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## Distinctiveness of psychological obstacles to recovery in low back pain patients in primary care

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### Abstract

Many psychological factors have been suggested to be important obstacles to recovery from low back pain, yet most studies focus on a limited number of factors. We compared a more comprehensive range of 20 factors in predicting outcome in primary care. Consecutive patients consulting 8 general practices were eligible to take part in a prospective cohort study; 1591 provided data at baseline and 810 at 6 months. Clinical outcome was defined using the Roland and Morris Disability Questionnaire (RMDQ). The relative strength of the baseline psychological measures to predict outcome was investigated using adjusted multiple linear regression techniques. The sample was similar to other primary care cohorts (mean age 44 years, 59% women, mean baseline RMDQ 8.6). The 20 factors each accounted for between 0.04% and 33.3% of the variance in baseline RMDQ score. A multivariate model including all 11 scales that were associated with outcome in the univariate analysis accounted for 47.7% of the variance in 6 months RMDQ score; rising to 55.8% following adjustment. Four scales remained significantly associated with outcome in the multivariate model explaining 56.6% of the variance: perceptions of personal control, acute/chronic timeline, illness identify and pain self-efficacy. When all independent factors were included, depression, catastrophising and fear avoidance were no longer significant. Thus, a small number of psychological factors are strongly predictive of outcome in primary care low back pain patients. There is clear redundancy in the measurement of psychological factors. These findings should help to focus targeted interventions for back pain in the future.

### Keywords

Psychological factors; Low back pain; Primary care; Predictors; Prospective cohort

## 1 Introduction

One in four low back pain patients in the United Kingdom (UK) consult their general practitioner [17] and although most stop consulting within 3 months, 60–80% still have pain or disability a year later [13,29]. Recovery is typically slow and incomplete [28] and patients who do not make an early recovery are more likely to proceed to long-term disability. Recent reviews [30,35,73] consistently underline the role of psychosocial factors in predicting clinical outcome. The largest body of published studies about predictive factors

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relates to psychological obstacles to recovery, and, according to Blyth and colleagues [5], is flooded with ‘fuzzy’ thinking and confusion.

Guidelines [11,68,71] recommend that health professionals consider, and screen for, psychological factors. Yet many of these may be both important obstacles to recovery as well as potentially modifiable through clinical interventions [34,42]. These include fear avoidance [7,12,40], catastrophising [23,61,66] or perceptions about risk of persistence [28], depression [23,28], self-efficacy [30], expectations [30,72], beliefs about the future [63] and patients’ illness perceptions regarding their back problem [19]. A comprehensive picture of the role of psychosocial factors is lacking [53] since studies focus only on one or a few factors in isolation. Their relative importance, in terms of explaining outcome, is unknown.

Koes and colleagues [37] have called for more systematic identification of key psychological obstacles to recovery in primary care back pain patients, and for the development of early, targeted interventions. Maximising the potential for optimally targeted interventions is predicated on better understanding of the prognostic factors that are (a) most predictive of outcome and (b) most likely to be modifiable in primary care [43]. Only then can we achieve closer matching of treatments to patient characteristics [67]. Intervention studies are increasingly trying to modify psychological obstacles to recovery [27,67,70]. For example, fear avoidance has been the subject of epidemiological [40,60] and intervention studies [6,22,32] yet a recent review concluded limited evidence to link fear avoidance beliefs with poor prognosis [54].

We designed a prospective cohort study of low back pain consulters to determine the psychological factors that: (i) are associated with low back pain at presentation and (ii) most strongly predict clinical outcome 6 months following consultation, to inform targeting of interventions in primary care.

## 2 Methods

### 2.1 Design and setting

We conducted a prospective cohort study of consecutive patients consulting with low back pain in 8 general practices in North Staffordshire and Central Cheshire in England. The practices cover a heterogeneous population, both socio-economically and geographically, and conduct regular audits of their coding practices as part of the Keele General Practice Research Partnership [55]. In the UK, approximately 98% of the population is registered with a National Health Service (NHS) general practitioner [9]. Ethical approval for the study was obtained from the North Staffordshire and Central Cheshire Research Ethics Committees and permission was given by each general practice. All participants received usual care from their general practitioner.

### 2.2 Patients and recruitment

Contact information for all patients aged 18–60 years consulting their general practitioner with low back pain from September 2004 to April 2006 was downloaded each week from practice databases. In the week following consultation, invitation letters were posted from each general practice with an information sheet and questionnaire. The last page of the questionnaire was a consent form and, on return, these were detached from the questionnaire to maintain anonymity. For non-responders, a reminder postcard was sent after 2 weeks and a reminder questionnaire after 4 weeks. Patients consulting more than once during the study were only invited to participate after their first consultation.

