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PERSPECTIVE

Clinical biopsychosocial physiotherapy assessment of patients with chronic pain: The first step in pain neuroscience education

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ABSTRACT

Pain neuroscience education (PNE) is increasingly used as part of a physical therapy treatment in patients with chronic pain. A thorough clinical biopsychosocial assessment is recommended prior to PNE to allow proper explanation of the neurophysiology of pain and the biopsychosocial interactions in an interactive and patient-centered manner. However, without clear guidelines, clinicians are left wondering how a biopsychosocial assessment should be administered. Therefore, we provided a practical guide, based on scientific research and clinical experience, for the biopsychosocial assessment of patients with chronic pain in physiotherapy practice. The purpose of this article is to describe the use of the Pain – Somatic factors – Cognitive factors – Emotional factors – Behavioral factors – Social factors – Motivation – model (PSCEBSM-model) during the intake, as well as a pain analysis sheet. This model attempts to clearly establish what the dominant pain mechanism is (predominant nociceptive, neuropathic, or non-neuropathic central sensitization pain), as well as to assess the provoking and perpetuating biopsychosocial factors in patients with chronic pain. Using this approach allows the clinician to specifically classify patients and tailor the plan of care, including PNE, to individual patients.

Introduction

Chronic pain, also described as "pain that persists beyond normal time of healing and/or pain persisting for 3–6 months or longer" (Merskey, 1994), is a huge global issue and major healthcare problem (European Pain Federation, 2010), with a prevalence of 17–27% in populations all over the world (Blyth et al, 2001; Breivik et al, 2006; Leadley et al, 2012; Reid et al, 2011). In the US, chronic pain is more prevalent than diabetes, heart disease, and cancer combined (American Cancer Society, 2014; American Diabetes Association, 2012; American Heart Association, 2011). Chronic pain is associated with increased medical costs, decreased income, and huge economic burdens (Bekkering et al, 2011; van Tulder, Koes, and Bouter, 1995), and has a large negative impact on the patients' quality of life (Bekkering et al, 2011; Breivik et al, 2006).

In the last few decades, evidence has shown that a more or less irreversible state of hyperexcitability within the central nervous system, known as non-neuropathic central sensitization pain (CS), is present in patients with chronic pain (Koltzenburg, Torebjork, and Wahren, 1994; Latremoliere and Woolf, 2009; Torebjork, Lundberg, and LaMotte, 1992). According to Woolf and Salter (2000) CS is operationally defined as an amplification of neural signaling within the central nervous system that elicits pain hypersensitivity. CS is characterized by generalized hypersensitivity of the somatosensory system (Coombes, Bisset, and Vicenzino, 2012; Fernandez-Carnero et al, 2009; Moloney, Hall, and Doody, 2013; van Wilgen et al, 2013), resulting in amplification of signaling and eventually even pain without nociceptive input.

It is known that in patients with pain syndromes such as: fibromyalgia (Meeus and Nijs, 2007; Staud, 2011; Vierck, 2006); persisting traumatic neck pain (Herren-Gerber et al, 2004; Jull, Sterling, Kenardy, and Beller, 2007; Sterling, 2008; Sterling, Jull, Vicenzino, and Kenardy, 2003; Sterling, Treleaven, Edwards, and Jull, 2002); tension-type headache (Buchgreitz et al, 2008); migraine (de Tommaso et al, 2012); subacromial impingement syndrome (Paul,

Soo Hoo, Chae, and Wilson, 2012); tennis elbow (Coombes, Bisset, and Vicenzino, 2012; Fernandez-Carnero et al, 2009); nonspecific arm pain (Moloney, Hall, and Doody, 2013); low back pain (Giesecke et al, 2004; Roussel et al, 2013; Staud, 2011); pelvic pain (Farmer et al, 2011; Yang et al, 2003); chronic fatigue syndrome (Meeus et al, 2008); osteoarthritis (Mease, Hanna, Frakes, and Altman, 2011; Staud, 2011; Suokas et al, 2012); rheumatoid arthritis (Meeus et al, 2012); and tendinopathy (van Wilgen et al, 2013), the pain often cannot be explained (solely) by an obvious anatomic defect or tissue damage. In fibromyalgia, chronic whiplash, chronic fatigue syndrome, and irritable bowel syndrome CS is merely the predominant underlying pain mechanism (Nijs et al, 2012; Nijs, Van Houdenhove, and Oostendorp, 2010; Staud, 2011). In other chronic pain populations, such as low back pain and osteoarthritis, a subgroup may be present with predominant CS pain (Buchgreitz et al, 2008; de Tommaso et al, 2012; Mease, Hanna, Frakes, and Altman, 2011; Meeus et al, 2012; Nijs, Van Houdenhove, and Oostendorp, 2010; Paul, Soo Hoo, Chae, and Wilson, 2012; Smart, Blake, Staines, and Doody, 2011; Smart et al, 2012; Staud, 2011; Suokas et al, 2012).

