Cognitive Therapy and Research
https://doi.org/10.1007/s10608-024-10480-2

ORIGINAL ARTICLE

Intrusive Mental Imagery in Chronic Pain: Prevalence and Associations with Common Comorbidities

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Accepted: 22 March 2024

Abstract

Purpose Chronic pain is a highly prevalent and distressing condition with limited treatment efficacy. Prior research reports associations between the experience of mental imagery about chronic pain and pain itself, particularly in those with anxiety and depression. However, many aspects of these associations remain unexplored. A better understanding could help improve cognitive-behavioural therapies for chronic pain. This study aimed to describe the prevalence of intrusive pain-related mental imagery in a sample of people with chronic pain, examine the extent to which this imagery explained variation in pain intensity and disability, and examine the association between negative interpretations of imagery and pain.

Method A cross-sectional online survey was conducted. Participants with chronic pain ($n = 151$) completed standardised measures of anxiety, depression, health anxiety, general imagery use, and an adapted questionnaire about intrusive pain-related imagery.

Results Intrusive pain-related imagery was present in 52.3% of the sample. Demographic variables, anxiety, depression, and health anxiety significantly explained 19% ($p < .001$) of the variation in pain intensity and 20.2% ($p < .001$) in pain disability. The presence/absence of intrusive pain-related imagery did not significantly explain any additional variance for either outcome. However negative interpretations of imagery explained additional variance in pain disability. Intrusive imagery was interpreted negatively, experienced as moderately distressing, and was associated with higher rates of anxiety, depression and health anxiety.

Conclusions Experiencing intrusive imagery about pain is common, but its presence or absence appears to have no direct relationship on pain intensity or disability. The relationship is likely to be more complex, warranting further investigation. Negative interpretations of imagery represent a potential treatment target amenable to intervention.

Keywords Chronic pain · Imagery · Imagery-focused cognitive therapy · Cognitive behaviour therapy

Introduction

Chronic pain is defined as pain that persists for more than three months and characterised by significant emotional distress (International Classification of Diseases, 2021; ICD-11). Sub-categories include musculoskeletal pain, cancer-related pain and fibromyalgia, among others (ICD-11, 2021), and may be specific or generalised. Estimates indicate that moderate to severe chronic pain affects between a fifth and half of adults (Breivik et al., 2006; Fayaz et al., 2016). The economic cost to the United Kingdom and USA is estimated to be in the region of billions of pounds each year through lost productivity and healthcare expenditure (Hagemeier, 2018; Phillips, 2009). Despite this, research reflects that chronic pain is often inconsistently treated, not treated at all, or that those experiencing chronic pain rate their treatment as unsatisfactory (Bekkering et al., 2011; Breivik et al., 2006; Manchikanti et al., 2020).

One widely-used treatment for chronic pain is cognitive behavioural therapy (CBT). CBT aims to improve an individual's ability to adapt and manage their pain (Ehde et al., 2014; Turner et al., 2007) while targeting psychological and behavioural factors that serve to exacerbate pain and distress (Leeuw et al., 2007; O'Keeffe et al., 2020). National Institute for Health and Care Excellence (NICE, 2021) recommend

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Published online: 24 April 2024

CBT as a non-pharmacological intervention for chronic pain, however effect sizes are modest and there is further scope for improvement. These sub-optimal outcomes have led not only to development of new psychological treatment approaches, such as pain reprocessing therapy (Ashar et al., 2022), but also further calls for a better understanding of the factors underlying the maintenance and treatment of chronic pain (Crofford, 2015; Hylands-White et al., 2017; NICE, 2021). This is particularly pressing given the high prevalence and economic burden of chronic pain.

The underlying mechanisms of pain that persist beyond or without injury are only partially understood (e.g., Fornasari, 2012; NICE, 2021). It is widely acknowledged that chronic pain is not just the logical consequence of injury, and it is commonly accepted that the factors which maintain this unpleasant physiological and disabling experience are complex and include prominent roles for beliefs, response/coping behaviours and social support in the maintenance of the pain experience (Ehde et al., 2014; Meints & Edwards, 2018). One lesser-explored factor that may be relevant in the maintenance and treatment of chronic pain is mental imagery.

Mental imagery is defined as the experience of sensory perception in the absence of external sensory input (Pearson et al., 2015). Early proponents of cognitive therapy noted that cognitions include imagery, not just verbal thoughts (Beck, 1979), with distressing mental imagery presenting across a wide range of psychological disorders (Hackmann & Holmes, 2004; Ji et al., 2019). The relevance of understanding mental imagery in psychopathology is also highlighted by research showing that imagery elicits stronger emotional responses than verbal representations (e.g., Holmes et al., 2008) and is so deeply implicated in memory that it can be confused with reality (Holmes & Mathews, 2010).

