Defensive high-anxious individuals demonstrate different responses to pain management to those with lower levels of defensiveness and anxiety.

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Abstract

Objectives: Few studies have considered the effect of Weinberger et al.'s personality types on the management of pain. The aims of this study were to (i) identify whether the relationships between pain intensity, cognitive factors and disability at three and six months post baseline differs as a result of personality type; and (ii) identify whether personality type affects the likelihood of achieving a minimal clinical important change (MCIC) in pain intensity or disability at three and six months.

Method: Patients completed a set of validated questionnaires assessing personality type, cognitive factors, pain intensity and disability at three and six months post baseline.

Results: A greater proportion of defensive high-anxious individuals reported improvement for both pain (three month= 25%; six month= 38%) and disability (three month= 35%; six month= 50%) and showed stronger links between improvements in pain and disability and baseline psychological factors than non-extreme individuals.

Conclusions: The high proportion of defensive high-anxious individuals highlights the need for psychologically based interventions to be delivered earlier in the care process. Stratifying the population, based on personality type, may allow for more targeted interventions, which could be more cost effective and reduce the number of patients remaining in the care system.

Key words: Defensive high-anxious; Cognitive factors; Minimal clinical important change; Chronic pain; Treatment.

Introduction

Chronic pain affects approximately 14 million people in England and has a significant impact on the economy. Within the United Kingdom (UK), back pain specifically is estimated to cost £12.3 billion per year [1], this is the equivalent of 22% of the annual NHS budget (2014).

Pain management programmes (PMPs) are designed to address cognitive factors and provide patients with self-management strategies in order to reduce their use of healthcare services. Successful self-management can be difficult for some individuals while others appear able to effectively manage their condition at home, and do not need to regularly utilise healthcare services. The mechanisms behind these individual differences are poorly understood, but have been suggested to be a function of personality type. Some studies have identified differences between individuals with high or low trait anxiety which predispose individuals to respond differently to pain related stimuli [2]. Some of these findings are equivocal and may indicate an interaction between anxiety and other factors. The inclusion of defensiveness alongside trait anxiety (personality type) has highlighted differences in how individuals respond to treatment and health outcomes in chronic illness populations [3-6], however, there is limited evidence within chronic musculoskeletal pain populations.

Weinberger et al. [7] proposed four personality profiles based on their trait scores on two orthogonal dimensions (trait anxiety and defensiveness), high-anxious (HA; high trait anxiety and low defensiveness); defensive high-anxious (DHA; high trait anxiety and defensiveness); low-anxious (LA; low in both trait anxiety and defensiveness); and repressors (REP; low trait anxiety and high defensiveness). The four personality profiles are believed to show different behaviours when confronted with stressful situations. Defensive high-anxious individuals are often omitted from studies because they are relatively rare within the general population. Within the clinical environment, however, they make up approximately 39-46% [8, 9] of the

population. They have also been found to utilise a greater number of treatment options (e.g., physiotherapist, chiropractor, doctor) compared to the other personality types, despite reporting similar levels of pain intensity and satisfaction with treatment [10]. These findings suggest that the interaction of anxiety and defensiveness may influence patients' interpretation of pain and therefore, persistence within the care system.

There has been only limited research has investigating the interaction between defensiveness and trait-anxiety and the relationship with pain and disability. To our knowledge, our previous study was the first to demonstrate that within a defensive high-anxious group, cognitive factors (catastrophising, depression and self-efficacy) explained 48% of the variance in disability while pain intensity was not significantly related. Whereas within individuals who score in the mid-range of anxiety and defensiveness (the non-extreme group) the reverse was true, with the cognitive factors shown to not affect the variance in disability while pain intensity explained 36% [11]. A cross-sectional study looks at a snap shot in time and the relationships identified in the previous study are informative, however, it is important to investigate whether these cognitive factors are predictive of outcome by tracking patients over time. A critical consideration when investigating treatment outcome is the minimal clinically important change (MCIC) of patients based outcomes, such as pain intensity or disability. Ostelo and de Vet [12] suggested that MCIC is defined as the smallest change in an outcome measure necessary to yield a clinically important change in the health status of the patients. Currently, there is limited research which includes the MCIC, despite patient self-report being considered an important domain.

