PAIN IN THE CIVILIAN AND MILITARY WORKPLACE

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ABSTRACT

Acute and chronic pain affects more Americans than heart disease, diabetes, and cancer combined. Conservative estimates suggest the total economic cost of pain in the United States is $600 billion, and more than half of this cost is due to lost productivity, such as absenteeism, presenteeism, and turnover. In addition, an escalating opioid epidemic in the United States and abroad spurred by a lack of safe and effective pain management has magnified challenges to address pain in the workforce, particularly the military. Thus, it is imperative to investigate the organizational antecedents and consequences of pain and prescription opioid misuse (POM). This chapter provides a brief introduction to pain processing and the biopsychosocial model of pain, emphasizing the relationship between stress, emotional well-being, and pain in the military workforce. We review personal and organizational risk and protective factors for pain, such as post-traumatic stress disorder, optimism, perceived organizational support, and job strain. Further, we discuss the potential adverse impact of pain on organizational outcomes, the rise of POM in military personnel, and risk factors for POM in civilian and military populations. Lastly, we propose potential organizational interventions to mitigate pain and provide the future directions for work, stress, and pain research.

Keywords: Pain; stress; military; protective factors; PTSD; opioid

Pain is the most expensive medical condition in the United States (Gaskin & Richard, 2012; Institute of Medicine Committee on Advancing Pain Research & Education, 2011). At an annual cost between $560 and $635 billion, pain costs...
more than the combined cost for heart disease ($309 billion) and cancer ($243 billion) (Gaskin & Richard, 2012). Furthermore, the cost of lost work productivity associated with pain ($299–335 billion), not medical treatment, has the greatest economic impact.

Most of the early investigations into the impact of pain on lost productivity focused on absenteeism (Blyth, March, Nicholas, & Cousins, 2003). However, mounting evidence suggests reduced productivity at work due to chronic pain, or presenteeism, has a much larger impact on overall work effectiveness than absenteeism (Blyth et al., 2003; Gaskin & Richard, 2012; Leeuwen, Blyth, March, Nicholas, & Cousins, 2006; Pohling, Buruck, Jungbauer, & Leiter, 2016). Chronic pain may impact productivity in direct and obvious ways, such as limiting physical activity or interfering with attention. Or, it may indirectly reduce work productivity by decreasing emotional well-being, given prior work suggests that poor emotional well-being is associated with detriments in job performance (Adler et al., 2006). Although investigation into the avenues through which chronic pain influences presenteeism, absenteeism, and other organizational outcomes is still in its infancy, a few recent studies have begun investigating these mechanisms (Byrne & Hochwarter, 2006; Christian, Eisenkraft, & Kapadia, 2015; Ferris, Rogers, Blass, & Hochwarter, 2009).

Pain is a dynamic process influenced by biological, psychological, and social factors (Edwards, Dworkin, Sullivan, Turk, & Wasan, 2016; Gatchel, Peng, Peters, Fuchs, & Turk, 2007). Biological factors (e.g., biomechanical stress) undoubtedly impact pain conditions, but biological factors alone have proven to be poor predictors of pain and disability, particularly in chronic conditions. Decades of clinical and experimental pain research strongly suggests that emotional well-being influences pain processing. In addition, prior work suggests organizational factors (e.g., occupational stress, leadership, and job demands) affect emotional well-being (Harms, Krasikova, Vanhove, Herian, & Lester, 2013; Tetrick & Winslow, 2015). Thus, organizational factors which impact emotional well-being may also indirectly impact pain.

The military provides an ideal population to study the biopsychosocial model of pain as it relates to the work environment for three primary reasons: (1) serving in the military is commonly associated with heavy physical demands and elevated risks for musculoskeletal injuries; (2) consistently rated as one of the most stressful occupations, military personnel are vulnerable to determinants in emotional well-being and psychological functioning, such as post-traumatic stress disorder (PTSD) and depression; and (3) prescription opioid misuse (POM) in current and former military service members has risen dramatically in recent years and may be associated with physical and psychosocial work hazards.

**DYNAMICS OF PAIN**

Pain is an unpleasant subjective sensory and affective experience influenced by biological, psychological, and social factors (Edwards et al., 2016; Staud, 2012;
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Woolf, 2010). Although commonly seen as nuisance, perception of pain is an adaptive function essential for survival. This is evident in patients who frequently injure themselves unintentionally, develop infections, and even die due to medical conditions which cause deficits in pain perception. In contrast, chronic pain patients suffer from severe and intractable pain that can last for months, years, or even decades (Gatchel et al., 2007). This can lead to significant decrease in physical, psychological, and social functioning. Patients with chronic pain often become disabled and unable to work, which furthers the distress associated with chronic pain.

Pain was initially viewed by medical professionals as a symptom of actual or potential tissue injury proportional to the degree of injury or noxious stimulation (Edwards et al., 2016; Gatchel et al., 2007). Early experimental research discovered pain receptor fields and pathways which activated and elicited pain when stimulated with various noxious stimuli (Melzack, 1996). Although pain pathways have biological underpinnings (e.g., pain receptors and sensory neurons), cognitive and effective brain processes modulate and influence the culminated pain experience (Garcia-Larrea & Peyron, 2013). Beecher (1946) first noticed the discrepancy between injury and pain when treating World War II soldiers. Despite suffering severe physical trauma on the battlefield, many soldiers reported little or no pain and required relatively low levels of pain medication. This was in stark contrast to military patients he treated in domestic clinics who required greater pain medication for lesser injuries. Thus, he surmised that additional contextual mechanisms must also influence pain perception.

Melzack and Wall (1965) supported Beecher’s speculation with their Gate-Control Theory of Pain. While this theory has since been amended and elaborated upon (see Staud, 2012), it posited that additional mechanisms modulate pain at the level of the spinal cord. Input from other neurons in the peripheral and central nervous system could either open or close the gate (i.e., activate or block spinal transmission neurons). An open gate would transmit nociceptive signals to the brain and a closed gate would prevent transmission. Thus, activation of nociceptive fibers in the peripheral nervous systems may or may not translate to conscious pain perception (Staud, 2012).

From an evolutionary perspective, pain modulation is an adaptive trait (Staud, 2012). When trying to fight or escape from a predator, it may be advantageous to inhibit pain, since immediate survival takes precedence over tending to tissue damage. In contrast, facilitating pain to heal and avoid further tissue damage may be more advantageous after the passing of threat. Thus, the context in which pain occurs influences the perception and evaluation of pain and, in turn, directs behavior. Psychological factors (e.g., attention and emotion) and social factors (e.g., social support and work stress) associated with pain modulation will be discussed in subsequent sections (Edwards et al., 2016).

Classification of Pain

Pain can be categorized in different ways, such as duration and body site, but the most concise way to conceptualize pain may be by a mechanism-based
classification system (Loeser & Melzack, 1999; Woolf, 2010). In this respect, pain can be separated into three categories: nociceptive (transient), acute (inflammatory), and chronic (pathological). The antecedents and consequences of each type of pain vary, and biopsychosocial factors influence all types of pain. Pain that progresses into a chronic state appears to be strongly influenced by psychological and social factors (Gatchel et al., 2007).

Nociceptive Pain
Nociceptive pain is the immediate and overwhelming pain associated with intense noxious stimuli, such as heat, cold, pressure, or chemical (Woolf, 2010). Nociceptive pain is transmitted through a series of neurons that stretches from sensory receptors (nociceptors) in tissue to transmission neurons in the spinal cord and ultimately to a matrix of multiple brain centers, collectively known as the pain matrix (Garcia-Larrea & Peyron, 2013). Garcia-Larrea and Peyron (2013) conceptualize the pain matrix as a composite of three interdependent neural networks and their psychological correlates: the nociceptive, perceptive-attentional, and reappraisal-emotional networks.