Several studies have sought to investigate mental imagery in the context of chronic pain. For example, Berna et al. (2011) interviewed 10 women with chronic pelvic pain and found that all of them reported negative intrusive mental images related to their pain. Philips (2011) also used an interview method, reporting that 78% of the sample of people experiencing pain attending an Occupational Rehabilitation Center reported distressing mental images coming to mind while experiencing pain. Gillanders et al. (2012) and Gosden et al. (2014) used questionnaires to investigate the experience of mental imagery related to pain amongst patients with chronic pain attending a pain clinic, and found a prevalence of pain-related imagery of 22.9% and 36%, respectively. A larger online survey of 785 women with endometriosis-associated pain, conducted by Graham et al. (2020), found that 52% reported pain-related imagery. Overall, these studies suggest that a substantial proportion of people with chronic pain experience mental images related to this pain, and these images tend to be intrusive (i.e., occur involuntarily), vivid, and distressing (although some participants have also reported positive, comforting mental imagery, e.g. Berna et al., 2011; Graham et al., 2020). Where investigated, these studies have tended to find that participants with pain-related imagery report higher levels of depression, anxiety (Gillanders et al., 2012; Gosden et al., 2014; Graham et al., 2020) and pain-catastrophising, factors which are associated with both higher levels of pain as well as anxiety and mood related to problems (Gillanders et al., 2012; Graham et al., 2020), with the direction of influence between these factors unclear but likely to be of a cyclical nature. Overall, these studies clearly indicate the importance of better understanding mental imagery in the context of chronic pain.

One important aspect of understanding and using intrusive imagery therapeutically is the individual *meaning* ascribed to by the person experiencing it, i.e., how these images are interpreted. Several studies investigating mental imagery associated with chronic pain have explored how people interpret the *content* of the images experienced, for example as depicting anatomical or metaphorical representations of pain, or disability in the future (e.g., Gosden et al., 2014; Philips, 2011). However, people also ascribe meaning to the fact that they are experiencing intrusive imagery in the first place (i.e., a more meta-cognitive interpretation of the occurrence of such imagery). According to cognitive-behavioural accounts of imagery in other disorders, for example post-traumatic stress disorder (PTSD; Ehlers & Clark, 2000), or more generally (Hales et al., 2015), negative interpretations of the occurrence of intrusive imagery (e.g., that the occurrence of intrusive imagery is a sign of 'going mad') play a central role in determining its negative effects, such as the impact on emotion and coping behaviour. There is some evidence to support this in the context of trauma. For example, Starr and Moulds (2006) found that negative interpretations of the experience of intrusive memories were significantly correlated with cognitive avoidance and rumination, and negative interpretations of intrusive mental imagery have been associated with greater PTSD severity (Clohessy & Ehlers, 1999). Similar findings have also been found in the context of depression, with more negative interpretations of intrusive mental imagery predicting higher levels of depression symptoms in both cross-sectional and longitudinal data (e.g. Newby & Moulds, 2010; Williams & Moulds, 2008). It is plausible that the extent to which people with chronic pain negatively interpret the experience of imagery could also contribute to distress and disability, for example through the exacerbation of anxiety and depression, with which chronic pain is highly comorbid (e.g., Bair et al., 2003; Rode et al., 2006), or via maladaptive efforts to suppress the images, which could potentially influence underlying emotional distress and prevent processing or resolution (as is the case in the context of PTSD; Ehlers et al., 2004).

If intrusive negative imagery, and its interpretation, do play an important role in chronic pain, this could provide a valuable route for improving CBT in the context of pain by targeting this imagery. Evidence-based imagery treatments already exist, with promising results in a range of psychological disorders (Hales et al., 2015), and this sets a precedent for adapted use in chronic pain. For example, imagery rescripting, a technique to reappraise and reduce the distress caused by negative mental images, is commonly used in CBT and increasingly for a range of disorders including health anxiety (Nilsson et al., 2019; Tolgou et al., 2018), social anxiety (Chapman et al., 2020; Leigh et al., 2020) and PTSD (Haan et al., 2020). Imagery rescripting could therefore potentially be beneficial in the context of chronic pain (e.g., Berna et al., 2012; Philips & Samson, 2012). However, despite the apparent transdiagnostic and treatment relevance of mental imagery, cognitive-behavioural therapies for chronic pain have historically focused more on verbal cognition; this reflects the more general pattern in CBT that people are often asked about automatic negative thoughts and core beliefs, but rarely about visual ideation or metaphors (Di Simplicio et al., 2012).

Aims

The present study aims to (1) extend findings from earlier research by describing the prevalence of negative intrusive pain-related mental imagery in a sample of people with chronic pain, (2) test the extent to which the presence or absence of such imagery explains variation in the subjective experience of chronic pain when controlling for common psychological co-morbidities (specifically depression, anxiety, and health anxiety) and general imagery use, and (3) examine how negative interpretations of pain-related intrusive imagery are associated with the subjective experience of chronic pain.

Method

Design

A cross-sectional online survey design was adopted. The survey was open between 30 June 2021 and 16 August 2021 and was distributed using snowball sampling approaches. The study was conducted in Bath (UK) and restricted to UK participation only.

Participants

Participation was limited to adults (age 18 +) who had received a prior diagnosis of chronic pain and also reported experiencing pain within the past three months, a period consistent with diagnostic norms for chronic pain (ICD-11). Participants with a history of psychosis were excluded to avoid confusion between pain-related imagery and hallucinations commonly associated with psychotic disorders. Participants were also asked to state the location of their pain and a specific diagnosis if they had received one. Sample size was not pre-specified, but determined by how many people had completed the study by the deadline of 16 August 2021.

