For example, research investigating gender differences may actually reflect differences in the willingness to disclose details pertaining to the experience of pain and related symptom complaints, rather than differences in the experience of the pain itself (Klonoff, Landrine, & Brown, 1993). To date, we have a limited understanding of the mechanisms that potentially underlie the well documented gender disparities in the prevalence and experience of pain. However, a number of possible mechanisms have been theorized and empirically supported to various degrees, including potential sex-related differences in hormones, endogenous opioid function, cognitive and affective influences (e.g., pain catastrophizing, depression), and social factors, such as gender roles (Fillingim, 2017).

**Race/Ethnicity**

The relationship between pain and race is complex. While there is limited evidence to suggest racial differences in the prevalence of chronic pain, a large body of research has shown that racial influences remain important differentiating factors in the experience of pain (Fillingim, 2017; Nahin, 2015). The bulk of the research within this sphere has focused on the comparison of African American and White American individuals. Studies have shown that African Americans report greater pain sensitivity, emotional responses related to pain, pain unpleasantness, dysfunction related to pain, and pain behaviors in comparison to White Americans (Chibnall, Tait, Andreson, & Hadler, 2005; Edwards, Fillingim, & Keefe, 2001; Green, Ndao-Brumblay, Nagrant, Baker, & Rothman, 2004; Rahim-Williams, Riley, Williams, & Fillingim, 2012; Riley et al., 2002; Sanders et al., 1992), as well as greater pain intensity in acute clinical pain and in a variety of chronic pain conditions (Breitbart et al., 1996; Chibnall et al., 2005; Selim et al., 2001).

However, empirical evidence also suggests that members of minority groups may wait for more severe symptoms to develop before seeking treatment, are at greater risk for undertreatment, and also show differences in pain coping; these factors are consequently important to consider within the broader context of research investigating racial differences in clinical samples (Anderson, Green, & R. Payne, 2009; McCracken, Matthews, Tang, & Cuba, 2001; Pletcher, Kertesz, Kohn, & Gonzales, 2008). As further context, a disproportionate number of African American live in rural areas and minority groups on average tend to have lower SES—factors which have consistently been associated with worse pain outcomes (see below). Thus, although genetic contributions may play a role, evidence suggests that documented racial differences may be more strongly related to contextual factors rather than biological differences associated with race per se (Day & Thorn, 2010; Fillingim, 2017; Kington & Smith, 1997; McIlvane, 2007; Williams & Collins, 1995).

**Socioeconomic Status**

A vast amount of research confirms that socioeconomic circumstance is profoundly related to health status (see Chapter 21) (e.g., Berkman, 2009; Matthews & Gallo, 2011). SES represents a dynamic,
multidimensional construct, with typical indicants including educational achievement, income, and occupation level. One review documented a distinct inverse relationship between SES indicants and health dating back to the earliest of records, existing in all countries where it has been examined (Williams & Collins, 1995). Portenoy and colleagues found that the likelihood of experiencing disabling pain was predominantly associated with SES factors (Portenoy, Ugarte, & Fuller, 2004). Another study found that individuals with lower SES report not only more physical health problems such as chronic pain, but also that the disadvantages of lower SES accrue across the lifespan with these problems increasing in prevalence with advancing age (Miech & Shanahan, 2000). Moreover, health disparities stemming from low SES are deleteriously inflamed by the fact that access to services and treatment are contingent upon economic factors (Williams & Collins, 1995). Taken together, there is evidence that SES is a unique predictor of health, independent of other demographic factors (including age, sex, and race) and, as noted earlier, SES may explain previously reported differences in these factors (Chibnall et al., 2005; Kington & Smith, 1997; McIlvane, 2007).

Rurality

Rural health has become recognized as an important issue in the modern healthcare system, with rural residency found to be associated with a greater likelihood of having disabling chronic pain (Hoffman, Meier, & Council, 2002). There are a number of wide-ranging health-related disadvantages of living within a rural location, however one of the most critical is an overriding lack of access to (or isolation from) the healthcare and treatment resources that are typically readily available in urban populations (Day & Thorn, 2010). These general health disadvantages are compounded by the fact that underemployment, a term which denotes an array of employment hardships of the working poor, is always reported at a higher rate in nonmetropolitan areas (Jensen, Findeis, Hsu, & Schachter, 1999). Rural poverty rates are also much higher than urban poverty rates, in proportion to the population size (Flynt, 1996). Thus, there appears to be a number of treatment and financial disparities associated with living in rural communities which limits access to appropriate healthcare and pain management options.

