

## PTSD, Trauma-Related Symptoms and Pain: A General Overview

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### Abstract

Posttraumatic stress disorder (PTSD) and chronic pain frequently co-occur. Patients with comorbid PTSD and chronic pain suffer more distress and disability than patients presenting with only one disorder. The present chapter provides a brief overview of the existing literature on the relationship between PTSD and pain. The goal of the chapter is to provide therapists and researchers with a guide to navigate the literature on this topic by addressing the following questions: (1) Why do PTSD and chronic pain co-occur? (2) Which aspects of this comorbidity should therapists take into account? (3) Are there treatment programs available for patients with comorbid PTSD and chronic pain? (4) What important issues still need to be researched? Finally, some advice regarding clinical practice is provided.

### List of Abbreviations

<b>PTSD</b>	Posttraumatic stress disorder
<b>TEI</b>	Trauma-exposed individuals
<b>SIA</b>	Stress-induced analgesia

Posttraumatic stress symptoms and posttraumatic stress disorder (PTSD) are thought to negatively impact physical health in many ways (Gómez-Pérez et al. 2012). The chronic stress reaction experienced by individuals with PTSD may lead to dysregulation of the pituitary-adrenal system, which may subsequently contribute to different health disorders and alterations in pain modulation (Stam 2007). The psychological aspects of PTSD may also impact physical health by acting as cognitive vulnerabilities or maintaining factors for other disorders such as chronic pain (Asmundson et al. 2002). In such, PTSD has been proposed as one of the potential mechanisms linking trauma exposure to chronic pain disorders (Shipherd et al. 2007). Some key facts about chronic pain are described in Table 1. Between 20 % and 34 % of patients referred for pain rehabilitation present with comorbid PTSD, which makes treatment more complex as symptoms of one disorder commonly exacerbate symptoms of the other disorder (Otis et al. 2003). The present chapter provides a brief overview of the existing literature on the relationship between PTSD and pain. The goal of the chapter is to provide therapists and researchers with a guide to navigate the literature on this topic by addressing the following questions:

1. Why do PTSD and chronic pain co-occur?
  - 1.1. Is the pain modulation system altered in patients with PTSD?
  - 1.2. What theories have been proposed to explain the co-occurrence of PTSD and chronic pain?

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**Table 1** Key facts about chronic pain

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Pain is a sensation in one or several parts of the body. It is an unpleasant subjective experience resulting from the interaction between perceptive, cognitive, emotional, biological, and social factors

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Pain lasting longer than 3 months is considered chronic pain

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Chronic pain of moderate to severe intensity is experienced by 19 % of European adults and seriously impairs the quality of their social and working lives. Half of these patients receive inadequate pain management

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The most frequent pain condition is chronic low back pain

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The most important domains affected by chronic pain are enjoyment of life, emotional well-being, energy, strength, and sleep-related problems

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Key facts of chronic pain – including its definition, prevalence in Europe, social and personal consequences, and the most important domains affected in chronic pain patients – are listed

2. Which aspects of this comorbidity should therapists take into account?
3. Are there treatment programs available for patients with comorbid PTSD and chronic pain?
4. What important issues still need to be researched?

Finally, some advice regarding clinical practice is provided.

## PTSD and Pain: Some Questions and Answers

### Why do PTSD and Pain Co-occur?

#### Is the Pain Modulation System Altered in Patients with PTSD?

Heightened pain sensitivity is thought to increase the risk for chronic pain (Nielsen et al. 2009). Individuals with PTSD have shown elevated levels of certain psychological characteristics (e.g., anxiety sensitivity, dissociation, depression, and physiological arousal) associated with increased pain sensitivity (Sharp and Harvey 2001) and tend to report higher levels of clinical pain than individuals without PTSD (Ruiz-Párraga and López-Martínez 2014). Therefore, alterations in pain sensitivity as a consequence of PTSD may be one factor that predisposes individuals with PTSD to develop chronic pain (Gómez-Pérez et al. 2014). However, results from experimental studies investigating pain sensitivity in individuals with PTSD remain inconclusive (for a comprehensive review, see Moeller-Bertram et al. 2011). Reviewed below are findings on pain hyposensitivity, pain hypersensitivity, and stress-induced analgesia (SIA) related to the experience of pain in patients with PTSD. A potential hypothesis regarding why inconclusive results have been reported, as well as some methodological limitations of previous work, are discussed.