Qualtrics software was used to detect and exclude any suspected fraudulent, automated or repeated submissions. A stringent minimum reCAPTCHA score of > 0.7 was adopted, where > 0.5 is recommended (von Ahn et al., 2008), due to the high response rate and initial review of responses. Of the 532 responses to the survey, 280 met this criterion (52.6%), of which 212 fully completed consent requirements (39.8%). Data was further screened manually to remove any responses that appeared automated or fraudulent, identified by unusually quick response times (< 5 min) and duplicate or erroneous answers to free-text fields. Flagged responses were cross-checked by a second researcher not otherwise involved in the study. A total of 167 (31.4%) remained, of which 151 had completed the survey to the end. Fisher's exact test determined that there were no significant differences in pain grade ($p = 0.493$) between partial responses ($n = 22$) and completed responses. When these responses were removed, missing values analysis found that just 0.7% of values were incomplete, below a commonly-used threshold of 5% indicating missing responses were completely at random. Little's Missing Completely at Random (MCAR) test on regression variables (Little, 1988) was not significant (χ^2 (26) = 16.00, $p = 0.936$), indicating that the data were most likely MCAR, making listwise deletion appropriate (Donner, 1981; Kang, 2013).

The final sample were mostly female, white British, with a diagnosis of fibromyalgia. The mean age was 46 (SD = 13.42), mean recency of diagnosis 7.92 years (SD = 9.20) and mean duration of pain 14.44 years (SD = 11.48). The majority of participants reported widespread pain (62.9%), defined as pain present in two or more body regions. Further descriptive statistics are found in Table 1.

Measures

Pain intensity and pain disability were assessed using the Chronic Pain Grade Questionnaire (CPGQ; Von Korff et al., 1992), which yields three sub-scale scores (pain intensity, pain disability, and disability points) which combine to provide an overall categorical grade ranging from Grade 0 (pain free) through Grade 4 (high disability, severely limiting). The scale is widely used in epidemiological research

Table 1 Demographics of total sample

Baseline characteristic	*N*	%
Gender		
Male	18	11.9
Female	128	84.8
Nonbinary	4	2.6
Other	1	0.7
Ethnicity		
White	144	95.4
Black African, Caribbean or Black British	1	0.7
Mixed or Multiple Ethnic Groups	1	0.7
Asian (Chinese, Indian, Bangladeshi, Pakistani, Other Asian)	4	2.6
Prefer not to say	1	0.7
Marital status		
Single	43	28.5
Married/civil partnership	84	55.6
Separated	4	2.6
Divorced	15	9.9
Prefer not to say	5	3.3
Employment		
Full/part time employment	58	38.4
Self employed	12	7.9
Sick leave	13	8.6
Unemployed	30	19.9
Retired	21	13.9
In education/training	5	3.3
Other employment status	12	7.9
Country of residence		
Australia	1	0.7
Canada	1	0.7
France	1	0.7
Germany	2	1.3
Ireland	3	2
United Kingdom	126	83.5
United States	17	11.3
Diagnosis		
Fibromyalgia	79	52.3
Multiple	47	31.1
Other	25	16.6

Note $n = 151$

(Elliott et al., 1999; Papaioannou et al., 2018), suitable for all chronic pain conditions, can be reliably self-administered, and has acceptable internal consistency ($\alpha = 0.74$; Hawker et al., 2011; Von Korff et al., 1992). Internal consistency in the present study was acceptable for pain intensity ($\alpha = 0.73$) and good for pain disability ($\alpha = 0.84$).

The Short Health Anxiety Inventory (SHAI; Salkovskis et al., 2002) measured health anxiety. The short 14-item version is comparable to the full scale, with good internal consistency ($\alpha = 0.89$). It has been used with chronic pain (Rode et al., 2006; Tang et al., 2007a, 2007b) and is sufficiently reliable with clinical and non-clinical groups (Alberts et al., 2013). Internal consistency in the present study was good ($\alpha = 0.87$).

The Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983) was used in the present study to measure generalised anxiety and depression and has been validated for use with chronic pain patients. It has two subscales, one for generalised anxiety and one for depression. Internal consistency in the present study was good ($\alpha = 0.86$).

The Spontaneous Use of Imagery Scale (SUIS; Reisberg et al., 2003) measured general imagery use. The scale has good internal consistency ($\alpha = 0.98$; Nelis et al., 2014), including in the current sample ($\alpha = 0.81$), and acceptable reliability and convergent validity. It has been used as a control measure to check for baseline use of imagery, including one study about chronic pelvic pain (Berna et al., 2011).