The neurophysiological changes in CS are related to changes in the pain neuromatrix, modulating pain processes by behavioral, emotional, social, and cognitive factors (Turk and Okifuji, 2002). It is known that pain catastrophizing (Gracely et al, 2004), pain-related anxiety (Gracely et al, 2004; Hirsh, George, Bialosky, and Robinson, 2008; Leeuw et al, 2007; Vlaeyen and Linton, 2000), trait anxiety (Hirsh, George, Bialosky, and Robinson, 2008; Sullivan, Thorn, Rodgers, and Ward, 2004) (trait anxiety is the personal level of anxiety), trait neuroticism (personal level of negative affectivity) (Evers, Kraaimaat, van Riel, and Bijlsma, 2001), depressive feelings and stress (Kuehl et al, 2010; McEwen and Kalia, 2010; Rivat et al, 2010), diminished self-efficacy (Turk and Okifuji, 2002), adverse life events (Generaal et al, 2016), and posttraumatic stress disorders (Cohen et al, 2002; Daenen et al, 2014; Sherman, Turk, and Okifuji, 2000; Sterling and Chadwick, 2010; Sterling, Hendrikz, and Kenardy, 2010) are present to varying degrees in patients with chronic pain. These can be a consequence of pain and/or can contribute to the transition and persistence of chronic pain. Emotions, thoughts, attention, and stress can influence the pain-facilitating pathways (Zusman, 2002), thereby leading to cognitive emotional sensitization (Brosschot, 2002). Catastrophizing, for instance, is related to activation of the pain neuromatrix, increased pain, affective distress, pain-related disability, and poorer treatment outcomes (Edwards, Bingham, Bathon, and Haythornthwaite, 2006; Gracely et al, 2004). Therefore, the initial

examination should take into account both somatic (bottom-up, pathoanatomical, peripheral signals) and psychosocial (top-down, dis-inhibition, or pain facilitation) factors.

Therefore a thorough clinical biopsychosocial assessment is required to understand the process of CS and allow an individualized, patient-centered explanation including biopsychosocial interactions, also known as pain neuroscience education (PNE) (Gallagher, McAuley, and Moseley, 2013; Louw, Diener, Butler, and Puentedura, 2011; Meeus et al, 2010; Moseley, 2002; Moseley, 2004; Moseley and Butler, 2013; Moseley, Nicholas, and Hodges, 2004; Nijs et al, 2011a; Van Oosterwijck et al, 2011; Van Oosterwijck et al, 2013). However, without clear guidelines, clinicians are left wondering how such biopsychosocial assessment should be carried out and how it allows for an interactive and patient-centered PNE. Therefore, the purpose of this paper is to provide a practical guide, based on scientific research and clinical experience, for the biopsychosocial assessment of patients with chronic pain in physiotherapy practice.

Intake

To facilitate the biopsychosocial intake of patients with chronic pain, we suggest the use of the PSCEBSM model (based on the SCEBS model (Speckens, 2004) plus pain and motivation): Pain – Somatic and medical factors – Cognitive factors – Emotional factors – Behavioral factors – Social factors – Motivation. This model starts with examining and determining the type of pain, continues with identifying the different factors associated with chronic pain, and ends with determining the stage of motivation of the patient. A flowchart of the model for use in clinical practice is offered in Figure 1. The pain analysis sheet (Figure 2) can be used to provide a clear overview of the PSCEBSM model, and guide the content of PNE and treatment. The use of this model takes time, modifications in clinical care, and needs adequate biopsychosocial communication skills.

P – type of pain

In order to allow tailoring PNE to the underlying pain mechanisms, it is important to differentiate between the three major pain types (nociceptive, neuropathic, and CS pain) (Figure 2). An algorithm with a set of classification criteria for differentiating predominant neuropathic, nociceptive and CS pain in patients with musculoskeletal pain has been proposed by 18 pain experts from seven countries (Nijs et al, 2014). To identify the predominant pain type, two steps need to

Table 1. Criteria for the differential classification between predominant neuropathic (Haanpää and Treede, 2010; Haanpää et al, 2011; Treede et al, 2008) and central sensitization pain. Adapted from Nijs et al. (2014).

Nociceptive pain	Neuropathic pain	Non-neuropathic CS pain
History of damage to body tissue in the previous 6–8 weeks.	History of a lesion or disease of the nervous system, or posttraumatic/ postsurgical damage to the nervous system.	No history of a lesion, damage, or disease of the nervous system.
Pain diminishes according to the natural healing phases.	Indications from diagnostic examinations to reveal an anomaly of the nervous system.	No indications from diagnostic examinations.
Related to tissue damage or potential damage. An ankle sprain or almost burning a hand.	Related to a medical or systemic cause such as stroke, herpes, diabetes, or some form of neurodegenerative disease.	No medical cause for the pain established.
Local pain, most often with diagnostic signs such as edema, hematomas, skin colorations, etc.	Pain and sensory dysfunction are neuroanatomical logical.	Pain is neuroanatomical illogical and segmentally unrelated to the primary source of nociception. Several regions of hyperalgesia at sites outside and remote to the symptomatic area (still at segmentally unrelated sites).
Pain is described as sharp, aching, or throbbing.	Pain is frequently described as burning, shooting, or pricking	Pain is most frequently described as vague and dull.

be taken. The first step entails recognizing neuropathic pain as the predominant pain type. Neuropathic pain is defined as "pain arising as a direct consequence of a lesion or disease affecting the somatosensory system" (Treede et al, 2008). Table 1, adapted from (Nijs et al, 2014), which shows the clinical differentiation between predominant nociceptive, non-neuropathic CS pain and neuropathic pain. In line with the diagnostic criteria for neuropathic pain (Treede et al, 2008), central neuropathic pain can be distinguished from CS pain by the lack of damage to the nervous system in the latter group.

The second step is to differentiate between predominant nociceptive and CS pain. The pain is more likely to be originated from CS if the perceived pain and disability are disproportionate to the nature of the injury or pathology (Nijs et al, 2014) AND one of the following two criteria: 1) The presence of a diffuse or neuro-anatomically illogical pain distribution (Nijs et al, 2014) that is not in accordance with dermatomes and myotomes. A widespread pain index (also known as body diagram) can be used to assess the pain distribution by mapping the pain locations (Margolis, Chibnall, and Tait, 1988; Margolis, Tait, and Krause, 1986).