Psychosocial Factors

A number of comorbid conditions are commonly reported that exacerbate chronic pain and negatively impact quality of life. Rates of comorbid depressive disorders among individuals with chronic pain are approximately 40–50% (Banks & Kerns, 1996; Dersh, Gatchel, Mayer, Polatin, & Temple, 2006; Romano & Turner, 1985); rates of suicide attempts are estimated between 5% and 14%, which translates to risk of death by suicide being at least doubled in individuals with chronic pain (Tang & Crane, 2006). Although epidemiological data on comorbid anxiety is lacking, one large–scale study of people with fibromyalgia, a chronic diffuse pain syndrome, reported approximately 44–51% endorsed substantial anxiety symptoms (Wolfe et al., 1990). Fear of pain, movement, and re-injury is common, and is particularly debilitating with these fear–related factors found to be stronger predictors of functional limitations than even pain severity, duration, or other biomedical factors (Crombez, Vlaeyen, & Heuts, 1999; Vlaeyen, Kole–Snijders, Rotteveel, Ruesink, & Heuts, 1995; Vlaeyen & Linton, 2000).

Epidemiological data also indicate that sleep disorders are particularly common among those with chronic pain, affecting an estimated 53–88% of individuals (Smith, Perlis, Smith, Giles, & Carmody, 2000; Tang, Wright, & Salkovskis, 2007; Wilson, Eriksson, D’Eon, Mikail, & Emery, 2002). Even when depression, anxiety, and other medical problems are controlled as covariates, there is a heightened risk for the development of insomnia among people with chronic pain (Taylor et al., 2007). It should be noted that some research suggests that the relation between sleep problems and chronic pain may be reciprocal (Smith & Haythornthwaite, 2004).
Pain-related catastrophizing has been shown to contribute to each of the aforementioned comorbid conditions (Byers, Lichstein, & Thorn, 2016; Quartana, Campbell, & Edwards, 2009; Vlaeyen & Linton, 2000). Indeed, pain catastrophizing, most often defined as an exaggerated negative mental set about actual or anticipated pain (Sullivan et al., 2001), is one of the most robust predictors of a range of poor pain-related outcomes. Pain catastrophizing significantly predicts higher pain severity, increased disability, poorer social functioning, longer recovery times following surgery, greater healthcare utilization, and worse mood, above and beyond other factors such as disease severity, pain intensity, anxiety, and neuroticism (see Quartana et al., 2009 for a review). Given its critical role across multiple domains of function, pain-related catastrophizing represents an important treatment target in the management of chronic pain (Thorn, 2017).

Equally as important as targeting risk factors is identifying factors that are protective and facilitate improved pain-related outcomes. Pain is often a particularly isolating experience, and social support may be a key protective factor associated with more rapid recovery from pain-related injuries, as well as enhanced adaptive psychological adjustment to chronic pain (Campbell, Wynne-Jones, & Dunn, 2011; Day et al., 2016; Steenstra, Verbeek, Heymans, & Bongers, 2005). One study found that the experience of positive emotions fostered recovery after pain flare-ups in both an arthritis as well as fibromyalgia sample (Zautra, Smith, Affleck, & Tennen, 2001); another study in a low back pain sample found subjective happiness was associated with improved general health perceptions (Takeyachi et al., 2003).

A number of adaptive cognitive domains also have been found to predict improved pain outcomes. A large body of research has focused on pain management self-efficacy—the conviction one can cope with and manage pain; findings have shown that self-efficacy plays a protective role in fostering adaptive physical and psychological adjustment to pain (e.g. Nicholas, 2007; Rudy, Lieber, Boston, Gourley, & Baysal, 2003). More recent research efforts have investigated the role of mindfulness and pain acceptance, and a rapidly building body of research is demonstrating the salutary effects of these constructs in relation to a range of pain-related outcomes (McCracken & Eccleston, 2003; McCracken, Vowels, & Eccleston, 2004; Schutze, Rees, Preece, & Schutze, 2010).

Chronic Pain Management

One of the most commonly prescribed treatments for chronic pain is opioid analgesic medication; however, opioid abuse has now been termed an “opioid epidemic” (Institute of Medicine, 2011; National Institutes of Health, 2011). Between 1999 and 2010, there was a 300% increase in the consumption of opioids, and death rates for drug poisoning involving opioid analgesics more than tripled, resulting in more than 16,000 opioid-involved overdose deaths in 2010 (National Centers for Health Statistics, 2015; National Institutes of Health, 2011). Despite their widespread use and lethal consequences, the long-term use of pain-relieving drugs such as opioids is often associated with minimal pain relief (Trescot et al., 2008), while creating negative side effects including tolerance effects, abuse, and physical dependence (Dart et al., 2015).