Intrusive pain-related mental imagery was assessed using the Response to Intrusions Questionnaire (RIQ; Clohessy & Ehlers, 1999). To our knowledge, no measure of imagery exists for chronic pain, though the RIQ has been used to assess imagery in cancer patients (Whitaker et al., 2009). Minor adaptations were made to the original version of the RIQ (Clohessy & Ehlers, 1999) to focus on pain and intrusive images rather than visual memories. Specifically, instead of asking if participants have experienced "any spontaneous memories of unpleasant events", the scale asked about "spontaneous intrusive images related to your pain", and also clarified that these could be also be future-oriented (i.e., not just memories). The individual questions and scales of the RIQ were otherwise unchanged (with the exception of changing the term 'this image' to 'these images'). The RIQ includes individual questions to assess the presence of pain-related intrusive imagery, frequency, subjective distress, dissociation, and perceived control. The RIQ has two sub-scales, one that measures responses to intrusive images in the form of rumination (e.g., "I dwell on them") and suppression (e.g., "I try to push them out of my mind"), and another that measures negative interpretations of mental imagery by asking about what the intrusive images mean to the individual (e.g., "Something is wrong with me", "Someday I will go out of my mind"). These negative interpretation questions are interspersed with four positively-oriented questions (e.g. I care about other people) that were originally included as a control scale and are not included in scoring. Internal consistency of the original sub-scale was acceptable ($\alpha = 0.75$) and in the present study was good ($\alpha = 0.86$). The adapted RIQ is presented in the supplementary material.

Procedure

The survey link, hosted on Qualtrics, was distributed primarily via social media (Facebook and Twitter), chronic pain management organisations, and a database of chronic pain research volunteers managed by the Centre for Pain Research at the University of Bath. Respondents answered anonymously. Those who completed the survey were offered participation in a £50 Amazon eGift card randomised prize-draw.

Participants who clicked on the survey link were presented with an information sheet and were asked to confirm they met inclusion criteria (over 18, given a formal diagnosis of chronic pain, experienced pain in the preceding three months) and exclusion criteria (absence of diagnosis of psychosis and bipolar). Respondents were then asked to indicate consent to participate prior to the presentation of the main battery of questionnaires. Following completion of the study questionnaires, a debriefing sheet and choice to opt-in to a follow up qualitative interview and prize-draw was presented. Information provided to participants before completing the questionnaire did not refer specifically to mental imagery to avoid self-selection and priming of responses.

Planned Analysis

All data analysis was completed using SPSS v28. Preliminary analyses were conducted to assess the normality of the data and describe sample characteristics in order to provide context for interpretation of findings.

Scatterplots of the dependent variables (pain intensity and pain disability) plotted against each of the continuous demographic and main study variables indicated assumptions of linearity were not met for some of the study variables. Accordingly, nonparametric Spearman's rank-order correlations—and for multinomial independent variables eta squared coefficients—were performed to assess correlational significance of each of these variables against pain intensity and pain disability. Chi Squared and independent t-tests were used to identify differences between people who did or did not experience pain imagery across pain location, recency of diagnosis, age and key outcome variables (SHAI, HADS and RIQ) and to compare with standard means. A question in the RIQ was used to separate people who experienced intrusive pain imagery and those who did not.

The main analysis sought to answer the three primary research questions. To determine the proportion of the sample which experienced intrusive pain-related imagery in this sample, a simple percentage calculation (yes/no) was performed. To assess the role of pain-related imagery in pain experience, two hierarchical multiple regressions, one for pain intensity and one for pain disability, were planned to test for any increase in R^2 variance explained by the addition of imagery over and above that explained by demographic and control variables. The first step of the hierarchy controlled for basic demographic details (age and gender). Second, variables were entered that previous research indicates are strongly associated with pain experience, namely health anxiety, generalised anxiety and depression (Bair et al., 2003; Hirsch et al., 2007; Rode et al., 2006). Finally, the presence of intrusive pain-related imagery (yes/no) was added in the third step. The same variables were used in both regressions. Partial regression plots and a plot of studentized residuals against the predicted values indicated that both regression models met the assumptions of linearity and homoscedasticity. Independence of residuals was assessed by a Durbin-Watson statistic of 1.87 for the pain intensity regression and 1.94 for pain disability. There was no evidence of multicollinearity, as assessed by tolerance values greater than 0.1. There were no studentized deleted residuals greater than ± 3 standard deviations and no values for Cook's Distance above 1. The normal *Q*–*Q* plots indicated that the variables were approximately normally distributed.

To assess the role of negative interpretations of intrusive pain-related imagery and its relationship with pain intensity and pain disability, two further regressions were planned including only participants who reported intrusive pain-related imagery ($n = 76$). Steps 1 and 2 of the hierarchical regression were the same as the previous hierarchical analyses. In the third and final step, an RIQ subscale measuring negative interpretations of imagery would isolate the variance accounted for by negative interpretation of imagery. Test assumptions were met for both regressions; Durbin–Watson statistics were 1.62 and 2.22 for pain intensity and disability, respectively.