Support for pain hyposensitivity in individuals with PTSD has been reported in several studies (Defrin et al. 2008; Geuze et al. 2007; Kraus et al. 2009; Schmahl et al. 2010). Researchers have found higher pain thresholds using thermal stimulation in participants with PTSD than in participants with other anxiety disorders (Defrin et al. 2008) and participants with borderline personality disorder (Schmahl et al. 2010). Lower pain intensity ratings in response to thermal stimulation have also been reported in war veterans with PTSD compared to veterans without PTSD (Geuze et al. 2007) and healthy controls (Kraus et al. 2009).

By contrast, evidence for pain hypersensitivity in individuals with PTSD has also been found (Defrin et al. 2008; Diener et al. 2012; Orr et al. 2000). Trauma-exposed individuals (TEI) with PTSD have shown lower pain thresholds than TEI without PTSD in two studies, one employing electrical stimulation (Orr et al. 2000) and the other using thermal stimulation (Diener et al. 2012). Individuals with PTSD have also

been shown to report higher pain ratings compared to individuals with other anxiety disorders in response to thermal stimulation (Defrin et al. 2008). However, Schmahl et al. (2010) found no differences in pain thresholds between participants with PTSD and healthy controls when using thermal stimulation. Thus, research on whether individuals with PTSD differ from healthy controls in pain sensitivity remains inconclusive.

Related to pain hyposensitivity and hypersensitivity is the phenomenon of SIA. SIA refers to the pain reduction that occurs in animals and humans when a stressful stimulus is presented before or during exposure to a noxious stimulus. Research on SIA in patients with PTSD has produced more consistent findings than research on pain sensitivity and cumulatively suggests that individuals with PTSD report stronger SIA than individuals without PTSD. Pitman et al. (1990) found that exposing veterans to stressful videos (i.e., war-related scenes) provoked an analgesic effect in veterans with PTSD, but not in veterans without PTSD, whose pain tended to increase after watching the video. Mickleborough et al. (2011) found that TEI with PTSD demonstrated greater activation in brain regions implicated in SIA and reported significantly lower pain intensity and unpleasantness ratings after listening to a trauma script than TEI without PTSD. Similarly, Diener et al. (2012) found that patients with PTSD demonstrated greater activation in brain areas associated with SIA, displayed greater increases in mechanical pain threshold and tolerance, and reported greater decreases in pain intensity, in comparison to TEI without PTSD in response to an arithmetic task designed to induced stress in the participants.

Pain is a stressful phenomenon, and (as reviewed above) laboratory pain induction procedures may induce SIA in participants with PTSD because they are more vulnerable to stress, but may not induce SIA in control participants. Thus, the way pain sensitivity varies throughout experimental procedures may be different among individuals with and without PTSD, which may explain why differences between individuals with and without PTSD are sometimes detected and others not. Despite this, variations of pain sensitivity have not yet been systematically examined in individuals with and without PTSD. Instead, researchers have frequently averaged static pain indices taken at different points of the procedure, which may have masked existing pain sensitivity differences between the groups or led to the observed increased pain thresholds found in some of the studies on individuals with PTSD.

Some evidence supporting this pain sensitivity variation hypothesis is available. Creech et al. (2011) found heightened pain sensitivity in TEI at baseline, which was attenuated by the stress provoked by writing about the traumatic experience. Strigo et al. (2010) found greater brain activation in areas related to pain processing in response to an initial painful stimulation in female victims of partner violence with PTSD than in women without PTSD, which is indicative of an initial higher sensitivity to pain. With repeated pain exposure, this greater brain activation was followed by a subsequent decrease in pain ratings and the attenuation of activation in the corresponding areas of the brain. Similarly, Diener et al. (2012) found both lower initial pain thresholds – indicative of higher pain sensitivity – and a stronger SIA effect in TEI with PTSD. More studies examining changes in pain sensitivity in response to stress are needed.

Although the studies reviewed herein suggest that trauma exposure may lead to alterations in the perception of pain via PTSD, other factors (e.g., depression) may lead to pain alternations. Only a few studies have compared differences in pain sensitivity between TEI (with and without PTSD) and individuals who have not experienced a trauma to help delineate this relationship. Gómez-Pérez and López-Martínez (2013) found that both trauma-exposed women with and without PTSD reported higher pain unpleasantness in response to the immersion of their hands into cold water than women who had not been exposed to trauma. However, differences between the trauma-exposed women with and without PTSD were not significant, which suggests that exposure to trauma, but not PTSD, may account for differences in reports of pain unpleasantness. Interestingly, the trauma-exposed women without PTSD recovered faster from pain than the women who had not been exposed to trauma, suggesting that they may have possessed resiliency characteristics against extreme stress. Similarly, Kraus et al. (2009) did not find