The nociceptive network, or sensory-discriminative network, conveys the location and intensity of the stimulus and is associated primarily with increased activation in the somatosensory cortex of the brain. Stimulation of the nociceptive network alone does not elicit pain and is not associated with the unpleasantness or emotional response to pain. Conscious perception of pain is dependent on integration of noxious stimuli by the second-order perceptive-attentional network. Initial cognitive evaluation, appraisal, and modulation of pain are also associated with activation in the perceptive-attentional network. This network, which is also activated during other cognitive and effective processes independent of pain, conveys the unpleasant emotional experience of pain.

The third-order level of pain processing occurs in the reappraisal-emotional network of the pain matrix. This network involves higher-level cognitive processing which attaches meaning and consequence to pain, draws on previous pain experiences, and is heavily involved in descending modulation of nociceptive signals. Emotional and attentional modulations are important characteristics of the pain experience and underpin many of the risk and protective factors (e.g., depression and mindfulness) associated with chronic pain. The impact of cognitive and effective processes on pain perception will be discussed further in subsequent sections.

Acute Pain
Acute pain is pain which results from tissue damage and is normal part of the healing process (Gatchel et al., 2007; Woolf, 2010). After tissue damage, a cascade of inflammatory responses results in restructuring of the cellular membrane of nociceptive fibers around the injury site (Woolf, 2010). In addition, prolonged stimulation of nociceptors causes local molecular changes, such as release of substance P (Besson, 1999). Together these structural and molecular changes
lower the activation threshold for noxious stimuli and increase the rate of firing. Increased input to transmission neurons in the spinal cords from nociceptive neurons induces similar changes in cellular structure and excitability of transmission neurons. Previously innocuous sensory stimuli, such as mild pressure or heat, become more likely to elicit pain. In non-pathological states, the structure and function of the pain pathway returns to its original state after the affected tissue heals, and medical treatment for pain is no longer needed.

**Chronic Pain**

Pain that persists after the normal healing process (typically no greater than three months) is considered chronic (Gatchel et al., 2007). Chronic pain disorders include a multitude of medical conditions with different etiology, mechanisms, symptoms, and treatment strategies. Osteoarthritis, rheumatoid arthritis, chronic musculoskeletal pain (e.g., low back pain, neck pain, and wrist pain), phantom limb pain, chronic headache, irritable bowel syndrome, and fibromyalgia are examples of chronic pain conditions (Lumley et al., 2011). Furthermore, it is common for patients to suffer from more than one chronic pain conditions at a time. In military populations, the most prevalent and germane forms of chronic pain tend to be musculoskeletal pain, osteoarthritis, and phantom limb pain.

The etiology of chronic pain is significantly more complex than nociceptive or inflammatory pain, and biomedical models have been less effective in treating chronic pain (Gatchel et al., 2007; Turk, Fillingim, Ohrbach, & Patel, 2016). Psychological and sociocultural factors have greater influence in chronic pain conditions. In some cases, no precipitating anatomical abnormality, such as a herniated intervertebral disc or damaged cartilage, can be identified (Beattie, Meyers, Stratford, Millard, & Hollenberg, 2000). Furthermore, anatomical abnormalities are not strongly correlated with patient ratings of pain severity or life dysfunction (Staud, 2012). For example, some patients with severely damaged intervertebral discs report no back pain, while others report severe back pain without disc damage or any other identifiable abnormality (Beattie et al., 2000). In other words, injury is often not directly associated with the extent of symptoms (Staud, 2012). Furthermore, surgery to correct an anatomical abnormality frequently fails to alleviate pain (Chan & Peng, 2011). In fact, conservative estimates suggest 20% of spinal surgeries fail to significantly reduce pain and improve function. Thus, the connection between stimulus, physiology, and pain is more complex in chronic pain than nociceptive or inflammatory pain.

**BIOPSYCHOSOCIAL MODEL OF ACUTE AND CHRONIC PAIN**

Determining the occupational risk factors of acute or chronic pain as well as developing prevention and treatment methods requires a multifactorial model. The biopsychosocial model of pain encompasses physiological correlates of pain (i.e., potential or actual damage to the body) with psychological and social constructs
associated with pain (Edwards et al., 2016; Gatchel et al., 2007). Physiological factors associated with pain in the workplace include strains, sprains, stress fractures, degenerative disc disease, spinal stenosis (narrowing of the spinal canal), and joint degeneration (Bartynski, 2009; Bernard, 1997; Kumar, 2001; Neogi, 2013). While other occupational injuries incite pain (e.g., lacerations, burns, and abrasions), our review of biological risk factors will focus on musculoskeletal injury, since it is the most common type of non-fatal occupational injury in the civilian and military workforce (Bernard, 1997; Hauret, Jones, Bullock, Canham-Chervak, & Canada, 2010; Ruscio et al., 2010). Psychosocial factors include attention and memory, mood, emotion, job stress, and social support (Edwards et al., 2016; Garcia-Larrea & Peyron, 2013).

**Biological Risk Factors**

Injuries to the musculoskeletal system may be acute or have a chronic progression (Kumar, 2001). Acute musculoskeletal injuries are associated with a specific and discernable incident, such as overexertion, slip and fall, crushing, laceration, etc., in which excessive biomechanical stress leads to rapid structural failure of muscles, ligaments, bones, tendons, or other musculoskeletal components (Coenen, Kingma, Boot, Bongers, & van Dieën, 2014; Hauret et al., 2010; Kumar, 2001). In contrast, musculoskeletal disorder (MSD) may develop from damage to musculoskeletal tissue that occurs gradually through repeated and cumulative exposure to smaller biomechanical stressor, or micro-trauma (tendonitis, lumbar disc degeneration, carpal tunnel syndrome; Bernard, 1997; Coenen et al., 2014; Forde, Punnett, & Wegman, 2002). A systematic review of work-related MSD risk factors in the civilian workforce identified multiple biomechanical risk factors, such as heavy physical work, awkward posture, frequent lifting, and repetitive work, although the risk factors may vary according the type of MSD (da Costa & Vieira, 2010). In some occupations, biomechanical factors associated with work were related to approximately 50% of hospitalizations due to lumbar disc disease, a type of back injury (Wahlström, Burström, Nilsson, & Järvelom, 2012). Prior work suggests that firefighters, nurses, and bus drivers have elevated rates of MSD, which may be related to biomechanical risk factors encountered in these occupations (Bernard, 1997).

*Injury in the Military*

Few occupations are as physically demanding or as potentially dangerous as serving in the military. At a minimum, all military personnel must participate in physical training and maintain a moderate level of physical fitness. However, many occupations within the military require heavy physical work. Thus, personnel are exposed to multiple biomechanical risk factors. In addition, service members engaged in combat operations may be wounded in battle and suffer severe musculoskeletal trauma. Although the prevalence of blast injuries suffered in battle by military personnel are not observed in the civilian workforce, police officers and other first-responders may also encounter comparable violence and injury.
Non-Battle Injury. In 2006, there were over 743,000 injury-related musculoskeletal conditions among non-deployed, active duty military personnel, with a rate of 628 injuries per 1,000 person-years (Hauret et al., 2010). Inflammation and pain (overuse) accounted for 82% of injury-related musculoskeletal conditions, including both acute and chronic. Regarding body site, lower extremity overuse injuries were most common, such as stress fractures, Achilles tendonitis, and plantar fasciitis. Most musculoskeletal injuries in the military parallel civilian work populations – falls, trips and slips, repetitive movement, and over-exertion. These injuries occur during exercise, road marching, hiking, while entering or exiting a vehicle, and mounting or climbing an object (Anderson, Grier, Canham-Chervak, Bushman, & Jones, 2015; Ruscio et al., 2010). Owing to high standards of physical fitness, military personnel experience high rates of overuse injury resulting from physical training (i.e., exercise), which are commonly observed in sports medicine but less frequently in most civilian occupations (Bernard, 1997; Hauret et al., 2010; Lauder, Baker, Smith, & Lincoln, 2000). Unfortunately, injuries because of overuse and overexertion are unavoidable given the strenuous weight-bearing physical activities required of service members (Jones, Canham-Chervak, Canada, Mitchener, & Moore, 2010). Although motor vehicle accidents are a common reason for all-cause injury, these injuries most commonly occur off-duty in privately owned motor vehicles. Thus, the motor vehicle accidents that occurred at work were responsible for only a small portion of the total injury burden.