Research evidence shows that psychosocial approaches are at least as effective as medically based treatments such as surgery and medication management (Eccleston, Palermo, Williams, Lewandowski, & Morley, 2009; Morley & Williams, 2015). However, there is a general lack of awareness in both stakeholders and the general public alike of how effective and important these approaches are in treating and managing chronic pain (Darnall et al., 2016). Although a number of psychosocial treatments have demonstrated efficacy in the context of chronic pain (Day, 2017; Jensen, 2009; Kabat-Zinn, 2013; McCracken & Vowles, 2014), the largest breadth and depth of evidence supports cognitive behavioral therapy (CBT). Thus, the remaining focus in this chapter will be on describing the application, evidence, and mechanisms of action underlying CBT, which is based on a biopsychosocial framework.
Cognitive Behavioral Therapy (CBT)

CBT was first applied to the problem of chronic pain in the early 1980s (Kerns, Turk, Holzman, & Rudy, 1986; Turner, 1982; Turner & Clancy, 1988), and over three decades and a plethora of research later, it has been shown to be an efficacious approach across a range of various pain types (Ehde et al., 2014). A large number of randomized controlled trials (RCTs), meta-analyses, and systematic reviews have shown support for the efficacy of CBT, predominantly in adult populations with a primary pain type of chronic back pain, headache, orofacial pain, or arthritis-related pain (Aggarwal et al., 2011; Andrasik, 2007; Eccleston et al., 2009; Ehde et al., 2014; Hoffman, Papas, Chatkoff, & Kerns, 2007; Williams, Eccleston, & Morley, 2012). There is also strong evidence for the efficacy of CBT in child and adolescent samples as well as other pain conditions, such as cancer (Ehde et al., 2014). However, a systematic review reports that the application of CBT for neuropathic pain (i.e., pain caused by a lesion or disease of the somatosensory nervous system) is currently not supported (Eccleston, Hearn, & Williams, 2015).

The most consistently reported benefits of CBT include short- and long-term improvements in pain intensity, interference in daily activities due to pain, mood, physical function, and disability, as well as less pain catastrophizing (Aggarwal et al., 2011; Andrasik, 2007; Eccleston et al., 2009; Ehde et al., 2014; Hoffman et al., 2007; Williams et al., 2012). Although research investigating the mechanisms underlying these effects has lagged behind the research documenting efficacy, evidence suggests that change in pain-related cognitions such as pain catastrophizing may be particularly important (e.g., Burns, Day, & Thorn, 2012; Thorn et al., 2007; Turner, Holtzman, & Mancl, 2007). Indeed, research indicates that such cognitive change may be a critical mechanism underlying the effectiveness of a range of effective chronic pain treatment approaches (e.g. Turner et al., 2016).

Compared to traditional biomedical interventions, CBT is relatively cost-effective. For example, one study, using Medicare reimbursement rates, examined the costs of a 10-session, group delivered CBT program to those of a typical lumbar spinal fusion surgery and found that the surgical costs were 168 times greater than the costs of delivering CBT (Bruns, Mueller, & Warren, 2012). Not only does the inclusion of CBT potentially result in reduced medical costs, but a study conducted within a chronic low back pain sample has shown that compared to standard inpatient rehabilitation without CBT, adding a CBT component resulted in reduced work absenteeism six months following the program (Schweikert et al., 2006). The inclusion of CBT to an outpatient active management advisor consultation, as compared to consultation alone, resulted in sustained benefit over a one-year period in pain-related disability, at low cost to the healthcare provider (Lamb et al., 2010). Thus, there is strong evidence supporting both the effectiveness as well as cost-effectiveness of CBT for chronic pain conditions.

Conclusion

Rates of chronic pain and comorbid conditions (including depression, opioid addiction, and others) are on the rise globally, with risks disproportionately distributed across a number of demographic stratifications. We now know with conviction that the experience of chronic pain is intimately linked to supraspinal cortical activity and processes, and is influenced by the convergence of a multitude of highly interconnected biological, psychological, and social factors. Thus, effective treatment can intervene at any one of these levels, and will ideally target multiple contributing factors, as is the case with the gold standard interdisciplinary pain management approach. The evidence supporting the efficacy and cost-effectiveness of CBT for a range of chronic pain conditions has continued to increase exponentially over the past three decades, and evidence for approaches based on mindfulness and acceptance principles is also rapidly accumulating.
Relatively less is known about the underlying mechanisms of these approaches, which is an important gap to address in future research. Gaining this mechanism knowledge will ultimately afford the capacity to streamline intervention packages to distill them down to the most powerfully active ingredients, as well as lead to the development of algorithms to match patient profiles to the treatment approach that will efficiently optimize clinically meaningful benefit for a given individual. There is a critical need to address health and treatment disparities, and to advance both chronic pain preventative efforts as well as management approaches in order to optimize quality of life, functioning, and well-being, despite the pain.

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