The widespread pain index, which includes 19 body regions (each region that has pain is given a point, for a range of scores from 0 to 19 points), can be used to aid in this process (Wolfe et al, 2010). A score of 7 or greater suggests widespread pain. 2) Hypersensitivity of senses unrelated to the musculoskeletal system (Nijs et al, 2014), which can be assessed using the Central Sensitization Inventory (CSI) (Table 2). This includes hypersensitivity to light, sounds, smell, taste, and a hypersensitive skin. The CSI appears to be a valid, reliable, usable, and diagnostically relevant questionnaire assessing common symptoms and facilitating factors to CS in 25 items (Kregel et al, 2015; Mayer et al, 2012). Based on a validation study, a cutoff score of 40 points indicates the possibility that the symptoms are due to predominant CS pain (Neblett et al, 2014; Neblett et al, 2015). However, the score of the CSI should be interpreted with caution and in accordance with the clinical symptoms of the patient. More detailed information regarding differentiating between predominant nociceptive and CS pain and how to apply this information in clinical practice can be found in the original paper (Nijs et al, 2014), or adopted for low back pain patients in a more recent paper (Nijs et al, 2015).

The outcome of the mechanism-based classification of pain types can be either predominant nociceptive, neuropathic, CS, or a mixed type of pain. The next step is to identify which factors play a role in the continuation of the patient's pain. These factors can be divided according to the other domains of the PSCEBSM model.

S – somatic and medical factors

In patients with CS, somatic and medical factors that may be present include: other (past and present) illnesses that might influence CS; nonuse or disuse of body parts; changed movement patterns; exercise capacity; and strength and muscle tension/tonus during movements. Medication can have (positive/negative) side effects. Therefore other medical issues and drug use should ideally be examined by a medical physician; however, a physiotherapist's basic understanding of pathophysiology and medications interacting with the central nervous system is important when providing PNE. Physiotherapists are indeed capable of gathering this type of information. However, the prescription, administration, and modification of medications should be performed by a physician.

Following the intake, a thorough physical examination should take place. It is important to recognize that in the presence of CS, findings on clinical tests such as the Straight Leg Raise, Upper Limb Neurodynamic Tests (ULNTs) and assessments of movement or

Table 2. Cutoff scores and implications for the questionnaires used during the biopsychosocial intake.

Questionnaire	Range/Cutoff score	Implications	Psychometrics	Practical issues	Used by the authors in clinical practice
Central Sensitization Inventory (CSI) (Mayer et al, 2012; Neblett et al, 2014, 2015)	0–100/>40 points	Symptom presentation may indicate the presence of CS pain	Test–retest reliability 0.82 Cronbach's alpha 0.88 Sensitivity 81–82,8%, Specificity 54.8–75%	Number of items: 35 Time to administer: 10 min	Yes
Leeds Assessment of Neuropathic Symptoms and Signs (LANSS) (Bennett, 2001)	0–24/≥12 points	Neuropathic mechanisms are likely to contribute to the patient's pain	Cronbach's alpha of 0.74 Sensitivity 83%, Specificity 87% Good validity and reliability	Number of items: 7 Time to administer: 2–3 min	If necessary
Body diagram (Wolfe et al, 2010)	–	No cutoff score exists	–	Time to administer: 5 min	Yes
Brief Illness Perception Questionnaire (Brief IPQ) (Broadbent, Petrie, Main, and Weinman, 2006; Leysen et al, 2015)	–	Each item has to be viewed separately	Moderate overall test–retest reliability Good concurrent, predictive and discriminant validity	Number of items: 13 Time to administer: 5–10 min Available on: http://www.uib.no/ipq/index.html	Yes
Pain Catastrophizing Scale (PCS) (Osman et al, 1997; Sullivan, Bishop, and Pivik, 1995)	≥30 points	The patient is likely to catastrophize if the score is above 30 Higher scores indicate higher catastrophizing	Cronbach's alpha 0.88–0.95 Good construct, criterion, concurrent and discriminant validity(Osman et al, 2000)	Number of items: 13 Time to administer: 5–10 min Subscales: Rumination: items 8, 9, 10, 11 Magnification: items 6, 7, 13 Helplessness: items 1, 2, 3, 4, 5, 12	Yes
State-Trait Anxiety Inventory (STAI) (Spielberger, 1989)	≥39–40 (Knight, Waal-Manning, and Spears, 1983) ≥54–55 for older adults (Kvaal, Ulstein, Nordhus, and Engedal, 2005)	Two subscales: State and Trait, range of scores 20–80 per subtest Higher scores indicate greater anxiety	Test–retest reliability 0.31–0.86 Cronbach's alpha 0.86–0.95 (Julian, 2011) Validity S-scale limited	Number of items: 40 Time to administer: 10 min State Anxiety: current state of anxiety Trait Anxiety: relatively stable aspects of "anxiety proneness"	If necessary
Tampa-Scale of Kinesiophobia (TSK) (Vlaeyen, Kole-Snijders, Boeren, and van Eek, 1995)	≥37	The patient most likely has fear of movement Higher scores indicate greater fear of movement	Moderate construct, concurrent and predictive validity, good internal consistency, and a moderate to good retest reliability (Roelofs et al, 2004; Swinkels-Meewisse et al, 2003)	Number of items: 17 Time to administer: 5–10 min The scoring on items 4, 8, 12, and 16 should be reversed	If necessary
Injustice Experience Questionnaire (IEQ) (Sullivan et al, 2008)	≥19 in WAD* (Scott, Trost, Milioto, and Sullivan, 2013)	Above this score perceived injustice is associated with high pain severity, not returning to work, and narcotic use Higher scores indicate more perceived injustice	Cronbach's alpha 0.92 Test–retest reliability 0.90–0.98 (Rodero et al, 2012; Sullivan et al, 2008) Good construct validity	Number of items: 12 Time to administer: 5–10 min Subscales: Blame/Unfairness: items 3, 7, 9, 10, 11, 12 Severity/Irreparability: items 1, 2, 4, 5, 6, 8	Yes

(Continued)

Table 2. (Continued).