differences in pain sensitivity between male veterans with and without PTSD during a heat stimulation task; both groups of veterans showed lower heat and cold pain thresholds than individuals who had never been exposed to combat. Nonetheless, veterans with PTSD reported lower subjective pain than both veterans without PTSD and controls. Ruiz-Párraga and López-Martínez (2014) examined differences in pain intensity among three groups: patients with chronic pain and comorbid PTSD; patients with chronic pain without comorbid PTSD, but who had experienced a trauma; and patients with chronic pain without a history of trauma. Patients with chronic pain and PTSD reported higher pain intensity, pain-related disability, and emotional distress than the other two groups. Additional studies in which TEI with PTSD are compared with TEI without PTSD and individuals who have not experienced a trauma are needed in order to clarify which alterations in the experience of pain are due to trauma exposure and which ones result from PTSD. Moreover, careful screening for trauma in control participants is important, as previous research has been limited in doing this.

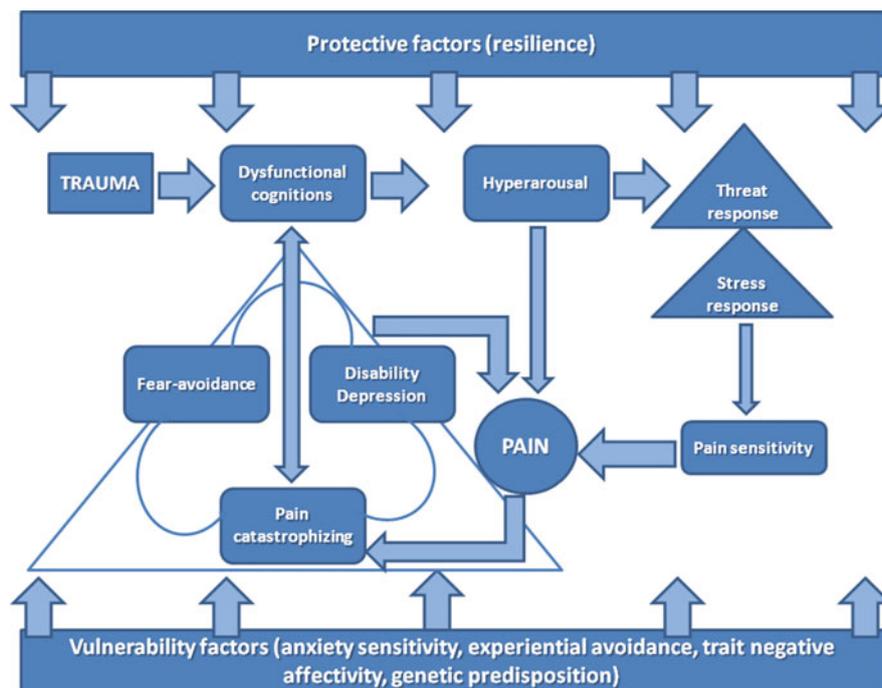
Investigating pain modulation among TEI and individuals with PTSD has many challenges and limitations, which may have contributed to inconclusive findings. Confounding variables such as gender, comorbid pain, psychiatric diagnoses, and medication use (Moeller-Bertram et al. 2012) are important to control for but are nearly impossible to concurrently control for. Studies published to date comprise very small, heterogeneous samples, which remains to be a major limitation in this line of research. Most of the research that has been done has used war veterans for participants, who often present with a multitude of factors, in addition to PTSD, that may influence the experience of pain. Recruiting individuals with PTSD who do not experience pain is also a difficult feat. These recruitment challenges in addition to the different pain induction procedures employed across studies to date complicate result comparison and limit the conclusions that can be drawn.

In conclusion, evidence to date suggests that differences in pain sensitivity exist between individuals with and without PTSD and that patients with PTSD experience reduced pain sensitivity under stressful circumstances; however, it remains unclear whether individuals with PTSD demonstrate lower or higher sensitivity to pain when not under stress. Future studies examining the dynamic and homeostatic process of pain modulation in individuals with PTSD while addressing previous limitations are needed.

### **What Theories Have Been Proposed to Explain the Co-occurrence of PTSD and Chronic Pain?**

Several theories to explain the co-occurrence of PTSD and chronic pain have garnered empirical support and have led to new interventions for this comorbidity. The most influential ones are (1) the shared vulnerability model (Asmundson et al. 2002), the triple vulnerability model (Otis et al. 2003), the mutual maintenance model (Sharp and Harvey 2001), and the mutual perpetuating model (Liedl and Knaevelsrud 2008). The first two models emphasize the existence of common risk factors for developing both PTSD and chronic pain when exposed to situations that are traumatic and painful, whereas the last two emphasized factors that interact to maintain both disorders. These models are briefly described below.