Battle Injury. Battle injuries are significantly less common than non-battle injuries (Cohen, Griffith, Larkin, Villena, & Larkin, 2005). However, injuries suffered during battle can cause severe physical trauma (Geiling, Rosen, & Edwards, 2012). The nature of enemy combat tactics as well as advances in medical technology and personal protective equipment has led to an increased rate of survival from injuries which would have been fatal in previous wars (Geiling et al., 2012). For instance, the ratio of wounded versus dead service members was 8.2 in Operation Enduring Freedom (OEF) and 7.2 in Operation Iraqi Freedom (OIF) compared to just 2.3 in World War II and 3.2 in Vietnam war. Although service members injured in OEF and OIF may survive such severe injuries, these wounded veterans face significant physical and psychological challenges on the path to recovery.

There has been a proliferation in the use of improvised explosive devices (IEDs; e.g., car, roadside, and suicide bombs) by enemy combatants during OIF and OEF. The rise in IED attacks has pertinent implications on health outcomes (Clark, Walker, Gironda, & Scholten, 2009; Cohen et al., 2005; Geiling et al., 2012; Lew et al., 2009). Explosive blast and projectiles from IEDs typically have a different profile than traditional battlefield wounds, such as gunshot. IED injuries are associated with a combination of trauma types (e.g., soft tissue injury, fracture, burn, and concussion) to multiple body sites, also known as polytraumatic injury (Clark et al., 2009; Lew et al., 2009). Individuals with blast injuries have significantly higher rates of amputation, penetrating head injury, and psychiatric diagnosis compared to non-blast or non-battle injury (Clark et al., 2009). In a sample of 29 spinal injury patients from OIF, over 90% of the injuries were caused by
IEDs (Cohen et al., 2005). In comparison, only one spinal injury was a result of a gunshot wound, the most common source of spinal cord injury in prior conflicts. The 7.4% incidence of spine injuries in a study of OIF soldiers was higher than any previous American military conflict in 60 years. Prior work reported service members injured by blasts received two to four times the prescription opioid (PO) pain medication dosage compared to other injuries upon admission to the hospital, and they continued to have significantly higher opioid dosage at discharge (Clark et al., 2009). These veterans may also face multiple surgeries, prolonged hospitalization, and long-term rehabilitation (Geiling et al., 2012).

**Psychosocial Factors**

**Pain and Emotion**

As we have emphasized thus far, pain is not simply a sensory experience. Pain is an aversive experience which motivates behaviors intended to protect against tissue damage and promote survival (Navratilova & Porreca, 2014; Rhudy, 2015). By eliciting an unpleasant emotional experience, pain motivates immediate withdrawal and avoidance of noxious stimuli. Furthermore, pain facilitates learning and reinforces future behavior that avoids identical or similar painful stimuli. In addition, relief from pain reduces negative effect and increases positive effect via the dopaminergic reward system, further reinforcing avoidance learning.

The relationship between pain and emotion is also bidirectional (Rhudy, 2015). Thus, emotions can influence pain perception as well by facilitating (i.e., enhancing) or inhibiting pain. In general, negative emotions facilitate pain and positive emotions inhibit pain (Rhudy, 2015; Rhudy et al., 2010). Rhudy et al. (2010) exposed participants to the International Affective Picture System (IAPS) and found that showing participants unpleasant pictures increased sensitivity to experimental pain (i.e., pain facilitation), while showing participants pleasant pictures decreased pain sensitivity (i.e., pain inhibition). Furthermore, the degree of pain inhibition or facilitation is commensurate with the arousal elicited by emotion. The most unpleasant pictures in the IAPS (mutilated bodies) elicited the greatest pain facilitation, and the most pleasant pictures (erotica) elicited the greatest pain inhibition. However, this dynamics may be altered in cases of extremely high unpleasant emotional arousal, such as a life-threatening situation or phobic response (Rhudy, 2015). Highly unpleasant emotional states may lead to dramatic inhibition of pain, which most likely evolved to enhance fighting or evasion behaviors during threatening situations. In contrast, no prior research suggests that any level of pleasant emotional arousal is associated with pain facilitation.

The association between emotion and pain is essential to motivating avoidance behavior and ensuring survival. However, the reciprocal ability of emotional states to modulate pain also makes the pain system vulnerable to dysfunctional emotional processing and may lead to exaggerated pain facilitation, as observed in chronic pain conditions (Bushnell, Ceko, & Low, 2013 Edwards et al., 2016). On the other hand, positive emotional styles may protect individuals against biological and social vulnerabilities to chronic pain by inhibiting pain (Edwards et al., 2016; Goodin et al., 2013).
Psychosocial Risk and Protective Factors

Psychosocial risk factors for chronic pain do not necessarily incite acute or chronic pain (Lumley et al., 2011). However, they may modify pain processes (e.g., central sensitization) and contribute to the transition from acute to persistent pain following initial physical insult (Lumley et al., 2011; Tracey, 2010). Many psychosocial risk factors have been identified (Edwards et al., 2016; Gatchel et al., 2007; Turk et al., 2016). Psychological risk factors include persistent mood disorders, such as depression and PTSD, as well as other maladaptive psychological schema associated with chronic pain, such as pain catastrophizing and injury sensitivity. Social risk factors include solicitous social responses (i.e., encouraging rest and disuse), workplace bullying, and role conflict at work (Christensen & Knardahl, 2014; Edwards et al., 2016; Kivimaki et al., 2004).

In contrast to identifying risk factors, researchers have also begun investigating so-called protective factors which may prevent chronic pain and disability, such as optimism, mindfulness, and positive effect (Edwards et al., 2016; Finan & Garland, 2015; Goodin et al., 2013; McCracken & Vowles, 2014). Risk and protective factors also influence the success rate of treatment and degree of functional disability. Given their bidirectional relationship with chronic pain, psychosocial factors will first be discussed as an antecedent to chronic pain. In a subsequent section, reduced psychosocial function will be interpreted as a consequence of chronic pain when discussing its impact on organizational outcomes.

Psychological Risk Factors.

Depression. Pain is strongly associated with emotion, and thus influenced by healthy or maladaptive emotional functioning (Gatchel et al., 2007). Mood disorders are the most common comorbidities of chronic pain (Banks & Kerns, 1996; Gatchel et al., 2007; Turk et al., 2016). The unpleasantness and persistent disruption due to chronic pain can wear on even the most resilient individuals. Patients can transition from a healthy and active lifestyle prior to chronic pain to severe disability and functional impairment after onset. Unsurprisingly, the incidence of depression is significantly higher in chronic pain patients (Bair, Robinson, Katon, & Kroenke, 2003; Goulet et al., 2016). Although depression and other mood disorders were originally thought to be a consequence of chronic pain, it appears that the relationship between chronic pain and psychological functioning is bidirectional (Edwards et al., 2016; Gatchel et al., 2007; Jarvik et al., 2005; Turk et al., 2016).