The aims of this study were to (i) determine whether the personality types, as defined by Weinberger et al., [7] influenced the key relationships between pain and disability and a variety of psychological factors; and (ii) identify whether personality type affects the likelihood of achieving a MCIC in pain intensity or disability at three and six months.

Method

Participants

Participants were recruited from their current hospital based pain management programme (PMP), which was in line with the British Pain society guidelines. The PMPs included a psychologically based group rehabilitative intervention which was delivered once a week for 6 weeks by a physiotherapist. The aim was to improve the physical, psychological, emotional and social dimensions of quality of life for people with chronic pain. PMPs focus on the patient's physical and psychological wellbeing, rather than seeking to treat a disease or biomedical problem. Similar to the NICE guidelines, PMPs consist of an education element and guided practice [13]. Patients remained on their current treatment programme and no additional intervention was given. Patients who had suffered from chronic pain for more than 3 months were given an information pack by their clinician asking them to contact the Chief Investigator of the study if they wished to take part. The study was approved by [omitted at the request of the journal] and all participants gave informed consent. Exclusion criteria were; evidence of red flags (e.g., specific pathologies such as cancer), diagnosis of serious spinal pathology such as malignancy and vertebral fracture, acute herniated disc with nerve root entrapment, other health conditions that prevented them from exercising e.g., cardiac pacemaker, unstable angina or poorly controlled cardiac problem, under 18 years of age. Patients who had taken part in our previous study [11] were asked to complete a set of validated questionnaires at three and six months after entry into the pain management programme. If patients responded to the first questionnaire (baseline), they were then sent a second questionnaire at three months. From the baseline sample (n= 79), 58 patients responded to the second questionnaire. Patients who responded to the second questionnaire were then sent a third questionnaire six months post baseline (47 responses were received). If participants had

not responded to a questionnaire pack within three weeks, they were sent one reminder letter and questionnaire pack. If they did not respond to the reminder, they were assumed to have withdrawn from the study.

Personality type was assessed based on criterion splits on the trait subscale of the State-Trait Anxiety Inventory (STAI) [14] and the Marlowe-Crowne Social Desirability Scale (MC-SDS) [15]. Figure 1 demonstrates criterion splits of the four personality types for this study. Criterion splits allow us to investigate the non-extreme individuals who are not defined by Weinberger et al. and fall in the middle of the two scales. Due to low numbers of high-anxious, low-anxious and repressor individuals at three and six months post baseline, only data from defensive high-anxious and non-extreme individuals were taken forward for statistical analysis. Defensive high-anxious (DHA) individuals were classified as scoring higher than 8 on the MC-SDS and 45 on the STAI. The 'non-extreme' (NE) group scored between 5-8 on the MC-SDS and 29-45 on the STAI. Patient characteristics are presented in Table 1. Ethical approval was granted by the University Ethics committee and the NHS Health Research Authority.

[Figure 1 near here]

[Table 1 near here]

Measures

At each time point, participants completed a questionnaire pack assessing cognitive factors, pain intensity and disability.

Current Pain Intensity

A numerical rating scale (NRS) was used to assess pain intensity. Participants were asked to rate their pain over the last 24 hours on a scale ranging from (0) 'no pain' to (10) 'pain as bad as could be'. The 11 point NRS has been supported by previous research and has been

recommended by the Initiative on Methods, Measurement and Pain Assessment in Clinical Trial (IMMPACT) to assess chronic pain intensity [16].

Defensiveness

The 10-item short form of the Marlowe-Crowne Social Desirability Scale (MC-SDS) [15] was used to assess defensiveness. The scale consists of items that are culturally approved but unlikely to occur. A correlation coefficient of r = 0.9 (p< 0.001) has been reported between the 10 item MC-SDS and the original 33 item MC-SDS [17] with an internal consistency alpha coefficient of 0.66 [18]. The MC-SDS measures affect inhibition, as defensiveness has been defined as the protection of self-esteem [17].