According to the shared vulnerability model (Asmundson et al. 2002), certain individual characteristics that are partially genetically determined (i.e., anxiety sensitivity, negative affectivity, tendency to avoid hazard, and intolerance of uncertainty) are common predisposing factors for both PTSD and pain disorders. Similarly, the triple vulnerability model (Otis et al. 2003) posits that three personal characteristics – namely, a lack of perception of control over pain, the traumatic situation, and its psychological consequences; a low self-efficacy and negative affect; and a tendency to respond with fear – make people vulnerable to both disorders when exposed to traumatic and painful stimuli. In contrast, the mutual maintenance model (Sharp and Harvey 2001) states that certain aspects of PTSD exacerbate pain symptoms and certain aspects of pain exacerbate PTSD symptoms. Some of the maintaining factors proposed in this model are attentional biases toward painful and hazard stimuli, anxiety sensitivity, pain as a trauma reminder, avoidance of trauma reminders and pain, fatigue and



**Fig. 1** Model relating trauma-related symptoms and chronic pain symptoms. Protective, vulnerability, and maintaining factors shared by PTSD and chronic pain which may explain their comorbidity

lethargy associated with comorbid depression and generalized anxiety, and cognitive demands generated by having to cope with symptoms of both disorders. Finally, according to the perpetuating model (Liedl and Knaevelsrud 2008), patients with PTSD demonstrate dysfunctional cognitive processes that increase their physiological and cognitive arousal. This heightened arousal leads them to avoid anxiety-provoking stimuli and increases pain. In turn, patients' increased pain may reinforce their negative beliefs about the pain and exacerbate their fear of potentially painful situations. Patients may then avoid anxiety-provoking activities and potentially painful activities, which ultimately results in more arousal, more pain, more inactivity, and depression.

The abovementioned models were proposed to explain how experiences that are both painful and traumatic lead to the co-occurrence of PTSD and pain disorders; however, according to recent findings, this co-occurrence may develop after traumatic events that do not entail pain or injury. In many cases, chronic pain precedes trauma and PTSD development. Häuser et al. (2013) found that the temporal sequence of traumatic experiences, the development of PTSD, and the development of chronic fibromyalgia pain differ among people. In a sample of 395 patients with fibromyalgia, only 4 % developed PTSD and this pain disorder during the same year following a traumatic experience. For 66.5 % of the patients, the traumatic experience and PTSD symptoms preceded the onset of fibromyalgia, which supports the idea that traumatic experiences and PTSD increase the risk of developing fibromyalgia. Nonetheless, for 29.5 % of the patients, the onset of their fibromyalgia preceded their traumatic experience and onset of PTSD symptoms, which suggests that the pain disorder may have hindered coping when confronting life stress. Therefore, it seems that the mechanisms linking PTSD and chronic pain are complex and may vary among patients. Therapists should carefully assess the personal characteristics of their patients and the context in which PTSD and pain appear when applying the aforementioned theories to particular individuals. A model representing some of the potential relationships between trauma-related symptoms and chronic pain symptoms is presented in Figure 1.

## **Which Aspects of This Comorbidity Should Therapists Take into Account?**

As evidenced in the abovementioned theories, several psychological aspects may contribute to the comorbidity of PTSD and chronic pain. Research suggests that treating common psychological aspects between the two disorders may improve treatment efficacy. Reviewed below are some of the psychological aspects to consider in treatment:

### **Anxiety Sensitivity**

Anxiety sensitivity refers to the tendency to fear anxiety-related sensations (e.g., increased heart rate, sweating) because of beliefs that such sensations will have negative physical, cognitive, or social consequences. It has been proposed as both a vulnerability and maintaining factor for PTSD and chronic pain disorders. In chronic pain samples, it is related to higher pain intensity, emotional distress, depression, pain-related anxiety, disability, and more visits to the physician (McCracken and Keogh 2009). Reducing anxiety sensitivity may lead to reductions in both arousal and pain intensity (Asmundson et al. 2014).

### **Fear of Physical Sensations and Avoidance**

Both patients with PTSD and patients with chronic pain tend to respond with intense fear to physical sensations, which in turn leads to avoidance behaviors. Thus, fear and avoidance should be targets for the treatment of both conditions. Education about the disorder mechanisms is usually an important part of cognitive-behavioral interventions. For patients presenting with PTSD and chronic pain, it may be beneficial for therapists to explain how fear and avoidance of pain, physical sensations, and negative feelings, may be aggravating symptoms of both disorders, instead of explaining models for each disorder separately. A starting point may be to introduce Liedl and Knaevelsrud's (2008) perpetuating model to patients. Subsequently conducting interoceptive exposure may be advisable, as this technique has shown promising results in reducing anxiety sensitivity, fear of pain, and PTSD symptoms (Asmundson et al. 2014).