Jarvik et al. (2005) reported in a prospective study that depression predicted pain better than anatomical abnormality three years following the initial assessment. Depressed patients were more than twice as likely to report back pain. Other research suggests that depression symptoms may increase disengagement from daily activities and lead to greater perceived pain interference and chronic disability (Casey, Greenberg, Nicassio, Harpin, & Hubbard, 2008; Morasco et al., 2013). Thus, depression may be both an antecedent and consequence of chronic pain.
Fear and Anxiety. Fear and anxiety are emotions which promote avoidance behavior of immediate or potential threats to the self (Turk et al., 2016; Vlaeyen & Linton, 2000, 2012). Fear is caused by immediate threats which call for decisive action (i.e., fight or flight), while anxiety is elicited by potential impending threats and promotes future avoidance. Pain is intended to signal the imminent or actual threat of bodily damage and is thus capable of eliciting significant fear and anxiety. Furthermore, pain can signal a physical threat from an external stimulus (e.g., heat from a flame) or internal stimulus (e.g., putting pressure on a fractured leg). An important distinction between anxiety and fear is that anxiety is a future-oriented emotion associated with worry and rumination which does not require actual exposure to the threatening stimulus to cause distress and prompt avoidance (Vlaeyen, 2000).

After an injury, engaging in certain physical activities or movements (e.g., joint pressure or spine flexion) may be painful, appraised as physically threatening, and, in turn, evoke fear of (re)injury (Edwards et al., 2016; Gatchel et al., 2007; Vlaeyen & Linton, 2000, 2012). Over time, movements which elicit pain will be avoided in favor of positions or activities which reduce pain (Edwards et al., 2016; Turk et al., 2016; Vlaeyen & Linton, 2000, 2012).

During the phase of acute pain, this promotes rest and healing of damaged tissue. However, prolonged and/or exaggerated fear and anxiety toward physical activity may contribute to the development of chronic pain and disability. Furthermore, heightened vigilance to pain associated with pain-related fear may increase somatic awareness and focus attention toward noxious stimuli, thus increasing pain sensitivity (Crombez, Van Damme, & Eccleston, 2005; Vlaeyen & Linton, 2000). As a result, activities which elicit pain may be avoided or discontinued, resulting in reduced function and increased disability. Pain-related fear and anxiety are integral components of psychiatric anxiety disorders, such as PTSD.

Post-Traumatic Stress Disorder. Military organizations are unique in that their occupational hazards include, among other things, fire fights, mortar attacks, and IEDs. The danger associated with this occupation put service members at a heightened risk for traumatic injuries to themselves and fellow service members and even death. Furthermore, military personnel may have to directly injure or kill enemy combatants or witness others killing combatants.

Exposure to these life-threatening situations and traumatic injuries puts service members at an elevated risk of PTSD. Furthermore, there is a strong association between PTSD and pain (Brennstuhl, Tarquinio, & Montel, 2015). In a nationally representative sample, McWilliams, Cox, and Enns (2003) found that the rate of PTSD in patients with chronic pain was more than three times higher than patients without pain. Furthermore, prior work suggests that the relationship between chronic pain and PTSD is even stronger in veterans (Edwards et al., 2016). A recent review by Fishbain et al. (2017) determined prevalence of PTSD in subgroups of chronic pain patients (e.g., chronic low back pain, fibromyalgia, headache, and motor vehicle accident). Approximately 50% of the veteran group had a comorbid diagnosis of chronic pain and PTSD compared to 10% of the general population group.
PTSD, such as depression, is also associated with poorer treatment outcomes for chronic pain, and patients may benefit from concurrent treatment of the disorders (Bosco, Gallinati, & Clark, 2013). Patients with pain diagnosed with concurrent PTSD were three times more likely to be prescribed opioids, in higher doses, and for a longer period (Seal et al., 2012). This is especially alarming, given prior work suggesting that PTSD is a significant risk factor for POM (Rigg & DeCamp, 2014; Seal et al., 2011).

The mechanisms underlying PTSD and chronic pain are still being investigated; however, multiple models have been proposed to explain strong association between PTSD and chronic pain (Asmundson, Coons, Taylor, & Katz, 2002; Brennstuhl et al., 2015). Two prominent models are the mutual maintenance model and the shared vulnerability model, both of which draw from cognitive-behavioral models of chronic pain and PTSD (Asmundson et al., 2002; Brennstuhl et al., 2015; Sharp & Harvey, 2001; Vlaeyen & Linton, 2000).

The mutual maintenance model theorizes seven cognitive and emotional processes associated with each disorder and influences the expression of the other: attention biases, anxiety sensitivity, persistent reminders of trauma, avoidance-coping, depression, perception of anxiety and pain, and limited adaptive coping strategies (Asmundson et al., 2002; Brennstuhl et al., 2015; Sharp & Harvey, 2001). Attentional biases are activated when painful stimuli remind the patient of the original trauma (Sharp & Harvey, 2001). Consequentially, patients will become hypervigilant and hypersensitive to pain sensations, since experiencing pain becomes associated with the trauma. Anxiety sensitivity disposes individuals to misinterpret anxiety symptoms as an indication of harm. As a result, pain and bodily sensations associated with PTSD (e.g., arousal) elicit catastrophic thoughts. Chronic pain also becomes a persistent reminder of the trauma and may lead to reviviscence of the trauma (i.e., flashbacks) and arousal which, in turn, may sustain the connection between pain and the trauma. Both disorders encourage avoidance behaviors toward activities which elicit symptoms of the disease (i.e., avoidant coping styles). In chronic pain, a patient may avoid walking down stairs because it elicits pain, and a patient with PTSD may avoid crowded areas because it elicits anxiety and arousal. As a result, both disorders lead to reduced function and social interaction. Depression is also common in both disorders and promotes lack of engagement and exposure to aversive situations which may be necessary for treating PTSD and chronic pain. Anxiety often increases pain, possibly due to elevated arousal and muscle tension (Gatchel et al., 2007). Given that PTSD elicits anxiety and hyperarousal, it may increase pain sensitivity also (Vlaeyen & Linton, 2000, 2012). Lastly, the overwhelming and persistent nature of chronic pain and PTSD may exhaust cognitive resources, thereby reducing the ability to employ adaptive pain-management strategies (Sharp & Harvey, 2001). The impact of chronic pain symptoms on PTSD and the impact of PTSD on chronic pain symptoms may lead to a mutually reinforcing process which persist and worsen symptoms. Thus, interventions which consider both disorders may be the most impactful.

The shared vulnerability model posits that individuals with certain psychological tendencies (e.g., elevated fear response and lower threshold for physiological
responsiveness to stressors) who are exposed to certain environmental conditions will develop PTSD and chronic pain concurrently (Asmundson et al., 2002; Brennstuhl et al., 2015). Individuals with psychological vulnerability who suffer a physical injury will develop chronic pain. In contrast, individuals with psychological vulnerability who experience a life-threatening traumatic event will develop PTSD. Thus, an individual with a psychological vulnerability will develop chronic pain and PTSD if the individual is exposed to an event that (1) causes physical injury that elicits pain and (2) is traumatic and life-threatening (Asmundson et al., 2002).

The directionality of PTSD and chronic pain is still being investigated, but there is a mounting evidence that PTSD, especially combat-related PTSD in veterans, is a risk factor for chronic pain (Brennstuhl et al., 2015; Edwards et al., 2016). Also, the mutual maintenance and shared vulnerability model of PTSD and chronic pain implicate certain psychological processes that may be intervention targets. Targeting these maladaptive processes may concurrently reduce symptoms and disability associated with both disorders, regardless of directionality. Indeed, Shipherd et al. (2007) demonstrated that pain was reduced by 50% after treatment for PTSD without ever being directly targeted by the intervention. Prior work suggests that treatment of PTSD may lead to more positive coping strategies, reduced avoidant behaviors, and better emotion regulation, all of which are also effective treatment strategies for chronic pain (Shipherd et al., 2007; Turk et al., 2016).

