Trait anxiety and sensory processing profile characteristics in patients with non-specific chronic low back pain and central sensitisation - A pilot observational study

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A B S T R A C T

Introduction: People with non-specific chronic low back pain (NSCLBP) and central sensitisation (CS) exhibit sensory processing alterations, somatosensory hypersensitivity and differences in the brain's emotional networks. The concept that CS relates to pre-morbid trait sensory processing and anxiety characteristics is unknown. The aims of this pilot observational study were to test concept plausibility in a NSCLBP population with central sensitisation by investigating: 1) the range of Central Sensitisation Inventory scores, to determine the extent of symptoms of central sensitisation; 2) whether there are identifiable patient characteristics of trait anxiety and trait sensory profile differences; and 3) whether potential relationships exist between trait anxiety, trait sensory profiles and the extent of symptoms of central sensitisation.

Methods: People with NSCLBP and CS were recruited from physiotherapy outpatient clinics in New Zealand and the United Kingdom. Outcomes included the Central Sensitisation Inventory (CSI), Adolescent/Adult Sensory Profile and the State/Trait Anxiety Inventory (trait section) with the Marlowe Crowne Sociable Desirability Scale. Descriptive and non-parametric tests for correlation were used to analyse the data, p < 0.05.

Results: Of the 21 people recruited, 16 (76.2%) had CSI scores ≥40 in association with 1) an abnormally high prevalence of extreme scores of a) high trait Sensory Sensitive, Sensation Avoiding and Low Registration sensory profiles and b) low trait Sensation Seeking profile, 2) high trait anxiety sub-types and 3) minimal low trait anxiety. Moderate correlations were identified between trait sensory profiles and 1) CS pain (Sensory Sensitive R = 0.57, p < 0.01, CI = 0.07 to 0.88, Sensation Seeking R = 0.47, p < 0.05, CI = 0.27 to 0.91) and Low Registration (R = 0.49, p < 0.05, CI = 0.03 to 0.84). The CSI scores moderately correlated with trait anxiety (R = 0.63, p < 0.01, CI = 0.22 to 0.86).

Conclusion: These results provide concept plausibility that the extent of CS pain in people with NSCLBP might be associated with pre-morbid trait anxiety sub-types and abnormal trait sensory processing profiles. A larger study to confirm the findings is warranted.

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1. Introduction

Chronic low back pain is a significant health problem as well as an economic burden worldwide (Manchikanti et al., 2009). A proportion of people with non-specific chronic low back pain experience pain arising from a predominantly central sensitisation pain mechanism (Nijs et al., 2015) and this is associated with sensory processing alterations (Wand et al., 2011). In recent years, there has been considerable growth in the understanding of pain mechanisms, now broadly classified into three groups: nociceptive pain, neuropathic pain and central sensitisation pain (Nijs et al., 2014).
Symptoms resulting from central sensitisation (CS) tend to be disproportional to the extent of tissue pathology (Nijs et al., 2010; Smart et al., 2012), and may even be experienced in the absence of tissue pathology (Moseley and Butler, 2015). Pain associated with central sensitisation results from an augmentation of responsiveness of central neurons to input from unimodal and polymodal receptors (Mayer et al., 2012), characterised by generalised hypersensitivity of the somatosensory system (Nijs et al., 2010). Central sensitisation involves facilitation of peripheral stimulus processing and alterations in descending inhibitory control of nociceptive input to the brain (Woolf, 2011).

Central sensitisation is considered to be a dominant mechanism common to many chronic musculoskeletal pain conditions including a proportion of people with non-specific chronic low back pain (NSCLBP). Central sensitisation is regarded as the pain mechanism most difficult to treat (Latremoliere and Woolf, 2009), which may be partly due to the paucity of evidence underpinning its aetiology.

In addition to sensitisation of the central nervous system, people with predominant CS pain exhibit cortical disinhibition and neurological disruption resulting in sensory processing alterations (Moseley and Flor, 2012). Patients with NSCLBP exhibit these sensory processing alterations (Wand et al., 2010; Wand et al., 2013) and differences in the brain’s neural activation networks compared with recovered back pain patients (Erpelding et al., 2012); (Mansour et al., 2013). It could be assumed that sensory processing alterations such as sensory hypersensitivity develop simultaneously with CS pain; an alternative hypothesis, however, is that these alterations were present pre-morbidly.