Questionnaire	Range/Cutoff score	Implications	Psychometrics	Practical issues	Used by the authors in clinical practice
Psychological Inflexibility in Pain Scale (PIPS) (Wicksell, Lekander, Sorjonen, and Olsson, 2010)	–	No cutoff score exists. Higher scores indicate less psychological flexibility	Cronbach's alpha 0.90 (avoidance), 0.75 (fusion), and 0.89 (total scale). Intercorrelation between subscales 0.46. Acceptable model fit. Good construct and concurrent validity	Number of items: 16. Time to administer: 5–10 min. Subscales: Avoidance of pain: items 2, 3, 7, 8, 9, 11, 13, 14, 15, 16. Fusion with pain thoughts: items 1, 4, 5, 6, 10, 12	If necessary
Center for Epidemiologic Studies Depression scale (CES-D) (Eaton, 2004)	≥16	Indicative of "significant" or "mild" depressive symptomatology. Higher scores indicate more depressive feelings	Cronbach's alpha 0.88–0.91. Test-retest reliability ICC = 0.87, individual items ICC = 0.11–0.73. Poor to excellent validity. Sensitivity 80.0%, Specificity 69.8% (Kuptniratsaikul, Chulakadabba, and Ratanavijitrasil, 2002; LaChapelle and Alfano, 2005)	Number of items: 20. Time to administer: 5–10 min. Subscales: Somatic-retarded activity: items 1, 2, 3, 5, 7, 11, 20. Depressed affect: items 6, 10, 14, 17, 18. Positive affect: items 4, 8, 12, 16. Interpersonal affect: items 15, 19	If necessary
PHQ-2 and PHQ-9 (Arroll et al, 2010)	PHQ-9: >10	Indicative of a depressive disorder. Higher scores indicate more depressive feelings	Cronbach's alpha 0.86–0.89. PHQ-9 cutoff score of >10: Sensitivity 88%, specificity 88%. Good criteria validity (Arroll et al, 2010; Kroenke, Spitzer, and Williams, 2003)	PHQ-2: Number of items: 2. Time to administer: 1 min. PHQ-9: Number of items: 9. Time to administer: 5–10 min. Patients who screen positive on the PHQ-2 should be further evaluated with the PHQ-9 to determine if they meet the criteria for a depressive disorder. Time to administer: 10–15 min	If necessary
Activity Diary	–	Cutoff scores are not necessary.	–		Yes

*WAD: Patients with Whiplash Associated Disorders.

muscle strength can be altered due to the CS sensitivity. Due to the increased sensitivity to mechanical stimulations and changed patterns in the central nervous system in patients with CS, all physical examination tests (e.g. range of motion, strength, muscle tone, neurodynamic tests, and movement coordination) can evoke pain. Therefore, the aim of the physical examination is to support or refute the clinical picture of CS, assess movement quality, determine body movement if the manner in which the patient moves provokes symptoms consistent with CS (e.g. very guarded or with a lot of tone), and determine whether there is fear of movement. In the case of positive findings, clinical reasoning skills are required to decide whether or not such physical factors are of clinical importance for the individual patient and whether or not it contributes in the persistence of CS pain. Positive findings could be: bracing when bending; holding his/her breath while moving; increased tonus prior to movement; verbal or nonverbal signs of fear; and inconsistent movement patterns.

The physical examination is important for both the physiotherapist and the patient. By assessing complaints thoroughly, both parties can be reassured that anything dangerous/serious can be ruled out and confidence is restored that the patient's pain is taken seriously.

C – cognition/perceptions

As discussed previously, cognitions and perceptions are important factors that might contribute to (the maintenance of) CS pain. Besides influencing the hypersensitivity in the brain by activating the pain neuromatrix (Lee, Zambreanu, Menon, and Tracey, 2008), they also influence the behavioral and emotional factors of patients (Leventhal, Brissette, and Leventhal, 2003). During history taking, the patient's perceptions and cognitions should be assessed thoroughly. Most important are his/her perceptions about the physical and mental aspects of pain as well as the consequences. Furthermore the following factors should be assessed: the expectations for care (anticipated outcome, as well as the content of the treatment); expectations regarding the prognosis of their pain; the coherence (the patients' ability to comprehend their whole situation and their capacity to use available resources to deal with their pain); and emotional representation of the pain. Cognitive patterns, such as catastrophizing, perceived injustice, or perceived harm, are important to recognize.

In the following section several diagnostic questionnaires are suggested to support the clinician. Not all questionnaires have to be used; rather clinicians can decide based on their perceptions and the patient's characteristics. Table 2 provides the cutoff scores, clinical implications, and psychometric information for all questionnaires.