Trait-Anxiety

The trait scale of the State-Trait Anxiety Inventory (STAI) [14] was used to assess trait-anxiety. The scale consists of 20 statements that participants rate on a scale of 1 (not at all) to 4 (very much so). The trait component of the STAI has a test-retest reliability of between 0.73 and 0.86 [14].

Catastrophising

The Pain Catastrophising Scale (PCS) [19] is a self-report measure of catastrophic thinking associated with pain and consists of 13 items. The PCS asks participants to reflect on their painful experiences and indicate the degree which they experienced the 13 thoughts or feelings on a 5-point, Likert scale ranging from 0- 'not at all' to 4- 'all the time'.

Depression

The Centre for Epidemiologic Studies Depression Scale (CES-D) [20] is a 20 item self-report measure of depression symptoms. Each item asks participants how frequently a specific symptom was experienced in the past week, ranging from 0 (not even one day) to 3 (daily). High internal consistency has been reported with coefficient alphas ranging from 0.85-0.92 [20].

Disability

The Roland Morris Disability questionnaire (RDQ) [21] was used to assess disability due to pain. This is a 24 item self-report measure where participants answer either 'true' or 'false' to each statement about how they are feeling today. This measure has shown an acceptable level of reliability, with a correlation coefficient of 0.91 [21] and internal consistency of 0.90 [22].

Functional Self-efficacy

Similar to Woby, Roach, Urmston and Watson [23], the functional subscale of the Chronic Pain Self-Efficacy Scale (CPSS-PF) [24] was used to measure functional self-efficacy. The questionnaire is comprised of nine items scored on a 9 point, Likert scale. Three written descriptors anchor the scale scores at 0 (Totally Unconfident), 4 (Moderately Unconfident) and 8 (Totally Confident). Woby, et al. [25] assessed the psychometric properties of this scale, and reported alpha coefficients for internal consistency of 0.88 and test-retest reliability of 0.80-0.93.

Kinesiophobia

For the purposes of this study, the 11 item version of The Tampa Scale of Kinesiophobia (TSK) [26] was utilised to measure fear of movement or (re)injury. Respondents rate themselves on a 4-point, Likert scale ranging from 'strongly agree' to 'strongly disagree'. The TSK demonstrates good internal consistency ($\alpha = 0.79$), and test-retest reliability (ICC$= 0.81$) [27].

Statistical analyses

Heterogeneity checks were completed to ensure the groups differed in defensiveness and trait-anxiety. An attrition analysis was performed to assess any differences between the baseline characteristics of those who completed the trials and those who dropped out by 6 months. In order to assess differences between the groups for cognitive factors, pain, and disability, repeated measures ANOVAs were run with between subject factor of personality type (2: defensive high-anxious, non-extreme) and within subject factor of time (3: baseline, three

month, six month). Post hoc t-tests were run in order to determine any specific significant differences between the groups, and within the groups. Effect sizes are also reported. In order to identify whether the relationships between pain intensity, cognitive factors and disability at three and six months post baseline differs as a result of personality type, hierarchical regressions were performed for the defensive high-anxious and non-extreme groups separately. Within this study, disability was used as the outcome variable, age, sex, pain duration and baseline disability were entered in step 1, pain intensity in step 2, and the baseline cognitive variables were entered in step 3. All tests were conducted on both the three and six month data. In order to assess whether personality type moderates the relationship between disability and psychological variables, a moderation analysis was performed using the PROCESS macro [28].

The MCIC from baseline to three and six months for disability and pain intensity were calculated for the defensive high-anxious and non-extreme groups separately. Based on previous research the MCIC for pain intensity, was considered to be a reduction of 2 points [29] and for disability a reduction of 3 points in RDQ [12].