### **Experiential Avoidance and Acceptance**

Experiential avoidance is the tendency to escape and avoid unpleasant emotions, thoughts, memories, and other private unpleasant experiences. Experiential avoidance has been associated with both PTSD and chronic pain (Esteve et al. 2012). TEI with chronic pain and PTSD have reported greater experiential avoidance than TEI with chronic pain only (Ruiz-Párraga and López-Martínez 2014). A positive association between experiential avoidance and trauma-related symptoms has also been found among chronic pain patients (Ruiz-Párraga and López-Martínez 2015), which together predicted poorer pain adjustment.

By definition, the opposite of experiential avoidance is acceptance. In order to successfully process traumatic events, individuals must be willing to remain in contact with private events (i.e., emotions, memories, bodily sensations; Hayes et al. 1996). The protective role of acceptance in the context of chronic pain is well documented. Acceptance has been associated with lower pain intensity, improved daily functioning, and better mood (McCracken and Zhao-O'Brien 2010). One study has examined the role of acceptance in pain adjustment in chronic pain patients with comorbid PTSD symptoms and found that pain acceptance was negatively related to pain intensity, pain disability, and emotional distress (Ruiz-Párraga and López-Martínez 2015).

Given the evidence for the relationship between acceptance and chronic pain adjustment, it is no surprise that patients with chronic pain have been found to respond favorably to acceptance-based therapies (Veehof et al. 2011). Preliminary support for the effectiveness of acceptance-based therapies in the treatment of anxiety disorders – including PTSD – is also available (Swain et al. 2013). Acceptance and commitment therapy is designed to foster acceptance of the unpleasant sensations (i.e., pain, arousal),

while promoting behaviors oriented to achieve patients' life goals and reduce avoidance. Acceptance and commitment therapy could be a promising treatment option for patients with concurrent PTSD and chronic pain, although efficacy trials are required.

### **Posttraumatic Cognitions and Negative Evaluation of Symptoms**

Posttraumatic cognitions have been shown to be related to pain-related variables. For example, Porter et al. (2013) found that posttraumatic negative self-beliefs were associated with pain-related impairment, which suggests that certain types of posttraumatic beliefs partially mediate the relationship between PTSD and pain impairment. Targeting negative self-beliefs in therapy may improve chronic pain outcomes.

Pain catastrophizing – an exaggerated negative orientation to noxious stimuli – is another form of negative evaluation that may improve treatment outcomes when targeted in therapy with patients with PTSD and chronic pain. Traditionally, pain catastrophizing was considered a key factor in the transition from acute to chronic pain and was therefore the focus of several cognitive-behavioral therapy protocols for chronic pain conditions. Patients with chronic pain and PTSD symptoms have recently been found to report significantly greater use of catastrophizing (Alschuler and Otis 2012; Ruiz-Párraga and López-Martínez 2014), which further supports it as a target in therapy for comorbid PTSD and chronic pain.

Pain catastrophizing and emotional numbing have been found to share some common variance (López-Martínez et al. 2014). Emotional numbing is considered a dissociative symptom, functionally similar to avoidance and escape behaviors. Recent evidence suggests that negative appraisal (e.g., catastrophic evaluation of a stressful event) may increase the dissociative response to stress (e.g., numbing). In fact, pain catastrophizing has recently been found to predict increased dissociation in response to a painful task (Gómez-Pérez et al. 2013). As such, pain catastrophizing may lead to higher levels of stress among patients with PTSD and chronic pain, which may contribute to increased numbing symptoms. This hypothesis remains to be empirically examined.

Others' responses to chronic pain and PTSD symptoms may also exacerbate symptoms of both disorders. For example, if after a trauma the victim is rejected or criticized and he/she considers the critical views of other people to be important, the victim may internalize blame for the event, which could increase PTSD symptoms (Ehlers and Clark 2000). Significant others' responses to displays of pain may also have negative consequences for individuals with PTSD and chronic pain. Punishing actions from significant others (e.g., expressions of anger) in response to displays of pain have been shown to be more prevalent among veterans with PTSD and chronic pain than among veterans with chronic pain alone (Alschuler and Otis 2012). Thus, reducing punishing responses to pain may reduce both PTSD and chronic pain symptoms. Further research and consideration in clinical practice is needed on the effect of interactions with others on the experience of chronic pain and PTSD.