Results

Preliminary Analysis

Sample Characteristics

Mean SHAI scores (Table 2) were above a common clinical cut-off of 18 for hypochondriasis (Abramowitz et al., 2007; Tang et al., 2007a, 2007b), indicating a higher prevalence of severe and disabling health anxiety among the current sample compared with non-clinical and a sample of people chronic pain. The SUIS indicated a below-average level of general imagery use in the current sample (Table 2) compared with an average of previously-validated general population samples ($M = 38.70$, $SD = 7.80$; Nelis et al., 2014), $t(150) = -4.18$, $p < 0.001$). Mean scores for the anxiety and depression subscales were significantly higher than general population norms for anxiety (Table 2; $M = 5.99$, $SD = 3.55$),

Table 2 Summary statistics for total sample

Questionnaire	n	M (SD)	Range (Min–Max)	Population comparisons	
				M (SD)	p
Short Health Anxiety Inventory (SHAI)	151	19.65 (7.05)	36 (18–54)	9.19 (5.95)[a]	< .001
Hospital Anxiety and Depression Scale (HADS)	151	19.70 (7.13)	36 (5–41)	–	–
HADS-Anxiety	151	10.43 (4.30)	19 (2–21)	5.99 (3.55)[b]	< .001
HADS-Depression	151	9.30 (3.83)	19 (1–20)	6.7 (3.1)[b]	< .001
Spontaneous Use of Imagery Scale (SUIS)	151	35.54 (9.28)	44 (12–56)	38.7 (7.8)[c]	< .001
Response to Intrusions (RIQ)					
Negative interpretations	76	22.21 (9.88)	33 (6–39)	13.85 (7.14)[d]	< .001
Distress	79	3.92 (1.62)	6 (1–7)	–	–
Perceived control	79	3.47 (1.85)	6 (1–7)	–	–
Detachment	79	3.58 (1.77)	6 (1–7)	–	–
Numbness	79	3.48 (1.83)	6 (1–7)	–	–

RIQ scales except Negative Interpretations measured on 1–7 single-question scale

[a]Non-clinical sample, Alberts et al. (2011)

[b]Bocéréan and Dupret (2014)

[c]Nelis et al. (2014)

[d]Starr and Moulds (2006)

$t(150) = 12.70$, $p < 0.001$, and depression ($M = 6.70$, $SD = 3.10$), $t(150) = 8.33$, $p < 0.001$, respectively (Bocéréan & Dupret, 2014), while the mean HADS score of the sample was above a proposed optimal cut-off 16 (combined subscale score) for caseness (Bjelland et al., 2002).

There are few published datasets for the RIQ to compare against. In one example with nonclinical participants, the mean score of the negative interpretations scale was substantially lower ($M = 13.85$, $SD = 7.14$; Starr & Moulds, 2006), $t(150) = 7.38$, $p < 0.001$, than in the present sample (Table 2), indicating that participants had a particularly strong tendency to interpret their images negatively. Table 2 contains a summary of other RIQ items in the present sample.

Spearman's rank-order correlations (Table 3) found that both pain intensity and disability were significantly correlated with the SHAI, HADS but not SUIS. Intensity was correlated with negative interpretations of imagery and distress, while disability correlated with negative interpretations. Among imagery measures, overall pain grade correlated with imagery frequency, negative interpretations, and perceived control.

Independent-samples *t* tests comparing participants who reported intrusive pain-related imagery with those who did not found no significant difference in pain intensity ($t(149) = 1.17$, $p = 0.642$) or pain disability ($t(149) = 1.42$, $p = 0.058$) between the two groups. Spearman's rank order found no significant correlation between overall pain grade and whether or not an individual experienced images ($p = 0.189$). A chi-squared test found that participants who reported pain-related imagery did not significantly differ from those who did not by pain location $\chi^2(2) = 0.84$, $p = 0.658$. Independent-samples *t* tests found no significant difference between the two groups in diagnosis recency $t(135) = -0.29$, $p = 0.776$), pain duration $t(147) = -1.39$, $p = 0.168$), or participant age $t(147) = -1.53$, $p = 0.128$).

Those who reported intrusive pain-related imagery scored significantly higher on the SHAI ($M = 35.75$, $SD = 6.61$) than those who did not ($M = 31.35$, $SD = 6.83$), $t(149) = 4.02$, $p < 0.001$, and higher on the SUIS ($M = 37.57$, $SD = 8.69$) compared with those who did not ($M = 33.32$, $SD = 9.46$), $t(149) = 2.88$, $p = 0.005$. Those reporting intrusive pain-related imagery also scored significantly higher on the HADS ($M = 21.13$, $SD = 6.24$; $t(149) = 2.57$, $p = 0.011$) than those who did not ($M = 18.19$, $SD = 7.75$).

Main Analysis

Prevalence of Intrusive Pain-Related Mental Imagery

Slightly over half (52.3%) reported experiencing intrusive images related to their pain within the past week. Most reported images on a weekly basis ($n = 57$), while 24% said they were daily ($n = 19$). On average, imagery was moderately distressing, uncontrollable, detached and numbing (see Table 2).