Results

A statistical heterogeneity check confirmed that the defensive high-anxious and non-extreme groups were significantly different on measures of both defensiveness (t(53)= 6.56, p< 0.05) and trait anxiety (t(53)= 2.92, p< 0.05). An attrition analysis was run to identify any differences in baseline characteristics between participants who completed the 6 month follow up questionnaires compared to those who didn't. No significant differences were found in age (t(77)= 0.56, p= 0.956), sex (t(577)= 0.76, p= 0.44), pain duration (t(77)= 0.07, p= 0.95), pain intensity (t(77)= 0.37, p= 0.71), disability (t(77)= 0.47, p= 0.64), catastrophizing (t(77)= 0.83,

p= 0.41), depression (t(77)= -0.22, p= 0.83), self-efficacy (t(77)= -0.39, p= 0.70) or kinesiophobia (t(77)= -0.11, p= 0.91).

Patient characteristics

The repeated measures ANOVA for disability revealed there was no effect of time, however there was a significant interaction effect between time and personality type, $F(1, 31) = 4.53$, $p < 0.05$; $p\varepsilon^2 = 0.23$; $\beta = 0.71$. Follow up t-tests revealed there was a non-significant trend of defensive high-anxious individuals reporting higher baseline disability compared to non-extreme individuals (t(31)= 1.84, p= 0.07; r= 0.4). Furthermore, the defensive high-anxious group demonstrate significant reductions in disability (t(19)= 2.19, p< 0.05; r= 0.5) from baseline to three months and six months disability, t(15)= 2.29, p< 0.05; r= 0.5). There were no significant changes in disability over time for the non-extreme individuals.

Of the cognitive factors, only catastrophizing demonstrated a significant interaction effect between time and personality type, $F(1, 31) = 3.26$, $p < 0.05$; $p\varepsilon^2 = 0.12$; $\beta = 0.60$. Post hoc t-tests revealed at baseline defensive high-anxious individuals reported significantly higher catastrophizing compared to non-extreme individuals (t(31)= 2.45, p< 0.05; r= 0.4). Within group analysis revealed that the defensive high-anxious individuals had significant reductions in depression from baseline to three months (t(19)= 2.86, p< 0.01; r= 0.5) and baseline to six months (t(15)= 2.39, p< 0.05; r= 0.5).

Regression analysis

Preliminary examination of the data

None of the correlation coefficients exceeded 0.90, indicating the data were not affected by singularity. Durbin-Watson values (1-3), variance inflation factors (~10) and tolerances (~0.10)

were within acceptable limits for all regression analyses, suggesting that the assumption of independent errors was met. The predictor variables used in each of the regression analyses had variance inflation factors that were considerably less than 10 and tolerance levels that were higher than 0.2 indicating no problems with multicollinearity.

Analysis 1- predicting three-month disability from baseline cognitive factors in the defensive high-anxious group

Age, sex and pain duration were not significantly related to levels of disability, however, baseline disability was related to levels of disability at three months ($p= 0.04$). In the second step current pain intensity was not related to the variance in disability ($p= 0.09$). After controlling for the effects of demographics and pain intensity, the cognitive factors explained an additional 28% ($p< 0.01$) of the variance in disability. Examination of the beta values (Table 2) revealed that higher baseline disability ($\beta= 0.71$, $p< 0.01$) and kinesiophobia ($\beta= 0.29$, $p< 0.05$) and lower self-efficacy ($\beta= -0.58$, $p< 0.05$), were related to greater levels of disability. Depression and catastrophising were not significantly linked.

[Table 2 near here]

Analysis 2- predicting six-month disability from baseline cognitive factors in the defensive high-anxious group

As at three months, age, sex and pain duration were not significantly related to levels of disability ($p= 0.52$) and baseline disability was no longer related. In the second step, current pain intensity was not related to the variance in disability ($p= 0.14$). After controlling for the effects of demographics and pain intensity, the cognitive factors explained an additional 30% ($p< 0.05$) of the variance in disability. Examination of the beta values (Table 3) revealed that higher kinesiophobia ($\beta= 0.49$, $p< 0.05$) was related to greater levels of disability, however self-efficacy was no longer significantly linked.