### **Sleeping Problems and Other Comorbid Symptoms**

Sleep hygiene has been implicated in both PTSD and chronic pain. Between 70 % and 91 % of patients with PTSD have difficulty falling or staying asleep (Maher et al. 2006). Sleep has been hypothesized to facilitate emotional processing of traumatic events, and sleeping problems have been associated with the onset, maintenance, and exacerbation of PTSD symptoms (Maher et al. 2006). Detrimental effects of sleep issues have also been documented in individuals with chronic pain. Approximately 74.8 % of patients with chronic pain consider sleeping problems as a seminal pain treatment outcome (Turk et al. 2008). Sleep deprivation has been shown to lead to hyperalgesia and decreased thermal pain thresholds in healthy individuals (Kelly et al. 2011), which suggests a similar relationship may be found in individuals with chronic pain. Kelly et al. (2011) propose a vicious cycle between sleep and pain in that pain can interfere with sleep, which may result in increased pain the following day, leading to

**Table 2** Factors promoting resilience

Internal factors	External factors
Self-esteem	Safety
Trust	Religious affiliation
Resourcefulness	Strong role models
Self-efficacy	Emotional sustenance: the extent to which others provide the individual with understanding, companionship, sense of belonging, and positive regard (social and family support)
Internal locus of control	Access to support services
Secure attachments	Participation in community groups
Sense of humor	Community networking
Self-sufficiency	Ethical environment
Sense of mastery	Recognition
Optimism	
Acceptance of self and life	
Personal competence	
Interpersonal abilities such as social skills, problem-solving skills, and impulse control	

Internal and external factors that can be targeted to promote resilience are enumerated

further sleep problems the subsequent night. Therefore, treating sleeping problems in patients with concurrent PTSD and chronic pain may help reduce symptoms of both disorders.

### Resilience

In order to foster patients' well-being, it is important to not only target dysfunctional processes, but to promote positive characteristics and strengths. Resilience – a positive personality characteristic that moderates the negative effects of stress and promotes adaptation – has recently been shown to buffer the effects of PTSD symptomatology on pain adjustment in chronic pain samples (Ruiz-Párraga and López-Martínez 2015). Resilient TEI with chronic pain have shown more pain acceptance and engagement in valued activities, regardless of pain (Ruiz-Párraga and López-Martínez 2015). Several factors that may be addressed to increase resilience during therapy are summarized in Table 2.

### Other Factors

Depressive symptoms, decreased activity, and attentional biases have shown to also play a role in the exacerbation of PTSD and chronic pain. These factors and related treatment strategies are beyond the scope of this chapter, but have been reviewed elsewhere (see Asmundson et al. 2014) and should warrant treatment consideration.

In conclusion, growing literature suggests several psychological variables may concurrently exacerbate PTSD and chronic pain symptoms. Targeting such factors that contribute to both disorders may help improve the poor prognosis frequently reported in individuals with comorbid PTSD and chronic pain.

### Are There Treatment Programs Available for Patients with Comorbid PTSD and Pain?

Extant literature suggests that treating only one set of symptoms in patients with comorbid PTSD and chronic pain is less effective than simultaneously targeting both sets of symptoms. Unfortunately, patients with PTSD are not routinely screened for pain symptoms, and patients with chronic pain are not routinely screened for PTSD. As a result, the comorbidity between the disorders is usually undetected and untreated. Nevertheless, several promising therapies are now available for these patients. Most of these

**Table 3** Integrated treatment for PTSD and chronic pain (Otis et al. 2009)

Session	Topic
1	Education on chronic pain and PTSD and goal setting
2	Making meaning of pain and PTSD
3	Thoughts/feelings related to pain and PTSD and cognitive errors
4	Cognitive restructuring
5	Diaphragmatic breathing and progressive muscle relaxation
6	Avoidance and interoceptive exposure
7	Pacing and pleasant activities
8	Sleep hygiene
9	Safety/trust (related to pain and PTSD)
10	Power/control/anger (related to pain and PTSD)
11	Esteem/intimacy (related to pain and PTSD)
12	Relapse prevention and flare-up planning

The treatment sessions developed by Otis et al. (2009) for patients with PTSD and chronic pain are shown (Reproduced with permission from John Wiley and Sons, July 24, 2014)

treatments are aimed to reduce symptoms that are hypothesized to act as common vulnerabilities or maintaining factors for both disorders (see sections “[What Theories Have Been Proposed to Explain the Co-occurrence of PTSD and Chronic Pain?](#)” and “[Which Aspects of This Comorbidity Should Therapists Take into Account?](#)”).

