PAIN® 154 (2013) 419–426

PAIN®

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Pain-related anxiety influences pain perception differently in men and women: A quantitative sensory test across thermal pain modalities

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Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

ARTICLE INFO

Article history:
Received 23 June 2012
Received in revised form 22 November 2012
Accepted 1 December 2012

Keywords:
Anxiety sensitivity
Depression
Fear of pain
Pain perception
Pain-related anxiety
Sex differences

ABSTRACT

The sexes differ with respect to perception of experimental pain. Anxiety influences pain perception more in men than in women; however, there lacks research exploring which anxiety constructs influence pain perception differentially between men and women. Furthermore, research examining whether depression is associated with pain perception differently between the sexes remains scant. The present investigation was designed to examine how trait anxiety, pain-related anxiety constructs (ie, fear of pain, pain-related anxiety, anxiety sensitivity), and depression are associated with pain perception between the sexes. A total of 95 nonclinical participants (55% women) completed measures assessing the constructs of interest and participated in quantitative sensory testing using heat and cold stimuli administered by a Medoc Pathway Pain and Sensory Evaluation System. The findings suggest that pain-related anxiety constructs, but not trait anxiety, are associated with pain perception. Furthermore, these constructs are associated with pain intensity ratings in men and pain tolerance levels in women. This contrasts with previous research suggesting that anxiety influences pain perception mostly or uniquely in men. Depression was not systematically associated with pain perception in either sex. Systematic relationships were not identified that allow conclusions regarding how fear of pain, pain-related anxiety, and anxiety sensitivity may contribute to pain perception differentially in men and women; however, anxiety sensitivity was associated with increased pain tolerance, a novel finding needing further examination. The results provide directions for future research and clinical endeavors and support that fear and anxiety are important features associated with hyperalgesia in both men and women.

1. Introduction

Chronic pain is more prevalent in women [18], which theorists suggest may be attributable to psychological factors [21,44]. For instance, women typically experience greater fear of pain (ie, cognitive, emotional, behavioral, and physiological reaction to immediate or immanent pain) [3,9], pain-related anxiety (ie, future-oriented cognitive–emotional state focusing on potential pain) [1,9], and anxiety sensitivity (ie, the fear of anxiety sensations and putative vulnerability factor for development of chronic pain) [9,50]. These constructs theoretically contribute to avoidance of activities that may be associated with further pain but that would promote healing (eg, exercise), thereby contributing to progression from acute to chronic pain [4,5,35,57].

Experimental studies demonstrate that women also experience greater pain perception (ie, hyperalgesia) compared to men [18,19,21]. Again, these differences may be due in part to greater rates of fear of pain [23,28], pain-related anxiety [49,53], and anxiety sensitivity in women [39,55], as each of these are associated with hyperalgesia. Women also experience greater trait anxiety (ie, long-lasting propensity to experiencing general anxiety) [17] and depression [38], which have been associated with hyperalgesia [6,21,30,32,52].

Given the above findings, it is possible that higher rates of anxiety in women explain why they report greater experimental pain; however, research to date provides little support for this possibility. Indeed, several studies have demonstrated that trait anxiety and state anxiety (ie, anxiety in the present moment) are associated with hyperalgesia only in men [20,31,32], and anxiety constructs seem to be associated with pain exacerbation in men but not women with chronic pain [16,44,45]. Moreover, studies exploring sex-specific associations between pain-related anxiety constructs (eg, pain-related anxiety) and pain perception report inconsistent results (eg, significant effects only in women [53,57], in both sexes [33,51]), further obfuscating conclusions regarding sex-specific associations between hyperalgesia and anxiety. The

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0304-3959/$36.00
http://dx.doi.org/10.1016/j.pain.2012.12.001

need to further explore the association between pain-related anxiety constructs and pain perception in both sexes has been explicitly mentioned in recent literature [55], and Fillingim et al. recently concluded in a comprehensive review that "whether depression influences pain perception differently among women vs men is not yet known" [21]. Advances in this area may inform which long-lasting predispositions (ie, as opposed to state anxiety) could contribute to hyperalgesia or hypoalgesia (ie, reduced pain perception) differently between sexes, guiding contemporary theory [4,5,35,57] and chronic pain interventions targeting these predispositions [14,56,58].

The current status of literature points to 4 issues that warrant examination: (a) whether pain-related anxiety constructs or trait anxiety are associated with experimental pain perception, (b) if anxiety constructs are associated with experimental pain differently between sexes, (c) if depression symptoms are associated with pain perception differently between sexes, and (d) how trait anxiety, fear of pain, pain-related anxiety, anxiety sensitivity, and depression symptoms differ in their relationships to experimental pain when these are considered concurrently. The purpose of this investigation was to address these issues while minimizing potential confounds (eg, medical conditions) and generalizing the findings to both heat and cold stimuli and multiple indices of pain perception (ie, pain threshold, tolerance, intensity, unpleasantness).