[Table 3 near here]

Analysis 3- predicting three-month disability from baseline cognitive factors in the non-extreme group

In the first step, age and baseline disability were significantly related to levels of disability ($p< 0.01$) and explained 80% of the variance. In the second step, current pain intensity was not related to levels of disability ($p= 0.86$). After controlling for the effects of demographics and pain intensity, the cognitive factors did not explain the variance in disability at 3 months Examination of the beta values (Table 4) revealed, younger age ($\beta= -0.31$, $p< 0.05$) and higher baseline disability ($\beta= 0.68$, $p< 0.01$) were associated with higher levels of disability.

[Table 4 near here]

Analysis 4- predicting six-month disability from baseline cognitive factors in the non-extreme group

Table 5 shows that in step 1, only baseline disability was significantly related to levels of disability at six months ($\beta= 0.60$, $p< 0.05$). Similarly, in step 2 and 3, neither pain intensity nor the cognitive factors offered any significant relation to the variance in disability.

[Table 5 near here]

Moderation analysis

3 months

To test whether personality type moderates the relationship between baseline psychological variables and 3 month disability a hierarchical multiple regression analysis with interaction terms was conducted. In the first step the psychological variables, baseline disability and personality type were added. These variables accounted for a significant amount of variance in disability $R^2 = 0.756$, $F(6, 35) = 18.06$, $p = 0.000$. To avoid high multicollinearity with the interaction term, the variables were centered and interaction terms between the psychological variables, baseline disability and personality type were created.

Next, the interaction term between baseline disability, psychological variables and personality type was added into the regression model. Self-efficacy and baseline disability accounted for a significant amount of variance in disability levels at 3 months, $\Delta R^2 = 0.08$, $\Delta F(5, 30) = $, $p = 0.027$, self-efficacy $b = 0.64$, $t(38) = 1.08$, $p = 0.00$, baseline disability $b = -0.16$, $t(38) = -0.35$, $p = 0.000$.

6 months

To test whether personality type moderates the relationship between baseline disability, psychological variables and 6 month disability a second hierarchical multiple regression analysis with interaction terms was conducted. In the first step, the psychological variables, baseline disability and personality type were added. These variables accounted for a significant amount of variance in disability $R^2 = 0.756$, $F(6, 26) = 18.06$, $p = 0.000$.

Next, the interaction term between baseline disability, psychological variables and personality type was added into the regression model. Catastrophising and kinesiophobia accounted for a significant amount of variance in disability levels at 6 months, $\Delta R^2 = 0.08$, $\Delta F(5, 21) = 6.47$,

p= 0.027, catastrophising b = 0.04, t(29) = 0.20, p = 0.00, kinesiophobia b = -0.83, t(38) = -3.51, p = 0.00.

Responders and non-responders

Pain intensity

A comparison of the baseline to three month and baseline to six month MCIC for pain intensity (improvement = -2 points) [29] is demonstrated in Figure 2 for the defensive high-anxious and non-extreme groups. Both the defensive high-anxious (25%) and the non-extreme group (23%) had similar proportion of responder for reduced pain intensity from baseline to three months. In contrast, at six months, the defensive high-anxious group, demonstrated a greater proportion (38%) achieving a MCIC in pain intensity. Whereas within the non-extreme group, there was relatively little change with only 24% having a MCIC.

[Figure 2 near here]

Disability

A comparison of the baseline to three and six month MCIC for disability (improvement = -3 points) [30] is demonstrated in Figure 3 for the defensive high-anxious and non-extreme groups. Of the defensive high-anxious individuals, 35% had lower disability at three months compared to baseline, in contrast to only 14% of the non-extreme individuals. The proportion of defensive high-anxious individuals continued to improve with 50% having a MCIC from baseline to six months. The non-extreme individuals continued to show little change with only 6% of the group having lower disability at six months compared to baseline.