Treating comorbid chronic pain and PTSD must begin with a thorough assessment of each condition, which includes a comprehensive clinical diagnostic interview (Otis et al. 2003). During the treatment, several outcome measures should be administered at specified and repeated intervals. The interventions applied should undoubtedly have received empirical support, either individually or as part of a multidisciplinary treatment approach (Bosco et al. 2013). Interoceptive exposure, physical activity, and attention modification are all therapeutic strategies that have demonstrated evidence of effectiveness in reducing PTSD or pain-related outcomes (Asmundson et al. 2014).

Several integrated intervention programs are available for patients with comorbid PTSD and chronic pain. The first of them – developed by Otis et al. (2009) in a sample of war veterans – focuses on cognitive restructuring and combines components of the cognitive processing therapy for PTSD and the cognitive-behavioral therapy for chronic pain management. It comprises 12 sessions covering psychoeducation, cognitive restructuring, emotion regulation strategies, and other issues related to both disorders (see Table 3). Results of a pilot study suggested that participants who completed this program responded well to therapy and reported satisfaction with it (Otis et al. 2009). A randomized controlled trial for this program is currently being conducted by these researchers:

McGeary et al. (2011) developed a prolonged exposure treatment for active duty military personnel with PTSD and chronic pain based on Otis et al.’s (2009) program. The protocol integrated an abbreviated prolonged exposure PTSD treatment into a multidisciplinary pain treatment for orthopedic trauma patients. The efficacy of this intervention is currently being investigated.

More recently, Bosco et al. (2013) have developed a multidisciplinary behavioral health program, which is administered to war veterans at the Center for Post-Deployment Health and Education (Florida, USA). It addresses concurrent overlapping symptoms of pain, PTSD, and mild cognitive complaints. It focuses on improving daily functioning, increasing quality of life, and decreasing avoidance behaviors. Participants in the program engage in physical therapy, psychoeducational groups, and individual cognitive-behavioral therapy and receive medication management as needed. The core cognitive-behavioral therapy ingredient is exposure to fear stimuli. Participants are first educated on the way

**Table 4** Center for Post-Deployment Health and Education program treatment goals and interventions (Bosco et al. 2013)

Treatment goal	Intervention
Educate about the relationship between thoughts, emotions, and behaviors	Psychoeducation
Increase awareness about the interaction between chronic pain, emotional functioning, and cognitive functioning	
Educate about the role of cognitions in emotional and behavioral functioning	
Educate about the interactions between chronic pain and PTSD	
Educate about the role of fear avoidance in the development and maintenance of chronic pain and PTSD	
Reduce chronic pain and PTSD-related avoidance behaviors via systematic practice of increasingly challenging avoid stimuli	Construction of an in vivo hierarchy
Facilitate engagement in enjoyable activities to improve mood and challenge any inherent avoidances	Include behavioral activation activities on in vivo hierarchy
Correct attentional biases	Education, identification, and cessation of safety behaviors
Normalize emotional experiences or responses and associated physiologic sensations	Normalization, education about fight or flight response, ongoing identification, and systematic confrontation of avoidance or escape behaviors via real-life exercises/activities
Reduce tension, regulate distressing physiologic sensations	Structured relaxation training to decrease stress yet preclude buffering from feared stimuli
Reduce PTSD and other trauma-related symptoms	Prolonged exposure

The multidisciplinary program developed by Bosco et al. (2013) for patients with PTSD and chronic pain is shown (Reproduced with permission from Michelle A. Bosco, May 20, 2014)

PTSD and pain symptoms develop. Subsequently, a hierarchy of avoidance stimuli (related to both PTSD and pain) is built. Depressive symptoms are then addressed, usually by incorporating behavioral activation strategies into the stimuli hierarchy. Then, cognitive restructuring is conducted either directly (i.e., challenging automatic thoughts) or indirectly (i.e., strengthening self-esteem and sense of efficacy). Afterward, attentional biases are targeted. Thereafter, emotional responses and contributing physiological sensations are normalized. Finally, structured relaxation training takes place (see Tables 4 and 5). Participants may also concurrently receive additional physical health or mental health treatment for other significant health-related issues. The efficacy of this intervention remains to be examined.