2. Materials and methods

2.1. Participants

Ethical approval for this investigation was obtained from the University of Regina Research Ethics Board. After providing consent to participate, a total of 241 university students and community members (156 women and 85 men; age 18–55 years; mean ± standard deviation age 26.43 ± 9.43 years) completed a brief screening questionnaire to assess for exclusion criteria. Given the associations between pain perception and a number of psychological and medical conditions [34], 87 respondents who self-reported one of the following conditions were not invited to participate in the quantitative sensory testing procedures: a current diagnosis of a mental disorder, current or past chronic pain, current or past diagnosis of a medical condition suspected or known of being associated with pain sensitivity (eg, fibromyalgia, diabetes, irritable bowel syndrome), current analgesic medication use (other than occasional over-the-counter analgesics use), psychotropic medication use involving a dosage change within the past 2 months, or having a current condition that may render the participant unable to complete the research tasks condition (eg, skin lesions). Excluded participants were statistically significantly older than those who were not excluded ($t = 2.99$, $P < .05$) and more women were excluded relative to men ($\chi^2 = 15.84$, $P < .001$). A total of 154 participants (84 women, 70 men, aged 18–52 years, 24.68 ± 7.42 years) were subsequently invited to the laboratory and a total of 95 participants (52 women, aged 18–52 years, 25.04 ± 8.74 years; 43 men, aged 18–40 years, 23.70 ± 5.00 years) participated in quantitative sensory testing. Individuals who participated in quantitative sensory testing and those who declined the invitation were similar in age ($t = 1.45$, $P > .10$) and in sex ($\chi^2 = .42$, $P > .50$ comparing the ratio of men to women). Self-reported demographic information revealed that most women identified as white (90%), that most women were current students (65%), and that approximately half of women reported being part-time (31%) or full-time (25%) employed. Self-reported demographic information for men was similar to that of women, with most men identifying as white (88%) and as current students (65%), and approximately half of men being part-time (26%) or full-time (28%) employed.

2.2. Measures

2.2.1. State-Trait Anxiety Inventory, Trait (STAI-T)

The STAI-T is a 20-item self-report rating scale that measures trait anxiety (ie, a long lasting propensity to experiencing general anxiety) [48]. Each item is rated on a 4-point Likert scale ranging from 1 (almost never) to 4 (almost always). The STAI-T has demonstrated good reliability and validity in previous studies [30,48]. For the current sample, internal consistency was good ($\alpha = .89$).

2.2.2. Fear of Pain Questionnaire-Short Form (FPQ-SF)

The FPQ-SF is a 20-item self-report measure designed to assess fear of pain (ie, a present-oriented state focused on immediate or immanent pain associated with cognitive, emotional, physiological, and behavioral expressions) relating to various circumstances [3]. Each item (eg, *"Biting your tongue while eating," "Having someone slam a heavy car door on your hand"*) is rated with a 5-point Likert scale ranging from 1 (not at all) to 5 (extreme). The FPQ-SF has demonstrated good factorial validity and internal consistency in past samples [3,9]. For the current sample, internal consistency was good ($\alpha = .86$).

2.2.3. Pain Anxiety Symptoms Scale-Short Form (PASS-20)

The PASS-20 is a 20-item self-report rating scale that measures pain-related anxiety (ie, a future-oriented state focused on potential pain associated with cognitive and behavioral components and a weaker but prolonged state of physiological arousal) [36]. Each item (eg, *"Pain sensations are terrifying," "I worry when I am in pain"*) is rated with a 6-point Likert scale ranging from 0 (never) to 5 (always). The PASS-20 has demonstrated factorial invariance in clinical pain populations [9,10] as well as in nonclinical populations [1], supporting the validity of the measure. For the current sample, internal consistency was excellent ($\alpha = .91$).

2.2.4. Anxiety Sensitivity Index-3 (ASI-3)

The ASI-3 is an 18-item self-report questionnaire designed to measure anxiety sensitivity (ie, the fear of anxiety-related sensations based on the belief that they have harmful consequences) [54]. Items in the ASI-3 (eg, *"When I feel pain in my chest, I worry that I'm going to have a heart attack," "When I feel 'spacey' or spaced out I worry that I may be mentally ill"*) are rated on 5-point Likert scales ranging from 1 (agree very little) to 5 (agree very much). The ASI-3 has demonstrated factorial, convergent, discriminant, and criterion-related validity [54]. For the current sample, internal consistency was good ($\alpha = .81$).

2.2.5. Beck Depression Inventory-II (BDI-II)

The BDI-II is a 21-item self-report rating scale that measures the existence and severity of depression symptoms. All but 2 of the items are rated with a 4-point Likert scale ranging from 0 (eg, *"I do not feel sad"*) to 3 (eg, *"I am so sad or unhappy that I can't stand it"*) and the final 2 items (ie, *"changes in sleeping pattern," "changes in appetite"*) include additional response options to identify the direction (increase, decrease) of behavior change [8]. The BDI-II has demonstrated good internal consistency in previous studies [6–8]. For the current sample, internal consistency was good ($\alpha = .87$).

2.2.6. Numeric Rating Scales (NRS)

NRS were used to measure the subjective experience of pain intensity and unpleasantness. As used in previous studies [22], a 101-point scale ranging from 0 (no pain at all) to 100 (worst imaginable pain) was used to measure pain intensity. The pain unpleasantness NRS ranged from 0 (not unpleasant at all) to 100 (most