[Figure 3 near here]

Discussion

The results from this study highlight the importance of considering personality type in the management and assessment of chronic pain. Within the defensive high-anxious group, self-efficacy and kinesiophobia had a greater influence on disability. In contrast, the non-extreme group's levels of disability were not influenced by pain intensity or by psychological factors, and only baseline disability affected the variance at three and six months. The moderation analysis highlights that personality type influences the relationship between baseline disability and self-efficacy and disability at three months. At six months, personality type moderates the relationship between disability and catastrophising and kinesiophobia. Defensive high-anxious individuals reported greater improvement for both pain intensity and disability and showed stronger links between improvements in pain and disability and baseline psychological factors than the non-extreme individuals.

The majority of research within chronic pain populations has investigated the population as either a single homogenous group or stratified only based on levels of anxiety. The moderation analysis and regressions demonstrated that the cognitive factors had a different influence on disability depending on personality type. For the non-extreme group, cognitive factors did not influence levels of disability at three or six months. In contrast, within the defensive high-anxious group, the cognitive factors (lower self-efficacy and higher kinesiophobia) explain 28% of the variance in disability at three months and 30% (higher kinesiophobia) at six months. The significant influence of self-efficacy is consistent with previous research in chronic pain populations, which has identified self-efficacy to be a robust predictor for long term outcome for perceived disability [31]. Conceptually, self-efficacy is related to Behaviourist Theory and refers to the way individuals set goals and the anticipation of outcome [32]. The extent to which patients are disabled by pain, may depend upon their level of self-efficacy, whereby, patients with higher self-efficacy may more easily find strategies to

prevent further recurrences. Whereas individuals with lower self-efficacy may be more likely to avoid particular situations, a pattern which has been associated with helplessness and pessimistic thoughts [33]. Defensive high-anxious individuals have previously been found to be more pessimistic about outcome in high state anxiety situations than other personality types and to experience an amplified sense of threat to ambiguous situations [34, 35]. Their negative interpretation of such situations may reduce the likelihood that they will engage in physical activities, which they perceive will be harmful or to report higher levels of disability. The defensive high-anxious individuals reported higher levels of catastrophizing compared to the non-extreme individuals. Furthermore, within the defensive high-anxious group, kinesiophobia was found to influence disability at both three and six months. In line with the fear-avoidance model, Woby et al. [25] suggested that when there is a reduction in functional self-efficacy, higher fear of movement and catastrophizing, individuals are more likely to avoid certain activities which ultimately leads to greater disability, disuse and depression. This may be further exacerbated within the defensive high-anxious group as they are more likely to attend to threatening information and to see greater threat in ambiguous situations. Graded exposure to activities which may be perceived as threatening or harmful, has been shown to be an effective treatment [36, 37]. This type of intervention may be particularly beneficial for defensive high-anxious individuals, as it reduces fear of movement and improves self-efficacy with particular tasks and promotes more effective coping strategies. This may help clinicians to better target interventions and potentially decrease the rate of sick leave and influence adjustment to chronic pain, leading to lower healthcare utilisation [38]. By contrast, the non-extreme group showed no link between cognitive factors and disability. In this group, there is a less predictable relation between disability and cognitive factors. As the PMPs tend to focus upon addressing the ways that patients perceive their pain and at improving self-efficacy, it is not altogether unsurprising

that this personality group demonstrated relatively little response to the intervention as these factors are not significantly related to their disability.

The primary goal of treatment is to see an improvement in patients' pain intensity and disability, resulting in an improvement in daily living. Studies have investigated the MCIC to the patient [12, 39, 40], using standard outcome measures such as pain intensity and disability. A higher proportion of the defensive high-anxious individuals demonstrated an improvement in disability compared to the non-extreme group from baseline to three months (DHA= 35%; NE= 14%) and baseline to six months (DHA= 50%; NE= 6%). Interestingly, from baseline to three months, both the defensive high-anxious and the non-extreme groups had a similar percentage of individuals who improved in pain intensity (DHA= 25%; NE= 23%). From baseline to six months, the proportion of defensive high-anxious individuals continued to increase, however there was no change for the non-extreme group (DHA= 38%; NE= 24%).