Pain perceptions

The Brief Illness Perception Questionnaire (Brief IPQ) can be used to assess pain perceptions of the patient. The Brief IPQ consists of 13 items and is based on the Common Sense Model of Self-regulation (Leventhal, Brissette, and Leventhal, 2003) (described in Behavioral factors) and has a moderate overall test–retest reliability and good concurrent validity (Broadbent, Petrie, Main, and Weinman, 2006; Leysen et al, 2015). The questionnaire ends with a three-item rank to list the personal causes of the illness. In addition, the Brief IPQ assesses the expectations for care (items 2 and 4) as well as self-efficacy (item 3). Items 6 and 7 refer to worrying about and understanding pain, respectively. With our clinical expertise patients scoring high (≥6) on "worrying about their pain" and low (≤4) on "understanding their pain" could potentially benefit from PNE for decreasing worrying and improving the understanding of their condition.

Pain catastrophizing

When pain catastrophizing is suspected, the Pain Catastrophizing Scale (PCS) can be used to assess the degree of pain catastrophizing. The PCS is a valid and reliable 13-item questionnaire (Table 2) that examines the rumination, magnification, and helplessness patients have about their perceived ability to manage their pain (Osman et al, 1997; Sullivan, Bishop, and Pivik, 1995). In order to avoid prejudices, we propose omitting the words "pain catastrophizing scale" from the questionnaire when handing it over to the patient. If the patient scores high (≥30) on the PCS, their feelings and cognitions on catastrophizing should be acknowledged and explored in the PNE session. The patient should also be told that catastrophizing increases the activity in the pain signature in the brain and therefore increases their pain.

E – emotional factors

Emotional factors are related to cognitions and perceptions and include anxiety, anger, fear, depressive feelings, and posttraumatic stress. Physiotherapists can specifically ask about emotional factors related to the onset of pain, such as fear of specific movements, avoidance behaviors, a psychological traumatic onset of the pain, or psychological issues including work, family, financial, or social.

Anxiety

State anxiety (related to an event) and trait anxiety (personal level of anxiety) are important factors in chronic pain. In addition to questioning the patient about anxiety, we recommend using the State-Trait Anxiety Inventory (STAI). This questionnaire has 20 items for assessing trait anxiety and 20 for state anxiety. The STAI has a good internal consistency, is reliable, and has considerable construct and concurrent validity (Spielberger, 1989). A cutoff score of 39–40 has been suggested to detect clinically significant symptoms and a higher cutoff score of 54–55 has been suggested for older adults (Knight, Waal-Manning, and Spears, 1983; Kvaal, Ulstein, Nordhus, and Engedal, 2005). If the outcome of the STAI indicates that the patient has anxiety, either state or trait, the effects of this anxiety should be explored and discussed in the PNE session.

Fear of movement

Based on previous experiences, patients can become fearful and begin to avoid potentially painful movements. The Tampa-Scale of Kinesiophobia (TSK) is a 17-item scale that measures the somatic focus of patients (beliefs about underlying and serious medical problems), and activity avoidance (beliefs about (re) injury or increased pain). The TSK has moderate construct, concurrent and predictive validity, good internal consistency, and a moderate to good retest reliability (Roelofs et al, 2004; Swinkels-Meewisse et al, 2003). Patients scoring high on the TSK, above 37 points, are likely to have fear of movement (Vlaeyen, Kole-Snijders, Boeren, and van Eek, 1995) and during the PNE session the effects of fear of movement on the pain neuromatrix in the brain (by increased activity in the hypothalamic–pituitary–adrenal axis and increased attention) should be explained.

Anger

Perceived injustice as a form of anger can be measured using the Injustice Experience Questionnaire (IEQ). Perceived injustice can have negative effects on pain, disability, and treatment. For example, patients developing chronic pain following a car accident do not present with perceived injustice or anger in the acute stage, but develop it throughout the transition phase toward chronicity, with marked increased levels in the chronic stage (and not in those recovering) (Ferrari, 2015). Therefore, we recommend the use of the IEQ on patients who are suspected of having anger/perceived injustice such as a patient who develops chronic pain following a car accident. The IEQ has a high internal consistency, a good construct validity, and reliability (Sullivan et al, 2008). If high scores (>19) on this questionnaire are present, this can be used to focus part of the PNE, by first acknowledging their feelings of anger and injustice, and then explaining that such emotions sustain the pain signature in the brain and may present barriers to improvement.

Depressive feelings

Physiotherapists are not trained to diagnose depression or other psychological states, but should be aware of their existence and role in pain patients. Depressive feelings can be assessed through self-report questionnaires. The two-item Patient Health Questionnaire-2 (PHQ-2) and nine-item PHQ-9 are commonly recommended for depression screening in clinical and research settings. The PHQ-2 is a quick and helpful screening tool for depression, with a sensitivity of 86% and specificity of 78 (Arroll et al, 2010). Patients who report more than 2 points or higher on the PHQ-2 should be further evaluated with the PHQ-9. A score of 10 or higher on the PHQ-9 detects depression. The PHQ-2 has a high sensitivity (86%) and the PHQ-9 has higher specificity (91%) (Arroll et al, 2010). Additionally, the Center for Epidemiologic Studies Depression scale (CES-D) (Eaton, 2004) can be used. The CES-D is a 20-item self-report measure of depressive symptomatology during the past week. Scores of 16 or greater indicate more severe symptoms. The CES-D has a high internal consistency, good reliability, and convergent and divergent validity (Van Dam and Earleywine, 2011). Patients scoring high on this or any other scale for measuring depressive feelings need support, acknowledgement, comfort, and help, each of which can be provided in part by PNE.

There is a bidirectional relationship between depression and pain (Kroenke et al, 2011); however, because patients are often fearful of being labeled ("it's in your head"), we suggest explaining to patients with chronic pain that depression may be a consequence rather than a cause of chronic pain. Furthermore, we suggest explaining the interplay between pain and depression in the pain neuromatrix during PNE.