Social Risk Factors.

Solicitous Social Responses. Although pain is ultimately a private and subjective experience, pain perception may influence and may be influenced by the behavior of others (Gatchel et al., 2007; Hadjistavropoulos et al., 2011; Turk et al., 2016). Friends, family, co-workers, or acquaintances may react to an individual’s outward expressions of pain, or pain behaviors (e.g., grimacing or verbalization) by offering social support (Hadjistavropoulos et al., 2011; Turk et al., 2016). Certain types of social support may be detrimental to chronic pain depending on the qualities of support offered (Turk et al., 2016).

Solicitous social responses to pain are actions that discourage patients from performing daily functions and task, such as taking over responsibilities and encouraging patients to rest (Edwards et al., 2016; Jensen, Moore, Bockow, Ehde, & Engel, 2011; Turk et al., 2016). Although caregivers may intend this as a kind and sympathetic gesture toward someone living with chronic pain, solicitous responses may promote avoidance of certain activities that elicit pain and, as a consequence, learning to adapt or cope. Indeed, patients with family members or spouse with solicitous pain responses reported higher pain intensity and lower levels of functioning (Jensen et al., 2011; McGeary et al., 2016; Mohammadi, Dehghani, Sanderman, & Hagedoorn, 2017).

Negative spousal reactions may also be associated with emotional disturbances and affect the adjustment of chronic pain patients (Burns et al., 2013; McGeary et al., 2016). Patient perception of spouse criticism and hostility has been associated with increased pain intensity at the time of the perceived criticism and even three hours later (Burns et al., 2013). In a sample of active duty
military with chronic musculoskeletal pain, perceived negative responses from a significant other were associated with work-related fear avoidance, increased pain interference, increased affective distress, and worse physical health-related quality of life (McGeary et al., 2016).

**Job Stressors.** Early investigation into the impact of psychosocial work factors on pain lacked construct specificity, or focused primarily on one theoretical model, thereby making it more difficult to design and implement effective interventions (Christensen & Knardahl, 2012; Linton, 2001). More recent investigations have investigated relationships between pain and psychosocial work factors in greater detail and with a diverse set of psychosocial work constructs (Christensen & Knardahl, 2014; Eatough, Way, & Chang, 2012; Herr et al., 2015).

There is some evidence that job characteristics and experiences can be risk factors for increased pain. For example, studies of role conflict have found that it is a significant risk factor for neck pain (Christensen & Knardahl, 2010, 2014). In addition, workplace bullying has been implicated in the development of chronic pain disorders (Kivimaki et al., 2004). Other research has demonstrated that low job control and high role conflict are associated with higher levels of job strain and, in turn, higher levels of pain (Eatough et al., 2012). These results are suggestive of a link between psychosocial work stressors and musculoskeletal pain.

**Psychological Protective Factors.** Psychosocial risk factors for pain have historically received the maximum attention in pain research. However, there has been an increase in research investigating psychosocial factors that may protect against chronic pain (Edwards et al., 2016; Finan & Garland, 2015; Gatchel et al., 2007; Goodin et al., 2013). Such protective factors may promote adaptive psychological functioning and buffer against external psychosocial stressors and biological vulnerabilities.

**Optimism.** Prior work suggests that optimism may buffer against chronic pain and poor pain outcomes (Goodin & Bulls, 2013; Hood, Pulvers, Carrillo, Merchant, & Thomas, 2012; Tracey, 2010). Hood et al. (2012) reported participants with higher levels of optimism and hope had lower pain catastrophizing and reduced pain reports. In addition, Goodin et al. (2013) reported that individuals with high dispositional optimism reported less catastrophizing and less facilitation of experimental pain. A study of experimentally induced optimism and pain reported that optimism protected against pain-induced determinants in task-shifting performance (Boselie, Vancleef, & Peters, 2017). In military populations, optimism and related positive psychological characteristics have been shown also to decrease the likelihood of substance abuse post-deployment (Krasikova, Lester, & Harms, 2015).

**Positive Effect.** Although negative effect has received considerable attention in pain research, there has been an increased interest in positive effect (Finan & Garland, 2015). Positive effect is associated with reduced pain sensitivity in experimental and clinical settings (Rhudy, 2015; Sibille et al., 2012). In an experimental pain study, participants with a healthy effective style (low negative effect and high positive effect) demonstrated less passive coping strategies (e.g., reduced physical
activity and seeking help from others), endorsed lower somatic symptoms, and reduced ischemic pain (i.e., pain elicited by insufficient blood flow) sensitivity (Sibille et al., 2012). Prior work also suggests that individuals with higher positive effect may be more psychologically resilient to emotional disturbances elicited by increased pain, thereby leading to lower dysfunction and better pain outcomes (Zautra & Sturgeon, 2016).

**Mindfulness.** Cognitive appraisal of pain signals strongly influences pain processing. Exaggerated pain-related fear is associated with enhanced pain facilitation (Goodin et al., 2013). Thus, psychological states which attenuate negative appraisal and pain-related fear may also reduce pain intensity and protect against pain disorders.

Mindfulness can be roughly defined as a state of nonjudgmental awareness whereby individuals are aware and accept internal and external experiences without appraisal or mental elaboration (e.g., magnification and rumination; Grant, 2014; McCracken & Vowles, 2014). Thus, if an individual observes a painful sensation without exaggerated negative appraisal and pain-related fear, then the desire to avoid the pain is reduced, which may in turn reduce pain facilitation. Indeed, experienced meditators showed decreased activation in executive, evaluative, and affective brain networks, such as the prefrontal cortex and amygdala, while control participants did not (Grant, Courtemanche, & Rainville, 2011). In addition, a neuroimaging investigation of experimentally induced pain indicated a short mindfulness training intervention associated with altered neural activity and a significant reduction in pain ratings (Zeidan, Gordon, Merchant, & Goolkasian, 2010). Prior research also suggests that increased mindfulness may decrease pain-related anxiety and in turn improve functional outcomes (McCracken, Gauntlett-Gilbert, & Vowles, 2007).

**Social Protective Factors.**

**Organizational Factors.** Christensen and Knardahl (2010) reported that higher levels of the following organizational factors were associated with lower neck pain at baseline: decision control, support from immediate superior, empowering leadership, fair leadership, predictability during the next month, commitment to organization, and social climate. Furthermore, empowering leadership was one of the strongest predictors of neck pain. Participants reporting greater empowering leadership at baseline had lower odds of having neck pain at baseline and at follow-up. A prospective study of back pain reported that greater decision control, empowering leadership, and fair leadership were associated with less back pain (Christensen & Knardahl, 2012). Lastly, prior work reported that greater social support reduced the likelihood of persistent low back pain, and a better social climate at work predicted less neck pain (Christensen & Knardahl, 2014; Melloh et al., 2013).

**IMPACT OF CHRONIC PAIN ON EMOTIONAL WELL-BEING**

Chronic pain can be a devastating illness which spills over into multiple life domains. The persistent, unpleasant, and disruptive nature of chronic pain can be
overwhelming and distressing (Banks & Kerns, 1996; Eccleston & Crombez, 1999). It may lead to disengagement from enjoyable activities and loss of meaningful social roles (Banks & Kerns, 1996; Gatchel et al., 2007; Harris, Morley, & Barton, 2003). The burden of chronic pain may be particularly devastating to young and previously active veterans with greater family responsibilities than older individuals (Matthias, Miech, Myers, Sargent, & Bair, 2014). Consequently, reduced engagement and increased dysfunction due to pain may increase psychological distress (Banks & Kerns, 1996; Ojala et al., 2015). As a result, patients with chronic pain often suffer significant detriments in emotional well-being (Dersh, 2002; Gatchel et al., 2007).