The majority of studies investigating clinical interventions analyse group differences between treatment and control conditions, whereby it is assumed that if there is no difference in the means, or the mean is less than the MCIC then the treatment effect is unimportant. We can see that, by stratifying the population by personality type, more of the defensive high-anxious individuals perceive an improvement compared to the non-extreme individuals. The non-extreme individuals did not have any significant changes in their cognitive factors, compared to the defensive high-anxious group who reported significant reductions in depression at both time points. Previous research has shown that changes in depression from pre- to post-treatment, account for a significant amount of variance in changes in disability [41]. In addition, comorbid depression and chronic pain have been associated with more pain complaints, functional limitations and greater healthcare utilization [42, 43]. The defensive high-anxious individuals may be reporting lower depression and better outcome over time because, as treatment progresses, it is becoming effective by addressing cognitive factors. Current pain

management programmes do not focus on directly reducing pain intensity but are based on cognitive-behavioural principles to improve coping strategies, potentially resulting in reductions in pain intensity and disability. Other cognitive elements such as depression, self-efficacy and kinesiophobia have been shown to influence pain behaviour and pain intensity [43], which are factors that, within this study, influence the disability of defensive high-anxious individuals over time. In contrast, within the non-extreme group, psychological factors were not influential upon their levels of disability. The moderation analysis highlighted that cognitive factors (e.g., self-efficacy, kinesiophobia and catastrophising) are moderated by personality type. Compared to the non-extreme group, defensive high-anxious individuals have an enhanced attention towards pain related information. Research within depression literature, suggests that biased attention has an indirect influence upon memory through its impact on interpretation biases [44]. Whereby enhanced attention to negative information results in extensive elaboration and biased interpretation. This attributed meaning is likely to be stored within the long-term memory as a negative bias. Therefore, interventions focussed upon addressing cognitive elements may be more beneficial for defensive high-anxious individuals compared to the non-extreme group.

There are some limitations within this study, which should be considered. Firstly, data were based on self-report measures, which are potentially subject to bias and shared method variance. This study, however, explored the role of cognitive factors, which can only be measured by self-report. Secondly, there was no objective measure of disability and relied solely on self-report measures. A further limitation is the small number of repressors, high-anxious and low-anxious individuals that meant they had to be excluded from the longitudinal analysis. This prevented a more detailed comparison between all personality types at each time point. A further consideration is the modest sample size within the regressions. Some caution

should be taken in interpreting the results when the population is split based on personality type although effect sizes support the interpretations offered.

The differences between the defensive high-anxious and non-extreme personality types highlight the need for defensiveness to be included in future assessments of individuals with chronic pain. The distinct differences between the two groups also have important implications for assessing the effectiveness of treatment. There is a potential paradox within the defensive high-anxious individuals, who have previously been found to attend to pain related information, however, a higher percentage of individuals report an improvement in their levels of disability. These responses can only be partially explained by the individual's cognitive biases, other factors may include treatment type, environment (e.g., family support) and behaviour (e.g., readiness to self-manage). Based on the recommended outcome measures [45] used in this study, it could be suggested that current treatment is more effective for defensive high-anxious individuals compared to the non-extreme group. Their improvement may have been quicker or more pronounced if they were not attending to their pain and experiencing negative affect, which in turn influences their behaviour (e.g., avoidance of activities). Differentiating these two groups may allow for more targeted and cost-effective interventions.

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Table 1. Mean (±SD) for the defensive high-anxious and non- extreme group at each time point (* indicates significantly different from baseline).