Stress

Physiotherapists are suggested to screen their patients for posttraumatic stress disorder by asking the patient about prior traumatic events and whether they frequently relive the event, avoid situations that remind them of the event, or have negative changes in beliefs and feelings since the event. In addition, physiotherapists should also evaluate general levels of stress and/or stress intolerance. Stress can be related to work factors, relationships, financial stress, health-related stress, etc.

and should be investigated during the assessment. If relevant to the individual patient, the influence of stress on the pain neuromatrix and top-down inhibitory pathways should be explained during PNE.

B – behavioral factors

For physiotherapists it is important to assess current behavior and adaptations made as a consequence of pain. Both conscious and nonconscious behavior can be the product of cognitive and emotional information when perceiving and interpreting inputs or perceived threats to health and well-being (Leeuw et al, 2007; Leventhal, Brissette, and Leventhal, 2003; Pavlov, 1927; Skinner, 1938).

Patients can be roughly divided into three subgroups: 1) patients who demonstrate healthy behavior (pain experience results in no/low fear, confrontation, and recovery) (Crombez et al, 2012); 2) avoidance (described previously); and 3) persistence behavior. Persisters are patients who continue to perform painful activities until completion even though the activity is perceived as too hard (Huijnen et al, 2011). In the long run, persistence behavior can also be unhelpful and result in an extreme active–non-active pattern (also called "yo-yo" or "overactivity–underactivity cycling") of daily activity levels (Andrews, Strong, and Meredith, 2015; Harding and Williams, 1998). When assessing patients' behavior in clinical practice, the majority of patients present with a mixed pattern: they avoid certain activities or movements, and simultaneously persist in others. This observation underscores the need for a thorough individual assessment and questioning of each patient individually. Patients should be questioned about their work, home, and recreational activities to determine which are avoided or persisted. In addition, patients need to be asked when and why they chose to either persist or avoid the activities. An activity diary may aid in this process. There are different models explaining the above-mentioned behavior, such as the Common Sense Model of Self-regulation (CSMS), classical conditioning, and operant conditioning (Leventhal, Brissette, and Leventhal, 2003; Pavlov, 1927; Skinner, 1938).

The CSMS is a model that helps understand how the perceptions, experience, and impact of having a disorder might influence a patient's interpretation and response (Leventhal, Brissette, and Leventhal, 2003). Based on the perceptions a person has, he/she will present with certain behaviors in an attempt to influence the threat of a potentially painful event. After any event a person assesses whether or not the threat is diminished. If, for instance, the patient experiences

lower back pain during forward bending (threat), the perceptions and emotions can change the behavior and pattern of forward bending. The latest fear-avoidance model of Vlaeyen et al. (1995) supports the CSMS and the role of pain catastrophizing in pain chronification. According to the CSMS the fear-avoidance behavior of the patient, physical inactivity, disuse, and consequent disability result from current or previous pain perceptions. Therefore, the physiotherapist should assess the impact of pain perceptions and behaviors on levels of function (work, recreation, daily activities). For example when a patient expresses the avoidance of playing tennis due to potential back pain, the physiotherapist should ask about the patient's beliefs and emotions about what happens during this activity.

Unconscious behavior and classical conditioning (Pavlov, 1927) are also important. For instance, working in a stressful situation at a desk for long periods during which the patient perceives pain, the desk may become associated with the pain. The desk is a neutral stimulus, but can become associated with the pain and, in the end, can evoke pain. In a model recently proposed by Moseley and Vlaeyen (2015), they postulate that classical conditioning can eventually result in pain from non-nociceptive impulses by stimulus generalization, called the Imprecision Hypothesis.

Behavior and social factors may also become related through operant conditioning (changing of behavior by the use of reinforcement, after the desired response). Operant conditioning, as described by Skinner et al. (Skinner, 1938), is directly applicable to pain behavior (Fordyce et al, 1973). Operant conditioning works with positive and negative reinforcers. For example an unconsciously positive reinforcement of the pain behavior may occur when sympathetic attention is given to the patient, which is likely to strengthen the behavior and increase its likelihood in the future. When behavior is followed by negative reinforcement such as criticism, that behavior is less likely to occur in the future and behavior to remove or avoid the consequence is likely to increase. If neither happens the behavior is likely to go extinct (Fordyce et al, 1973; Skinner, 1938). In the assessment, physiotherapists should ask about avoided behaviors and how the social surroundings impact this response to identify potential positive and negative reinforcers.

S – social factors

Social and environmental factors that cause stress or a disbalance in the identified-self of the patient can

have a negative effect on pain. Social factors can be divided into: housing or living situation; social environment; work; relationship with the partner; and prior/other treatments. It is important to find out if there are components of the social factors that are helpful and supportive or stressful and unconsciously unhelpful. Other important social factors include prior/concurrent treatments and the attitudes and beliefs of these healthcare professionals (for instance, a former physiotherapist who has told the patient that his/her "disk was out of line"). These prior/concurrent treatments, as well as advice and explanations about the patient's condition, will influence their perceptions and current coping strategies. Therefore prior/concurrent treatments should be explored and communication between healthcare professionals is suggested.