Prior work suggests that over 40% of chronic pain patients have depression (Bair et al., 2003; Banks & Kerns, 1996; Dersh, 2002; Gatchel et al., 2007; Turk et al., 2016). In addition, chronic pain may elicit anger, anxiety, and hopelessness (Dersh, 2002; Gatchel et al., 2007; Matthias et al., 2014; Trost, Vangronsveld, Linton, Quartana, & Sullivan, 2012). Chronic pain may also influence behavioral health outcomes, such as increased risk of suicide, sleep impairment, and opioid misuse (Hooten, 2016; Ilgen et al., 2013; Seal et al., 2012; Turk et al., 2016). Thus, chronic pain has a significant impact on well-being and may indirectly impact work outcomes, such as presenteeism and absenteeism.

**ORGANIZATIONAL OUTCOMES**

*Absenteeism*

The relationship between pain and absenteeism is clear. Prior work has reported that osteoarthritis (OA) patients were absent three times as often versus controls and were significantly more likely to work part-time (Ricci et al., 2005). In a sample of Spanish workers, those reporting chronic pain had a significantly greater chance and period of absenteeism compared to individuals without pain (Mesas et al., 2014). Furthermore, younger workers had significantly higher incidence and duration of absenteeism due to chronic lower back or neck pain. A systematic review has reported that chronic pain had a consistent association with increased rates of pain and greater pain intensity was associated with greater sickness absenteeism (Patel et al., 2012).

There also appears to be a strong relationship between pain, psychological functioning, and absenteeism. Prior research has reported that chronic pain patients with depression were 2.9 times more likely to be absent than non-depressed individuals (Munce, Stansfeld, Blackmore, & Stewart, 2007). There may also be a synergistic relationship between psychological dysfunction and pain (Saastamoinen, Leino-Arjas, Rahkonen, & Lahelma, 2016). A recent study has found that emotional exhaustion and pain were independently associated with increased absenteeism (Saastamoinen et al., 2016). However, co-occurring pain and emotional exhaustion were associated with absenteeism in excess of the additive risk of each condition. Both pain and emotional exhaustion are associated with reduced coping resources, so the two conditions may compound and perpetuate each other. In addition, chronic pain patients with depression may use absenteeism as a coping strategy (Munce et al., 2007).
**Disability Discharge**

For the military, chronic pain not only limits function and increases absenteeism but it can also lead to medical disability and discharge, thereby creating greater turnover (Feuerstein, Berkowitz, & Peck, 1997; Gubata, Piccirillo, Packnett, & Cowan, 2013; Lincoln, Smith, Amoroso, & Bell, 2002). Indeed, musculoskeletal conditions are by far the most common reasons for disability discharge, and this trend is increasing at an alarming rate (Bell, Schwartz, Harford, Hollander, & Amoroso, 2008; Feuerstein et al., 1997; Gubata et al., 2013; Lincoln et al., 2002).

Prior research suggests that MSDs are responsible for over 50% of disability discharge, and soldiers hospitalized for a MSD had a five-year cumulative risk of 13.2% disability discharge (Lincoln et al., 2002). In addition, the prevalence of musculoskeletal-related disability increased from 70 per 100,000 in 1985 to 950 per 100,000 in 2005 (Bell et al., 2008). Unlike psychiatric conditions, which are more common in previously deployed service members, prior research suggests that musculoskeletal conditions occur at similar rates in both deployed and non-deployed populations, thereby adding to the organizational burden even during peacetime or limited military engagement (Gubata et al., 2013). In addition, these disorders are not limited to older service members at the end of their career. Lincoln et al. (2002) reported that disability discharge rates due to musculoskeletal conditions in the Army were highest among 21–34-year olds, those with a year or less of service, and lower pay grades. In addition, disability discharge was higher among soldiers reporting high job stress and lower job satisfaction.

**Presenteeism**

Although absenteeism represents a significant source of lost productivity associated with pain, this may only represent a small proportion of the actual cost. Many workers may still attend work despite experiencing pain (Agaliotis et al., 2013; Goetzel et al., 2004). However, this may result in detriments to job performance, such as reduced output, errors, and failure to meet production standards. This is known as presenteeism (Schultz, Chen, & Edington, 2009).

Prior work found presenteeism costs dwarfed other costs related to chronic illnesses (Goetzel et al., 2004). In addition, the impact of presenteeism on total health costs is likely a function of disease characteristics as some conditions are associated with more consistent work task interference, such as musculoskeletal pain (Goetzel et al., 2004; Schultz et al., 2009). Goetzel et al. (2004) found chronic pain conditions, compared to other health conditions, also had the greatest ratio of cost due to presenteeism versus all overall costs (i.e., presenteeism plus absenteeism, prescription, outpatient care, and hospitalization). By comparison, heart disease is likely more associated with medical costs and absenteeism, such as surgery and hospitalization, rather than presenteeism. Studies investigating pain interference specifically support these assertions. Patients with arthritis lost twice as much productive time compared to individuals without arthritis (Ricci et al., 2005). Agaliotis et al. (2013) found 80% of patients with chronic knee pain reported some reduction in work productivity, particularly in occupations with greater physical demands. Pohling et al. (2016) devised a study to investigate the
relationship between psychosocial work stressors, musculoskeletal complaints, and productivity losses. They reported that higher rates of musculoskeletal complaints were associated with higher productivity losses. Furthermore, they found evidence for the mediating role of musculoskeletal complaints on the relationship between work-related factors and presenteeism. A low-risk work condition in the area of work life (e.g., manageable workload, control, reward, and values) was associated with fewer musculoskeletal complaints, which in turn was associated with lower productivity loss due to health-related conditions.

Two population-based studies estimated the impact of chronic pain in Australia (Blyth et al., 2003; Leeuwen et al., 2006). Blyth et al. (2003) found 28.6% of chronic pain patients reported that their work was restricted by pain, 68% of participants reported working with pain, and 60% of males and 54% of females reported some pain interference with work effectiveness. When the effect of working with pain was included, lost productivity (absenteeism plus reduced on-the-job productivity) was more than three times greater. Interestingly, they found patients with a legal claim (e.g., worker’s compensation or accident compensation) not only had greater pain complaints and dysfunction but also took narcotic pain medication at a rate three times higher than individuals without legal claims (12.5% vs 34.7%).

A few recent studies have attempted to understand the impact of pain on specific organizational outcomes apart from general measures of presenteeism (Byrne & Hochwarter, 2006; Christian et al., 2015; Ferris et al., 2009). Christian et al. (2015) investigated the relationship between pain and discretionary behaviors at work. Their findings suggest that greater pain is associated with greater avoidance behaviors and lower promotive extra-role behaviors. They also found association between pain and resource depletion and job engagement. Days spent working with pain (83.8 days in six months) was much greater days than lost work days (4.5 days). Byrne and Hochwarter (2006) investigated the relationship between pain, perceived organizational support (POS), and job performance outcomes (i.e., effectiveness, work intensity, citizenship behaviors, and task performance). When POS was low, high levels of chronic pain were associated with low performance, low perceived citizenship, and low perceived effectiveness. However, when POS was average or high, this effect was attenuated. Ferris et al. (2009) investigated the impact of pain interference at work, or job-limiting pain (JLP) on organizational outcomes. JLP significantly predicted job satisfaction and citizenship behavior. Furthermore, they found that as pain increased, job satisfaction decreased in individuals with low political skill. Also, individuals with high JLP and low political skill had lower citizenship behavior.