The Role of Intrusive Pain-Related Imagery in the Subjective Experience of Chronic Pain

Two hierarchical multiple regressions were performed in line with the a priori analysis plan. Basic demographic measures, namely age and gender, were included as controls in the

Table 3 Spearman's correlations

	1	2	3	4	5	6	7	8	9	10	11	12
1. Chronic Pain Grade Questionnaire (CPGQ)—Pain Intensity	–	0.52**	0.32**	0.27**	0.30**	0.01	0.2	0.25*	0.34**	0.02	0.22	0.06
2. CPGQ—Pain Disability		–	0.64**	0.26**	0.37**	− 0.01	0.29**	0.34**	0.2	0.13	0.2	0.09
3. CPGQ—Pain Grade			–	0.13	0.28**	0.05	0.37**	0.30**	0.09	0.30**	0.2	0.13
4. Short Health Anxiety Inventory (SHAI)				–	0.60**	0.1	0.22	0.38**	0.23*	− 0.16	0.19	0.13
5. Hospital Anxiety and Depression Scale (HADS)					–	0.05	0.35**	0.45**	0.24*	− 0.09	0.38**	0.25*
6. Spontaneous Use of Imagery Scale (SUIS)						–	0.30**	0.22	0.36**	− 0.03	0.28*	0.16
7. Response to Intrusions Questionnaire (RIQ)—Imagery Frequency							–	0.48**	0.45**	− 0.15	0.38**	0.18
8. RIQ—Negative Interpretations								–	0.43**	0.02	0.43**	0.43**
9. RIQ—Distress									–	0.07	0.58**	0.47**
10. RIQ—Perceived control										–	0.06	0.30**
11. RIQ—Detachment											–	0.65**
12. RIQ—Numbness												–

$N = 151$ for variables 1 to 6, $N = 76$ for variables 7 to 12

*$p < 0.05$, **$p < .001$

first step. These did not significantly explain any variation in either pain intensity or disability. Health anxiety (SHAI) and generalised anxiety and depression (HADS) were added in the second step, along with age and gender significantly explained 19% of the overall variance in pain intensity and 20.2% in pain disability. However, the presence/absence of pain-related imagery (RIQ) did not significantly explain any additional variance for either regression (Table 4).

The Role of Negative Interpretations of Intrusive Pain-Related Mental Imagery in the Subjective Experience of Chronic Pain

Two further regressions were run to explore the role of negative interpretations of imagery among only participants who reported intrusive pain-related imagery ($n = 76$), shown in Table 5. As with the first set of regressions, demographic variables were entered first, followed by the SHAI and HADS. In the third and final step, an RIQ subscale measuring negative interpretations of imagery was added. Among this group, the demographic variables alone did not significantly explain any variation in pain intensity or disability. The SHAI and HADS, with demographics, significantly explained 19% of the variance in pain intensity and 20% in pain disability. The addition of negative interpretations was not significant for pain intensity, but did significantly explain with the other variables 25.2% of the variation in pain disability. Test assumptions were met for both regressions; Durbin-Watson statistics were 1.62 and 2.22 for pain intensity and disability, respectively.

Discussion

This study aimed to extend the current evidence relating to the prevalence of intrusive pain-related imagery in a sample of people with chronic pain, and examine the extent to which intrusive pain-related imagery—and negative interpretations of pain-related imagery—explained variation in pain intensity and disability.

The prevalence of intrusive pain-related imagery in the present study was 52.3%, similar to findings reported by Graham et al. (2020), higher than the 36% reported by Gosden et al. (2014) but lower than 78% in Philips (2011). It is possible that this variation is explained by the method of assessment, with generally higher estimates in studies using interviews (e.g., up to 100% in Berna et al., 2011) rather than questionnaire methods. The current study benefitted from a slightly larger sample than most previous studies of this nature (with the exception of Graham et al., 2020), with findings suggesting that imagery may be present in just over half of people with chronic pain, making it worthy of further study as a potential treatment target.

Table 4 Hierarchical regressions showing predictors of pain

Pain intensity	Model 1			Model 2			Model 3		
	B	SE_B	*β*	*B*	SE_B	*β*	*B*	SE_B	*β*
Gender (male)	− 0.7	6.41	− 0.02	− 0.7	3.12	− 0.07	− 2.98	3.14	− 0.07
Gender (nonbinary/other)	− 9.27	3.37	− 0.13	− 12.23	5.88	− 0.17	− 12.26	5.91	− 0.17
Age	0.01	0.09	0.01	0.08	0.08	0.08	0.08	0.08	0.08
Short Health Anxiety Inventory (SHAI)				0.3	0.19	0.16	0.3	0.19	0.16
Hospital Anxiety and Depression Scale (HADS)				0.58	0.18	0.31	0.58	0.18	0.31
Imagery							0.2	2.12	0.01
R2 (ΔR2)	0.02 (− 0.004)			0.19 (0.16)			0.19 (0.18)		
F for change in R2	0.8			15.31			0.01		
Sig. F change	*0.5*			*< .001*			0.93		
	Model 1			Model 2			Model 3		
Pain disability	*B*	SE_B	*β*	*B*	SE_B	*β*	*B*	SE_B	*β*
Gender (male)	− 3.67	5.1	− 0.06	− 6.8	4.7	− 0.11	− 6.6	4.71	− 0.11
Gender (nonbinary/other)	− 2.2	9.7	− 0.02	− 6.7	8.85	− 0.06	− 6.96	8.88	− 0.06
Age	0.18	0.13	0.12	0.28	0.12	0.18	0.28	0.12	0.19
Short Health Anxiety Inventory (SHAI)				0.19	0.28	0.07	0.15	0.29	0.05
Hospital Anxiety and Depression Scale (HADS)				1.11	0.27	0.39	1.11	0.27	0.39
Imagery							1.86	3.18	0.05
R2 (ΔR2)	0.02 (− 0.001)			0.20 (0.17)			0.20 (0.17)		
F for change in R2	0.95			16.31			0.34		
Sig. F change	0.42			*< .001*			0.56		