Finally, the Integrated Management of Pain and PTSD in returning Operation Enduring Freedom/Operation Iraqi Freedom/Operation New Dawn Veterans (IMPPROVE; Plagge et al. 2013) implements a collaborative approach focusing on behavioral activation to treat comorbid PTSD and chronic pain. IMPPROVE comprises an initial biopsychosocial evaluation and up to eight behavioral activation sessions involving primary care, mental health, and other clinicians. During the program, a physiatrist assists the psychologist in providing recommendations to primary care providers. An initial pilot study supported the feasibility of this intervention (Plagge et al. 2013). Treatment completers indicated improvements in PTSD symptoms, pain severity, pain disability, depressive symptoms, pain catastrophizing, fear avoidance, life satisfaction, and quality of life and, in general, were satisfied with the intervention. However, about half of the patients did not complete treatment.

In conclusion, several integrative programs have been developed for patients with comorbid PTSD and chronic pain. Nonetheless, all of them are aimed to treat military populations, and only preliminary data regarding the effectiveness of these programs are available. Integrative treatments for civilian populations

**Table 5** Main aspects of the IMPPROVE (Plagge et al. 2013)

Treatment planning	
Assessments	Biopsychosocial assessment (pain, PTSD, depression, substance abuse, treatment history, current functioning, and mental status)
	Assessment of treatment progress, guide treatment, and intervention effectiveness
Collaborative care management	Coordination between psychologist, psychiatrist, veterans, and services
	Cases are discussed weekly, and recommendations are summarized in the electronic medical record for the primary care providers (PCPs)
	The psychiatrist, PCPs, and referring provider receive feedback on the veteran's progress and engagement at mid- and posttreatment (including follow-up plans and any further recommendations)
Behavioral activation psychotherapy	Education about chronic pain and PTSD and behavioral activation rationality
	Identification of life values, collaborative development of treatments goals, and identification of barriers to these goals
	Identification of areas for activation and scheduling activities in order to increase awareness of the interactions among activities, emotions, and pain levels and identify helpful and unhelpful behavioral patterns
	Active problem-solving, motivational interviewing, relaxation strategies, time-based pacing, anger management, assertiveness training, activity scheduling, behavioral experiments, grounding, adaptive coping statements, and educations
	Review of the veteran's values, associated goals, and progress
	Review and relapse prevention planning (identification of relapse warning signs, strategies to handle triggers, and ways to maintain engagement in activities consistent with values)

The treatment plan designed by Plagge et al. (2013) for patients with PTSD and chronic pain is shown. IMPPROVE = Integrated Management of Pain and PTSD in Returning Operation Enduring Freedom/Operation Iraqi Freedom/Operation New Dawn Veterans

exposed to other traumatic events need to be designed. Randomized controlled trials are needed in both military and civilian populations.

### What Important Issues Still Need to Be Researched?

Research on the mechanisms linking PTSD and chronic pain started more than one decade ago; however, several aspects of the extant theories remain to be empirically examined despite the growing development of this field. Studies that take into account biological and psychological aspects of trauma and pain and address other limitations of previous research (reviewed above) are needed to clarify the effect of traumatic stress on the pain modulation system. The efficacy of interventions concurrently addressing PTSD and chronic pain symptoms remains to be established, and health programs to adequately screen for and treat this comorbidity must be developed and tested. Finally, preventative efforts, such as further research into resiliency variables, could help circumvent the detrimental effects of posttraumatic disorders such as PTSD and chronic pain.

### Practice and Procedures

In light of the information summarized above, we recommend professionals systematically screen for acute or chronic pain in patients with PTSD and utilize interventions addressing both disorders. Similarly, health professionals assisting patients with chronic pain should screen for and treat symptoms of PTSD, especially given that PTSD treatments (not directly addressing chronic pain) have shown to reduce self-reported pain intensity (Shipherd et al. 2007). When available, patients should be referred to

multidisciplinary treatments programs in which both PTSD and pain are targeted. Training professionals to specialize in understanding and treating this comorbidity will improve the care of patients suffering from both disorders.

## Summary Points

- Chronic pain and PTSD are highly comorbid disorders and are associated with a worse prognosis for patients when experienced together. The causal relationship between the two disorders remains unclear, but research suggests PTSD may cause alternations in the pain modulation system, which may predispose individuals to develop chronic pain.
- Under stress, patients with PTSD experience reduced pain sensitivity, but it remains unclear whether they demonstrate lower or higher sensitivity to pain when not under stress.
- Certain psychological variables exacerbate both PTSD and chronic pain symptoms. Concurrently addressing them in therapy may improve the poor prognosis often associated with comorbid PTSD and chronic pain.
- Preliminary support exists for multidisciplinary intervention programs for military populations; however, the need for integrative treatments for civilian populations remains.
- Therapists should screen for acute or chronic pain in patients with PTSD and for PTSD among chronic pain patients. When available, patients should be referred to multidisciplinary treatments programs targeting both disorders.

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