Low levels of social support may present barriers to improvement in chronic pain patients, and can be a sustaining factor in CS and worsen the prognosis (DeLongis and Holtzman, 2005; Nijs et al, 2011b). Unpublished results and clinical experience suggest that PNE can improve social support, especially when the therapist facilitates social support by asking the patient to bring their spouse, child, or a close friend to one of the sessions. If this is not feasible, significant others can be motivated to read information about CS, such as the book "Explain Pain" (Moseley, 2013).
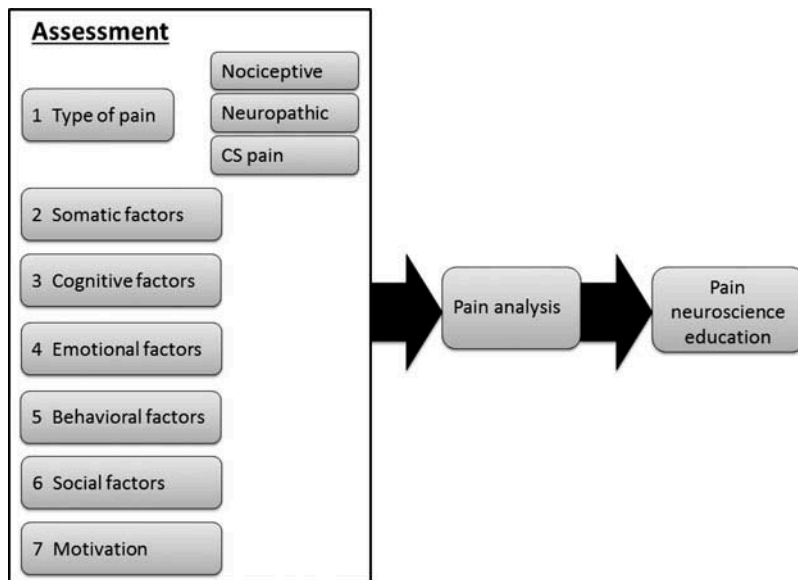
M – motivation

Determining motivation and readiness to change is vital for further treatment. The perceptions about the cause of pain and the treatment expectations are crucial to understand in order to target and modify them during the treatment (Turk and Okifuji, 2002). This is especially true if the proposed treatment (including PNE) might be different from what they have heard before, and more biopsychosocial focused.

The 16-item Psychology Inflexibility in Pain Scale (PIPS) can be used to assess avoidance of pain and cognitive fusion with pain where patients get intertwined with their thoughts, and thoughts are seen as a fact, for example, "I am my pain". The scale has good internal consistency as well as criterion and construct validity. Furthermore, it has been reported that psychological flexibility has a mediator function in the relationship between pain and kinesiophobia, pain and disability, and acceptance and catastrophizing, meaning that these relationships are largely influenced by psychological flexibility (Wicksell,

Lekander, Sorjonen, and Olsson, 2010). The PIPS is used to examine the patient's psychological flexibility to change. Previous research has shown that patients with chronic pain with a high degree of psychological inflexibility are likely to be nonresponders in an Acceptance and Commitment Therapy (ACT)-based rehabilitation (Wicksell, Olsson, and Hayes, 2010). Based on the assessment and a high score on one or both scales of the PIPS, the physiotherapist might decide not to initiate treatment. Alternatively, if the PIPS score is high, one could focus intensively on PNE to change cognitions and perceptions prior to initiating the remaining parts of the rehabilitation program. Once the focused PNE has been delivered, the PIPS is scored again to see whether there is a difference in score that might indicate that the patient is now ready for rehabilitation. We realize the latter is a pragmatic approach and not (yet) supported by research findings.

The stage of change model is another manner to assess the motivation for treatment and education of the patient. The start of the PNE should be tailored to the stage of change the patient is in (Prochaska and Norcross, 2001). One of the goals of PNE is to transition patients in their stage of change when necessary; however, the starting point should be adjusted to the stage of change a patient is in. The physiotherapist has to determine which phase the patient is in, considering both the perception and emotional state of the patient. In the pre-contemplation phase, the patient has no intention to change, and he/she is not willing to adapt another explanation or another treatment or coping strategy. In the contemplation phase the patient is aware of the problem and starts thinking about changing; however, he/she still has doubts, but is open to listen. The preparation phase is one step further: the patient is intending to take action in the next month and is more willing to listen to PNE and other new explanations. In the action phase, the patient modifies his/her behavior, experiences, and environment in order to overcome the problems. In this very important phase the physiotherapist plays an important role in the inventory of existing or potential barriers for maintaining this new behavior and changed perceptions. In the maintenance phase, the action has been successful and the patient works to prevent relapse and to consolidate the goals for more than six months. The last phase, termination, is the phase in which people have changed and no longer need to work to prevent relapse (Prochaska and Norcross, 2001).

Figure 1. Flowchart of the biopsychosocial assessment of patients with chronic pain.

Figure 2. Pain analysis sheet.

Discussion

This article describes the biopsychosocial assessment of patients with non-neuropathic CS pain in physiotherapy practice and includes a combination of clinical experience and scientific evidence. Certain aspects of this approach are scientifically validated, but some components and combinations of components have not been studied (Type of Pain + SCEBS model + Motivation). We attempted to clearly delineate what is supported by research and what is based on expert opinion.

Similar to the recommended approach outlined in this article, Dansie and Turk (2013) have previously presented a physician guide for the assessment of patients with chronic pain. Their assessment is based on three main questions: 1) What is the extent of the patient's disease or injury (physical impairment)? 2) What is the magnitude of the illness? That is, to what extent is the patient suffering, disabled, and unable to enjoy usual activities? 3) Does the individual's behavior seem appropriate to the disease or injury, or is there any evidence of symptom amplification for a variety of psychological or social reasons? Furthermore, they advise a standardized pain assessment and a brief screening interview in which the physician can screen for psychosocial problems. However, unlike the extensive description of the biopsychosocial assessment in our article they focused primarily on the assessment of pain and disability.