Table 5 Hierarchical regressions showing predictors of pain for imagers only

Pain intensity	Model 1			Model 2			Model 3		
	B	SE_B	*β*	*B*	SE_B	*β*	*B*	SE_B	*β*
Gender (male)	− 0.07	4.82	− 0.02	− 2.99	4.5	− 0.07	− 3.05	4.52	− 0.08
Gender (nonbinary/other)	− 9.27	9.16	− 0.13	− 12.23	8.47	− 0.17	− 11.6	8.62	− 0.16
Age	0.01	0.12	0.01	0.08	0.12	0.08	0.08	0.12	0.09
Short Health Anxiety Inventory (SHAI)				0.3	0.27	0.16	0.29	0.27	0.15
Hospital Anxiety and Depression Scale (HADS)				0.58	0.26	0.31	0.54	0.28	0.29
Negative Interpretations							0.08	0.17	0.06
R2 (ΔR2)	0.02 (− 0.03)			0.19 (0.13)			0.19 (0.12)		
F for change in R2	0.39			7.39			0.23		
Sig. F change	0.76			*< .001*			0.63		
	Model 1			Model 2			Model 3		
Pain disability	*B*	SE_B	*β*	*B*	SE_B	*β*	*B*	SE_B	*β*
Gender (male)	− 3.67	7.29	− 0.06	− 6.75	6.76	− 0.11	− 7.11	6.6	− 0.12
Gender (nonbinary/other)	− 2.2	13.86	− 0.02	− 6.72	12.73	− 0.06	− 2.61	12.56	− 0.02
Age	0.18	0.19	0.12	0.28	0.17	0.18	0.33	0.17	0.22
Short Health Anxiety Inventory (SHAI)				0.19	0.4	0.07	0.12	0.39	0.04
Hospital Anxiety and Depression Scale (HADS)				1.11	0.39	0.39	0.82	0.4	0.29
Negative Interpretations							0.53	0.25	0.26
R2 (ΔR2)	0.02 (− 0.02)			0.2 (0.14)			0.25 (0.19)		
F for change in R2	0.46			7.88			4.59		
Sig. F change	0.71			*< .001*			0.04		

However, contrary to expectations, the presence of intrusive pain-related mental imagery did not significantly explain any more of the variation in chronic pain intensity or disability than demographic and control variables in this sample, suggesting no direct relationship. Demographics (age and gender) and other control variables (health anxiety, anxiety and depression) combined significantly explained 19% of the variation in pain intensity and 20.2% in pain disability. Imagery made no additional contribution. Further analyses found no significant differences between those reporting pain-related imagery and those without in pain intensity/disability or overall pain grade, or in pain-specific demographic metrics such as pain location, duration, and diagnosis recency.

Initial consideration of these findings might perhaps suggest that imagery had no significant role in pain experience. However, further analysis suggests that this may be premature. First, participants reporting intrusive pain-related imagery experienced higher levels of health anxiety, anxiety and depression, than those who did not, consistent with prior research (Gillanders et al., 2012). Further, higher levels of health anxiety, anxiety and depression were correlated with more intense and more disabling pain and significantly explained at least some variation in both pain intensity and disability. It appears that imagery may play a mediating or moderating role which should be further investigated, however due to the apparently contradictory finding that pain outcomes are not explained by the presence of imagery, it is likely that the relationship is not linear, or is more complex than this study design was able to interrogate.

The third aim was to investigate the role of interpretations of imagery. Earlier studies have shown that the interpretation of intrusive imagery plays a central role in determining its negative effects (Ehlers & Clark, 2000; Hales et al., 2015). Consistent with this, additional regressions on the data of participants reporting intrusive pain-related imagery found that negative interpretations of imagery significantly explained an additional 5% variation in pain disability (but not intensity) over and above demographic and control variables, for a total of 25%.

Taken together, these findings support the notion that intrusive pain-related imagery is a potentially relevant form of cognition that could influence emotion, motivation and behaviour, and thus maintain emotional distress (Ji et al., 2019), but the precise nature of the interaction is not fully understood. However, the findings suggest that for pain-related disability, it is the interpretation of pain-related imagery rather than its presence or absence that may be important. This would be consistent with a cognitive-behavioural understanding of pain (Jamani & Clyde, 2008; Vlaeyen & Linton, 2000) and imagery (Hales et al., 2015) where the meaning attributed to the pain would present as a compelling treatment target, offering the opportunity to advance current treatment approaches for chronic pain. Given that there are already well-established imagery rescripting protocols (Chapman et al., 2020; Haan et al., 2020; Leigh et al., 2020; Nilsson et al., 2019; Tolgou et al., 2018), it is important that the utility of this approach is reviewed for potential use for this clinical population. However, while many aspects of the rescripting protocol may be generalisable between psychological disorders, further development would be warranted to tailor to the needs of this group. This might include further consideration of the physiological component of the cognitive-behavioural approach and how physiological arousal may influence pain, focussed targeting of specific pain-related beliefs common to this group (e.g., pain = harm) and the need for clinician knowledge of current explanatory models of chronic pain. Further work is needed to ensure specialty specific relevance in application of such protocols in order to optimise outcomes for this group.