**PAIN, OPIOIDS, AND OVERDOSE**

Few issues in mental health have attracted more public attention than opioid abuse, and rightly so (Katz, 2017). To say it’s an epidemic seems too cautious. Drug overdose in the United States was responsible for 52,404 deaths in 2015, the most ever recorded (Rudd, Seth, David, & Scholl, 2016). The dramatic increase in
overall drug overdose deaths is associated with a concomitant rise in the number of patients prescribed opioid medication for pain, deaths attributed to POs, and the transition of PO users to heroin (Banerjee et al., 2016; Hedegaard, Warner, & Miniño, 2017; Rudd et al., 2016). Opioids were involved in 33,091 of the overdose deaths (63.1%) in 2015. From 2000 to 2015, the rate of opioid overdose tripled, rising at an average of 5% annually (Hedegaard et al., 2017; Rudd et al., 2016). Furthermore, approximately 165,000 persons died from an overdose related to POs between 1999 and 2014 (Dowell, Haegerich, & Chou, 2016). Although the rate of PO overdose has shown some improvement in recent years, the rate of heroin overdose increased three-fold from 2010 to 2015 (Banerjee et al., 2016; Hedegaard et al., 2017; Rudd et al., 2016).

The military and veterans have not been spared from this epidemic. If anything, this crisis has been more harmful to this population (Bray, Olmsted, & Williams, 2012; Bohnert, Ilgen, Galea, McCarthy, & Blow, 2011). Prior work suggests that overdose deaths related to POs in the military may be twice the deaths in civilian population (Bohnert et al., 2011). Illicit drug use in the military steadily declined from 27.6% in 1980 to 3.4% in 2002, largely due to implementation of drug testing (Bray et al., 2010, 2012). However, illicit drug use increased to 5% in 2002 and 12% in 2008 (Bray et al., 2012). The reason for this dramatic increase appears to be due to increase in prescription drug misuse, particularly POM. In fact, when prescription drugs were excluded, rates of any illicit drug use stayed at approximately 2% from 2002 to 2008. In contrast, POM increased from 2% to 11% during the same period. Further, during this period there were very low rates of drug use across most categories except for pain relievers, which showed a marked increase from 1% in 2002 to 10% in 2008. Notably, heavy alcohol use increased from 1988 (15%) to 2008 (20%), which is in contrast with the relatively stable rate in the previous 10 years (Bray et al., 2010). This may signify the use of intoxicating substances to cope with stressors and other mental health problems. Recent trends in POM suggest that service members and veterans may be using opioids in a similar fashion.

A recent survey from one Army infantry brigade obtained three months after return from Afghanistan corroborates some of the prior findings (Toblin, Quartana, Riviere, Walper, & Hoge, 2014). Of the entire cohort, 15.1% reported past-month opioid use. Among soldiers prescribed opioids, 5.6% reported no past-month pain, 38.5% reported mild pain, 37.7% reported moderate pain, and 18.2% reported severe pain. In addition, 44.0% of soldiers reported chronic pain and 51.2% reported moderate to severe pain. These two findings are surprising, given the relatively young age of the sample.

Prior research suggests that there is a strong relationship between POM, psychological distress, and drug availability. Bray et al. (2012) found that the strongest predictors of prescription pain medication misuse were positive PTSD screening, engaging in heavy drinking, and having a prescription for pain medication. Prior work also found individuals who reported having been prescribed a prescription pain reliever within the last month were twice more likely to misuse a pain reliever than individuals having been prescribed a pain reliever during the past year (Jeffery, Babeu, Nelson, Kloc, & Klette, 2013). In addition, patients who received
at least a 211-day supply of POs had a greater risk for opioid abuse or dependence than those with a 91–120-day supply (Edlund, Steffick, Hudson, Harris, & Sullivan, 2007). This may suggest a “dose–response” relationship between number of days for which opioids are prescribed and risk of POM. Furthermore, prior research noted that symptoms of distress had a widespread association with prescription medication misuse, which suggests service members may be self-medicating to reduce distress and control mental health symptoms instead of utilizing legitimate health services and/or nonpharmacological treatments, such as counseling and relaxation techniques (Jeffery et al., 2013). Thus, the increased availability of POs obtained through legitimate prescriptions for pain medications from a doctor may increase the risk of POM, especially in patients on long-term opioid therapy who experience high psychological distress (Bray et al., 2012; Jeffery et al., 2013).

POs are the primary therapy for acute and chronic pain. Although POs are moderately effective in treating acute pain, the efficacy of long-term opioid therapy has not been demonstrated (Kissin, 2013; Manchikanti, Fellows, Ailinani, & Pampati, 2010). Surprisingly, Kissin (2013) was unable to find a single randomized controlled trial (RCT) study of POs lasting longer than six months published in a top-ranked medical journal. Considering the standard of evidence-based medicine and the ubiquity of long-term opioid therapy, the lack of a single long-term RCT is astounding and troubling.

The harm associated with exposure to opioid therapy, on the other hand, is well established (Sullivan & Howe, 2013). Interviews with inner-city veterans in New York revealed that most veterans did not use POs prior to military service, and PO use was often initiated during deployment (Golub & Bennett, 2013). Most veterans who reported POM during deployment also misused opioids after separating from the military. Furthermore, some veterans who used opioids during deployment as prescribed started misusing opioids after separation.

The relationship between psychological dysfunction and POM may be bidirectional (Scherrer et al., 2016). Scherrer et al. (2016) used a three-wave prospective cohort study to investigate whether opioid use was associated with depression in a sample of chronic low back pain patients. Baseline depression was significantly associated with Morphine Equivalent Dose (MED). During follow-up, the probability of having depression was significantly greater when subjects were taking more than a 50-mg MED compared to taking no opioids, and developing depression was associated with a more than two-fold increased chance of increasing rather than decreasing MED.

**THE ROLE OF ORGANIZATIONS IN COMBATING PAIN**

Pain is a complex biopsychosocial process, and managing it requires an equally interdisciplinary approach (Gatchel, McGeary, McGeary, & Lippe, 2014). It is now clear that biomedical treatments for chronic pain, such as POs and/or surgery, are insufficient and potentially dangerous (Chan & Peng, 2011; Gatchel et al., 2014; Kissin, 2013; Loeser, 2012; Turk et al., 2016). When referencing
decades of treating patients at pain clinics, Loeser (2012, p. 2) bluntly stated, “It did not enter our minds that there could be significant numbers of chronic pain patients who were successfully managed on opioids, because if there were any, we almost never saw them.” Considered within the context of the 20-year opioid epidemic, this observation is gut-wrenching: Despite little if any treatment efficacy and in the presence of overwhelming risks, millions of patients were nonetheless prescribed opioids, and as a result hundreds of thousands lost their lives. It seems that the call to prevent and manage pain using psychosocial approaches has never been louder.

Many individuals and organizations see pain as a biomedical problem which can only be treated in health care settings (Kristman et al., 2016). However, given the influence of workplace factors on employee’s health, the workplace also plays a significant role in prevention and treatment of pain (Blyth, Macfarlane, & Nicholas, 2007; Kristman et al., 2016; Shaw, Campbell, Nelson, Main, & Linton, 2013). This may be especially true of organizations with significant occupational risk factors for pain (e.g., high stress and high injury rate), such as the military. In addition, prior work suggests that unaddressed occupational risk factors may hinder clinical pain treatment (Shaw et al., 2013). Thus, employers may need to communicate and collaborate with patients and clinicians to create a plan conducive to the worker’s recovery (Kristman et al., 2016; Shaw et al., 2013). This may entail modifications to the work environment or schedule. However, intervening before the condition of worker deteriorates to this point is preferred. Once pain becomes chronic, it is difficult to treat, and complete amelioration is improbable (Gatchel, 2004; Gatchel et al., 2014; Jensen & Turk, 2014; Turk, Wilson, & Cahana, 2011). The goal of most chronic pain treatments is to manage and cope with chronic pain, not cure it.