	Defensive high-anxious			Non-extreme		
	Baseline (n= 26)	3 month (n= 20)	6 month (n= 16)	Baseline (n= 29)	3 month (n= 22)	6 month (n= 17)
% of whole population	33	34	34	38	37	36
Age (years)	55.19 (16.73)	56.35 (16.63)	55.38 (17.05)	54.41 (14.19)	55.23 (14.56)	54.12 (15.01)
Sex	20 Females 6 Males	16 Females 4 Males	12 Females 4 Males	21 Females 8 Males	15 Females 7 Males	11 Females 6 Males
Pain duration (years)	9.28 (11.98)	9.02 (11.62)	5.90 (5.95)	10.62 (13.34)	11.34 (14.27)	14.09 (15.60)
Pain intensity	6.08 (2.54)	5.50 (2.96)	5.00 (2.92)	5.83 (2.39)	5.95 (2.65)	6.06 (2.63)
Disability	17.35(4.87)	15.20 (6.58)	13.94 (7.66)	14.69 (5.59)	13.45 (5.16)	14.94 (5.99)
Catastrophising	28.77 (13.07)	25.65 (12.17)	22.88 (12.58)	21.52 (14.62)	18.05 (14.23)	20.53 (14.42)
Depression	25.58 (10.29)	22.80 (11.30)*	19.06 (13.60)*	20.41 (13.44)	16.77 (10.96)	20.82 (13.47)
Self-efficacy	32.50 (20.77)	31.00 (22.90)	41.00 (22.73)	35.52 (20.55)	37.18 (22.45)	33.76 (22.55)
Kinesiophobia	26.85(7.49)	26.80 (6.90)	25.50 (8.73)	24.83 (9.62)	24.00 (6.36)	26.29 (8.56)

Table 2. Regression analysis of baseline factors predicting three-month disability within the defensive high-anxious group.

Step	R²	R² change	F change	Standardised β	t
1. Demographics	0.53	0.53	4.31*		
Age				0.25	0.96
Sex				-0.37	-1.80
Pain duration				0.07	0.37
Baseline disability				0.71	3.38**
2. Pain Intensity	0.62	0.09	3.22	0.62	2.81
3. Cognitive factors	0.90	0.28	6.94**		
Catastrophising				-0.23	-1.35
Depression				0.11	0.65
Self-efficacy				-0.58	-2.90*
Kinesiophobia				0.29	-2.32*

Table 3. Regression analysis of baseline factors predicting six-month disability within the defensive high-anxious group.

Step	R²	R² change	F change	Standardised β	t
1. Demographics	0.53	0.53	3.09		
Age				0.24	0.76
Sex				-0.29	-1.15
Pain duration				0.12	0.49
Baseline disability				0.72	2.92
2. Pain Intensity	0.62	0.10	2.51	0.41	1.59
3. Cognitive factors	0.92	0.30	5.54*		
Catastrophising				-0.20	-1.20
Depression				0.22	0.89
Self-efficacy				-0.11	-0.44
Kinesiophobia				0.51	3.49*

Table 4. Regression analysis of baseline factors predicting three-month disability within the non-extreme group.

Step	R²	R² change	F change	Standardised β	t
1. Demographics	0.80	0.80	17.04**		
Age				-0.31	-2.16*
Sex				0.02	0.15
Pain duration				0.14	1.07
Baseline disability				0.68	4.78**
2. Pain intensity	0.80	0.00	0.03	-0.03	-0.18
3. Cognitive factors	0.89	0.09	2.59		
Catastrophising				-0.19	-1.50
Depression				-0.20	-0.82
Self-efficacy				-0.19	-1.15
Kinesiophobia				0.41	2.25

Table 5. Regression analysis of baseline factors predicting six-month disability within the non-extreme group.

Step	R^2	R^2 change	F change	Standardised β	t
1. Demographics	0.68	0.68	6.28**		
Age				-0.30	-1.38
Sex				0.16	0.92
Pain duration				0.12	0.56
Baseline disability				0.60	2.90*
2. Pain Intensity	0.74	0.06	2.72	0.40	1.65
3. Cognitive factors	0.90	0.16	2.65		
Catastrophising				0.14	0.43
Depression				-0.38	-1.14
Self-efficacy				-0.25	-1.14
Kinesiophobia				0.45	1.79

Figure 1. Diagram to demonstrate criterion splits of the personality types.

Figure 2. The percentage of individuals within each personality who reported MCIC in pain intensity from baseline to three months and six months (DHA= defensive high-anxious; NE= non-extreme).

Figure 3. The percentage of individuals within each personality who have shown MCIC in disability from baseline to three months and six months (DHA= defensive high-anxious; NE= non-extreme).