Limitations

Future research in this area must consider unresolved challenges in measurement. Psychological research currently lacks a reliable way to assess imagery in pain (Pearson et al., 2013), and it is possible that the present study findings reflect this issue. The absence of a validated imagery measure makes it difficult to compare imagery use within or across disorders including chronic pain. A measure of intrusive pain-related imagery based on a unified definition is needed to ensure consistency in research and monitoring of treatment outcomes (Hales et al., 2015). Although the start of the RIQ included an explanation of mental imagery, and "spontaneous intrusive images" in particular, participants can sometimes misinterpret what is meant by mental imagery (Hales et al., 2015), which presents a limitation for studies assessing its prevalence via questionnaire, as opposed to interview, methods. Additionally, given that people with chronic pain can experience not only negative but also positive imagery related to their pain (e.g., Berna et al., 2011; Graham et al., 2020), future studies could also benefit from asking about both kinds of imagery explicitly.

Despite prevalence of trauma and PTSD in chronic pain populations (which is particularly high in Fibromyalgia; Hauser et al., 2013) data relating to trauma was not captured in this study. As previously noted, imagery is a common target within trauma focussed therapy such as trauma focussed CBT, therefore measurement of trauma may have offered further insights into the complexity of relationships identified in this paper. Further work should consider the role of trauma and PTSD in understanding imagery and chronic pain.

The cross-sectional design and modest sample size provided limited scope for more detailed exploration of the associations between the different variables included, such

as temporal or causal relationships between pain-related imagery, pain, anxiety, and depression. Alternative designs that are better able to explore the complexity of the potential interactions, for example via intensive longitudinal data, are warranted.

Finally, the sample in the present study was skewed towards white, female participants residing in the UK with Fibromyalgia. While demographics were controlled for as far as possible, prior research finds substantial gender (El-Shormilisy et al., 2015; Greenspan et al., 2007) and ethnic differences (Campbell & Edwards, 2012) in coping strategies, mood, anxiety and pain experience, suggesting that the present findings should be interpreted with caution when generalising to the broader population. The high rates of Fibromyalgia in this sample may be associated with some degree of targeting; four of the 19 groups/organisations approached were Fibromyalgia specific. It could also be explained perhaps by higher levels of online engagement from this group due to the complex and confusing nature of the condition, however it is difficult to draw conclusions. Further work would seek to reflect more representative sampling of chronic pain sub-groups.

As only 32.6% of participants who started the survey provided data that could be used in the analyses also increases the risk of potential biases in the sample and emphasises the importance of following up these results with replications. However, the vast majority of excluded responses were due removed due to suspicions about automated/repeated responses, rather than due to dropping out or providing incomplete data.

Conclusions

These results provide support for the continued study of intrusive imagery as a common phenomenon in chronic pain. Imagery is often interpreted negatively, experienced as moderately distressing, and associated with higher rates of anxiety, depression and health anxiety. Presence of intrusive imagery in chronic pain did not explain any additional variance in pain intensity or disability over and above demographics, anxiety, depression and health anxiety, but the nature of interpretation of these images indicate a possible moderating or mediating role in pain. Future research should consider measures development and the used of more complex designs to explore precise mechanisms underlying the interaction between imagery, distress and pain. Imagery represents a target amenable to intervention in CBT, drawing on an already strong evidence-base to advance current treatment approaches to achieve better outcomes.

Acknowledgements The authors wish to acknowledge advice provided on statistical testing by Andrew Chapman of the University of Bath Statistics Advisory Service, and support in the conceptualisation and development of the research topic contributed by Sophie Harris and Edward Hirata, also of the University of Bath.

Funding This research received no specific grant from any funding agency, commercial or not-for-profit sectors.

Data Availability The data sets generated and analysed during the current study and analysis scripts are available in the Open Science Framework repository, with the exception of individual level demographic and pain history data due to concerns about potential identifiability (available on request): https://osf.io/x7wpt/.

Declarations

Conflict of Interest Jake Maxwell Watts, Simon E. Blackwell, Jo Daniels declare that they have no conflict of interest.

Animal Rights No animal studies were carried out by the authors for this article.

Ethical Approval Ethical approval was granted by the University of Bath ethics committee (PREC Reference Number 21-117). The authors state that they have abided by the Ethical Principles of Psychologists and Code of Conduct as set out by the British Association for Behavioural and Cognitive Psychotherapies and the British Psychological Society.

Informed Consent All participants provided written informed consent.

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