A recent review found that pre-morbid sensory sensitivity and psychological factors may have predisposed individuals to CS in some chronic musculoskeletal pain populations (Clark et al., 2017). The hypothesis underpinning this study, therefore is that pre-morbid sensory sensitivity and psychological factors may be related to individual trait characteristics, such as trait sensory sensitivity and trait anxiety.

Trait sensory sensitivity forms a component of individual trait sensory profiles (Brown et al., 2001; Engel-Yeger and Dunn, 2011). Trait sensory profiles are a measurement of individual neural thresholds and behavioural responses to sensory stimulation and can be used to identify individual differences in sensory processing function (Dunn, 1997; Brown et al., 2001).

Sensory processing is the registering, modulating and organising of sensory information from the environment (Brown et al., 2001) and creating an appropriate response output (Davies et al., 2009). Sensory input is received from cutaneous tactile receptors, muscle spindles and Golgi tendon organs, mechanoreceptors, the vestibular apparatus, the auditory, olfactory, gustatory and visual systems (Davies et al., 2009) and cerebral efferent connections including connections from emotional and psychological networks (Aron et al., 2012). Key components of sensory processing are the neural thresholds for sensory reception (sensory sensitivity) and the behavioural response to sensory stimulation, which vary between individuals based on trait sensory profile characteristics (Dunn, 1997).

The range of neural thresholds for receiving sensory information sits on a continuum from high threshold [hypo-sensitive] to low threshold [hyper-sensitive] (Dunn and Brown, 1997; Dunn, 2001). Cross sectional studies of healthy (non-pain) populations show a normal distribution curve of sensory sensitivity from high to low neural thresholds (Brown et al., 2001). The behavioural response to received sensory stimuli, dependant on neural thresholds, is on a continuum ranging between passive and active (Brown et al., 2001). The response continuum is associated with how an individual adapts to sensory input, either actively or passively, by increasing or decreasing input as necessary, in order to function comfortably.

According to Brown et al. (2001) some people have high sensory thresholds as a trait characteristic, in association with sensory hypo-sensitivity. Similarly, sensory hypo-sensitivity to some sensory stimuli has been found in some people with chronic limb pain (Moseley et al., 2008) and non-specific chronic low back pain (Moseley et al., 2008; Wand et al., 2010). It is possible, therefore, that some of the sensory processing alterations observed in these chronic pain populations may involve trait sensory hypo-sensitivity. People with trait sensory hypo-sensitivity may not score as highly on the Central Sensitisation Inventory (CSI, score<40) yet still exhibit a predominantly non-nociceptive, non-neuropathic pain mechanism, inferring a central sensitisation pain mechanism and this was taken into consideration in the development of the methods for this study.

High trait anxiety is associated with high trait sensory sensitivity (Engel-Yeger and Dunn, 2011), and central sensitisation, including those with NSCLBP (Franklin, 2014). A common link between anxiety and sensory sensitivity is the low threshold of sensitivity to stimuli (Ristic and Landry, 2015). Those with anxiety and high sensory sensitivity exhibit physiological differences involving impaired inhibitory control mechanisms and impaired cognitive function (Ansari and Derakshan, 2011b), similar to people with central sensitisation (Latremoliere and Woolf, 2009; Nijs et al., 2010; Berryman et al., 2013). Therefore, identification of trait anxiety and sensory profile characteristics might help understand the aetiology of central sensitisation in patients with NSCLBP and in turn help clinicians sub-classify patients who are at risk of developing central sensitisation.

The aims of this pilot observational study were to test concept plausibility in a NSCLBP population with central sensitisation by investigating:

1) the range of Central Sensitisation Inventory scores, to determine the extent of symptoms of central sensitisation, across the group,
2) whether there are identifiable patient characteristics of trait anxiety and trait sensory profile differences; and
3) whether potential relationships exist between trait anxiety, trait sensory profiles and the extent of symptoms of central sensitisation.

2. Methods

This research is presented according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement (Vandenbroucke et al., 2007).

2.1. Design

A cross sectional observational study design was implemented (Robson and Colin, 2002). Ethical approval was obtained from Manchester Metropolitan University, UK (ref:1205) and permission was given from the Northern Y Ethics Committee, New Zealand.

2.2. Sample

A sample size of n = 20, approximately 10% of the predicted sample required for the full study was calculated (Thabane, 2004). Sample size was calculated based on 9 variables (4 sensory profile scores, 4 anxiety sub-types and the CSI score variables) and 20 participants per variable, as recommended for a correlation study (Field, 2009).

Patients with NSCLBP were recruited from physiotherapy clinics...
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