Most organizations are limited in their capacity to aid treatment efforts. However, they may be positioned to facilitate pain-prevention efforts. As we have emphasized thus far, emotional processes are intrinsic to pain perception (Edwards et al., 2016; Gatchel et al., 2007). Furthermore, emotional distress is associated with greater pain and poorer outcomes (Chou & Shekelle, 2010; Edwards et al., 2016; Gatchel et al., 2007). As such, interventions which reduce emotional distress and enhance well-being may play a significant role in preventing pain disorders (Eatough et al., 2012; Pohling et al., 2016). One method to combat emotional distress is by reducing job stressors and/or increasing psychosocial resources (Tetrick & Winslow, 2015).

Prior research identified organizational factors which may increase the risk of pain conditions. These include low control, high quantitative demand, low social support, high role conflict, and low supervisor support (Christensen & Knardahl, 2012, 2014; Herr et al., 2015; Melloh et al., 2013). Interventions which target these risk factors may reduce the incidence or progression of pain disorders. Organizations may also mitigate some job performance deficits related to pain by increasing job resources. Prior findings suggest that increasing POS, political skill, job engagement, and job satisfaction may protect against decrease in performance associated with pain disorders (Byrne & Hochwarter, 2006; Christian et al., 2015; Ferris et al., 2009).
In addition to enhancing job resources, organizations may also protect against pain disorders by enhancing personal resources (e.g., psychological resiliency). Although workplace risk factors may increase vulnerability to pain, the workplace may also be a vehicle for interventions which increase resiliency to pain and other physical and mental health conditions (Glomb, Duffy, Bono, & Yang, 2011; Harms et al., 2013; Tetrick & Winslow, 2015). Many workplace interventions have been developed to promote resiliency to stressors, particularly in the military (Glomb et al., 2011; Harms et al., 2013; Johnson et al., 2014; Tetrick & Winslow, 2015; Vanhove, Herian, Perez, Harms, & Lester, 2016). In recent years, there has been a surge in research and implementation of mindfulness-based workplace interventions to cope with occupational stress (Glomb et al., 2011; Roeser et al., 2013; Tetrick & Winslow, 2015).

Mindfulness training teaches practitioners to reduce aversive thoughts, emotions, and behaviors by developing an attitude of open and nonjudgmental awareness toward everyday experiences (Garland, Hanley, Baker, & Howard, 2017; Glomb et al., 2011; Grant, 2014; Kabat-Zinn & Hanh, 2009). Mindfulness may protect against maladaptive chronic stress by reducing stress reactivity and enhancing top-down self-regulation (Garland et al., 2017). Similarly, Glomb et al. (2011) suggest that mindfulness exerts its positive influence on well-being by decoupling the self from thoughts, emotions, events, and experiences (i.e., decentering); reducing automatic and reactive mental process that constrain thinking; and increasing awareness and regulation of physiological systems. Prior work suggests that these core processes may increase active coping, counteract learned helplessness, increase perceived control, reduce rumination, and increase reward responsiveness (Garland et al., 2017; Glomb et al., 2011).

A prior study investigated the impact of a 20-hour mindfulness intervention, Mindfulness-Based Mind Fitness Training (MMFT), with a non-clinical sample of U.S. Marines prior to pre-deployment training (Johnson et al., 2014). Following a stressful combat training task, Marines who underwent the mindfulness training intervention demonstrated better heart rate and breathing recovery compared to controls. In addition, the MMFT group showed changes in brain activation associated with cognitive control, emotion-regulation, reward-monitoring, and interoception. Pre-deployment stress is also associated with decrease in work memory capacity and positive effect and increase in negative effect (Jha, Stanley, Kiyonaga, Wong, & Gelfand, 2010). However, prior findings suggest a mindfulness-based intervention may protect against these deficits. Also, a recent investigation reported that acceptance-coping strategies were more consistent and effective in dealing with stressors in basic military training than active coping strategies (Britt, Crane, Hodson, & Adler, 2016). Furthermore, the authors suggested mindfulness training, given its emphasis on accepting rather than attempting to control experiences, may be especially effective in environments where job control is limited, such as military settings. Lastly, an experimental investigation utilizing repeated psychosocial stress reported that a mindfulness-based intervention attenuated anticipatory sensitization of the cortisol response in individuals with high initial reactivity (Turan et al., 2015). Collectively, these results suggest that mindfulness training may increase resiliency and stress-coping in healthy
service members prior to stressful events, thereby preventing maladaptive psychological and physiological reactions.

Roeser et al. (2013) investigated the effects of mindfulness training on occupational stress and burnout in teachers at two separate test sites (United States and Canada) using a randomized, waitlist-control field trial. The intervention showed a significant positive impact on occupational well-being. Teachers who underwent mindfulness training had significant increase in mindfulness and self-compassion. Furthermore, the training group showed significant decreases in occupational stress and burnout, anxiety symptoms, and depression symptoms and a significant increase in attention/working memory capacity. In addition, mediation analyses suggesting decrease in stress, burnout, anxiety, and depression following the intervention were accounted for by increase in mindfulness and self-compassion. The intervention was not associated with improvements in physiological measures (blood pressure, cortisol, or heart rate), which may be due to methodological limitations.

Mindfulness-based interventions may also protect against POM in patients with comorbid chronic pain and POM (Garland et al., 2014). A prior investigation found that participants in a mindfulness training intervention for chronic pain and POM had greater reduction in pain severity and pain-related dysfunction compared to a traditional support group, and the mindfulness group had significant reductions in desire for opioid medication and opioid use disorder. Furthermore, increase in non-reactivity and reinterpretation of pain sensations mediated the relationship between the mindfulness intervention and pain reduction.

**FUTURE DIRECTIONS AND CONCLUSION**

Elucidating the complex and dynamic relationship between work, stress, and pain requires integration of literature from public health, occupational health psychology, industrial–organizational psychology, clinical psychology, organizational behavior, and organizational design (Tetrick & Winslow, 2015). Furthermore, designing interventions to mitigate the impact of pain on organizations would strongly benefit from a comprehensive model which incorporates these various domains. In addition, some methodological weaknesses could be improved upon in the future investigations of pain and disability (Kristman et al., 2016). These include a lack of random sample of workplaces for study (i.e., selection bias), over-reliance on large workplaces, over-reliance on worker self-report, lack of organizational perspective, and lack of investigation into etiologic mechanisms. More research is needed to understand in better way boundary conditions and the processes underlying the relationship between organizational factors and pain. Collecting a wide array of biological markers, including medical imaging, and using more rigorous pain measures may also increase the quality of findings. While most current research focuses on individual-level perspectives, the future research should strive to include whole workforce perspective, supervisor attitudes, and organizational practices and procedures.
Advances in pain treatment and prevention have been made, but the progress is slow, and the burden of an aging society continues to grow. Few of any organizations are more vulnerable to the consequences of pain and disability than the military. Pain clearly undermines force readiness by diminishing performance, escalating health care costs, and increasing attrition. Ineffective treatments for chronic pain contribute to an overreliance on PO therapy and the relentless and devastating opioid epidemic in the United States and elsewhere, while the high comorbidity of pain and PTSD leave military service members and veterans increasingly vulnerable. Furthermore, coping with pain and psychiatric illness creates additional challenges for veterans transitioning into the civilian workforce. Thus, we believe there is a palpable urgency for organizational researchers to familiarize themselves with the dynamics of pain and its implications for the workforce. Although clinical pain research is well developed, there needs to be a concerted effort to integrate pain with organizational outcomes, so the consequences of a pain epidemic can no longer be ignored.

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