Diagnosis/clinical reasoning

For some patients with chronic pain, getting a diagnosis that makes sense to them is the first step to self-management of their pain. By getting a diagnosis, the pain is no longer "in your mind", "imagination", or "hysteria" (Skuladottir and Halldorsdottir, 2011) and has become "legal" and acknowledged by healthcare professionals. Unpublished results by Thompson (2014) show that for patients with chronic pain who "thrive" (who live well with their pain), receiving the "chronic pain" diagnosis by a healthcare professional, even though shocking, was the first step in their self-management.

Identifying the primary mechanism contributing to that pain experience (nociception, neuropathic, CS, combination) is more important than classifying pain according to duration (Figure 3). Identifying whether or not the patient has predominantly nociceptive, neuropathic, or CS pain is a diagnosis in itself that offers potential treatment pathways (Nijs et al, 2014).

Biopsychosocial assessment: recommendations for further treatment

To assess pain as a biopsychosocial phenomenon and really comprehend the essence of a patient's pain problem take time. Obviously, it is important to focus on the changeable biopsychosocial factors while also being aware of non-changeable aspects such as personality, neuroticism, and the degree of trait anxiety, which are known to be stable to some degree over time (Anusic and Schimmack, 2016; Pettersson et al, 2004; Prenoveau et al, 2011; Spinhoven et al, 2014).

Knowledge of these biopsychosocial factors is essential for steering the plan of care and identifying the potential components of PNE to be used. The (psychosocial) education of the physiotherapist, including the competence, knowledge, biopsychosocial vision, interpersonal factors, and 'fingerspitzengefühl' (i.e. instinct, intuitive flair, high situational awareness, and ability to respond most appropriately and tactfully), combined with two-way communication and a patient-centered approach are important. Physiotherapists specialize in the assessment of function, physical activity, movements, muscle tension, etc. combined with strategies to treat these impairments. Even though questionnaires can help identify behavioral, cognitive, and emotional factors (Table 2), we must be reflective of our biopsychosocial view and knowledge of illness perceptions. Research has shown that physiotherapists struggle in this area (Daykin and Richardson, 2004; Haggman, Maher, and Refshauge, 2004; Overmeer, Linton, and Boersma, 2004; Singla, Jones, Edwards, and Kumar, 2015; Synnott et al, 2015; Valjakka et al; van Wilgen et al, 2014). It is important, as healthcare providers, to know and respect our limits, especially when working with patients with chronic pain. Throughout the assessment, physiotherapists should be aware of their limitations and ask themselves: "is this patient (with chronic pain) in the right place here with me, or should he/she
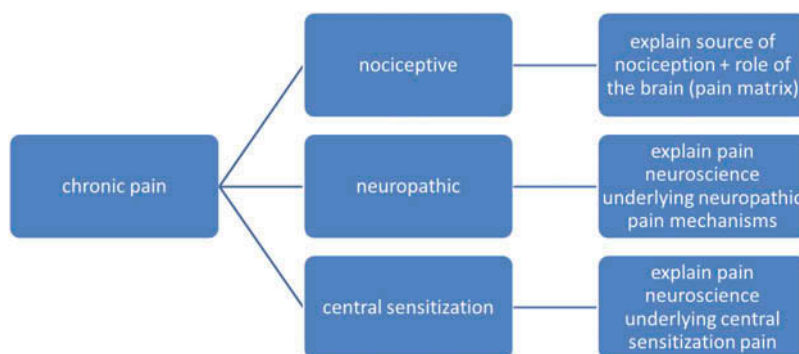

Figure 3. Pain Neuroscience Education tailored to the primary pain mechanisms of the patient.

be treated in a multidisciplinary setting or referred to another provider?"

Once indications for PNE are established, individualized therapy can be initiated by explaining the biopsychosocial diagnosis to the patient, reassuring them that their pain is real, and explaining why they are in pain (i.e. CS pain, neuropathic pain, and/or nociception). Changeable factors and the receptiveness of the patient to change further guide the content and the attitude of the physiotherapist during PNE. Based on the stages of change model (Prochaska and Norcross, 2001) patients in the pre-contemplation phase need a more "nurturing parent" role, and can be more resistant and defensive. Patients who are in the contemplation phase may benefit from a "Socratic teacher" who encourages patients to achieve insights into their own condition. If the patient is in the preparation stage, we recommend that the physiotherapist adopt the role of an "experienced coach" who can provide a new game plan or can review and modify the patient's own plan. Patients in the action and maintenance phases benefit from a physiotherapist who becomes more of a "consultant" who is available to provide expert advice and support (Prochaska and Norcross, 2001). Physiotherapists keen to learn more about this topic are referred to the cited references.

We have outlined how physiotherapists may take the first step in the successful treatment of patients with chronic pain, by motivating the patient to achieve goals and restore values and his/her identified-self (Higgins, 1987; Sutherland and Morley, 2008; Thompson, 2014). Chronic pain is complicated, and a thorough biopsychosocial intake, examination, and interdisciplinary treatment plan are required for success.

Conclusion

Prior to providing PNE and further treatment, an extensive biopsychosocial intake should be conducted. To our knowledge this is the first article describing the comprehensive biopsychosocial intake of patients with central sensitization in physiotherapy practice and is derived on scientific evidence as well as expert opinion. This approach needs to be investigated further in clinical trials with chronic pain patients.

We believe the biopsychosocial intake described here is necessary to clarify the primary type of chronic pain: predominant neuropathic, nociceptive, or CS pain. This allows the physiotherapist to assess the biopsychosocial factors that may be contributing to the continuation of pain. "Diagnosing" the patient as having CS pain, nociceptive pain, neuropathic

pain, or a combination is the first step in tailoring a patient-centered PNE that can aid the patient in his/her self-management process.

Declaration of interest

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