Computerized primary care records in the UK are recorded using the Read Code classification system, and patients were identified through the use of Read Codes indicating

a consultation about low back pain. A range of codes was used since most patients with low back pain are not given a specific diagnosis when seen in primary care and the codes selected were intended to include all cases of non-specific low back pain. Codes indicating a red flag diagnosis (e.g. cauda equina syndrome, significant trauma, ankylosing spondylitis, cancers) were excluded. The validity of Read Codes in electronic patient records in the UK has been established [26] and the Read Codes used were a subset of those used in a previous study [17].

## 2.3 Questionnaires

Patients were sent postal questionnaires at baseline and 6 months, which covered sociodemographics, low back pain information, and psychological factors suggested to be risk factors for poor prognosis.

**2.3.1 Sociodemographics**—This included information on gender, age, employment status, and job title to determine the individual's socio-economic classification [49,50].

**2.3.2 Low back pain information**—The Roland and Morris Disability Questionnaire (RMDQ) [57] was used to measure self-reported disability from low back pain and asks patients to think of themselves “today”. It includes 24 items and is scored from 0 (no disability) to 24 (highest disability). Low back pain symptom duration was determined through the duration of current episode [15,18] and recent radiating symptoms were defined as pain, numbness or pins and needles below the knee in the last 2 weeks.

**2.3.3 Psychological obstacles to recovery**—We identified potential psychological obstacles to recovery using six different tools that, in total, provided data on 20 psychological constructs.

**2.3.3.1 Illness perceptions:** Illness perceptions are purported to influence clinical outcome within the ‘common-sense’ or self-regulation model [41] which suggests that people develop personal representations about their illness and these influence their behaviour and thus, outcome [51]. Illness perceptions predict outcomes in many conditions [1,8,24,31,52] and have been shown to predict outcome in low back pain patients [19]. We used the Revised Illness Perception Questionnaire (IPQ-R) [46] to measure 12 sub-scales; 8 measured patients’ illness perceptions (illness identity, consequences, timeline – acute/chronic, timeline – cyclical, illness coherence, treatment control, personal control, emotional representations) and 4 captured patients’ views of the causes of their back problem (psychological cause, risk factors, immunity and accident/chance). Items were coded as per the guidance of the developers of the tool so that high scores represent strong perceptions on a particular dimension (for example, the individual perceives their back problem to have serious consequences on their life and that it will last a long time). For illness identity, the number of symptoms reported as related to the individual’s back problem was summed giving a possible range of values from 0 to 14.

**2.3.3.2 Fear avoidance beliefs:** Fear avoidance is a belief that certain activities should be avoided due to fear of causing pain or re-injury and has been suggested to predict future disability [62]. Fear of movement related to pain (labeled fear avoidance) was measured using the Tampa Scale of Kinesiophobia (TSK) [38]. This is based on 17 items each with a four-point Likert scale with scoring alternatives ranking from ‘strongly disagree’ to ‘strongly agree’ (range in scores: 17–68); higher scores indicate greater level of fear avoidance. Early factor analysis suggested four factors in the scale but more recent research suggested two factors: somatic focus and activity avoidance [56]. These two factors are reflective of the higher order construct, namely fear of movement and (re)injury [56] and the

total score has been recommended to study the role of general levels of fear of movement and re-injury [56,69].

**2.3.3.3 Coping:** Through the work of authors such as Lazarus and Folkman [39], the concept of psychological coping has developed and some studies have suggested the adoption of passive coping strategies, and specifically holding maladaptive catastrophic thoughts, is associated with disability in back pain patients [33]. Coping was measured using the 4 sub-scales of the Coping Strategies Questionnaire (CSQ24) for which higher scores on each sub-scale indicate higher frequency of the specific coping style (0 = never use it, 6 = always): catastrophising (6 items; sub-scale score: 0–36), diversion (6 items; 0–36), re-interpretation (6 items; 0–36) and cognitive coping (5 items; 0–30) [25].

**2.3.3.4 Anxiety and depression:** Depression, usually thought to be associated with catastrophising cognitions, has been a reasonably consistent obstacle to recovery in previous studies [16,53,76]. We measured anxiety and depression using the Hospital Anxiety and Depression Scale (HADS) (7 items each for anxiety and depression; item scores range from 0 to 3; sub-scale scores range from 0 to 21) on which higher scores indicate greater levels of distress [77].

**2.3.3.5 Self-efficacy beliefs:** A concept developed by Bandura [4], self-efficacy is a personal belief about how successfully one can cope with difficult situations, in this case, the degree of confidence a patient has in performing normal activities and tasks (such as household chores and increasing activity levels) despite their pain. Previous prospective studies have shown self-efficacy beliefs to be important determinants of pain behaviour and disability [2,14]. We used the Pain Self-Efficacy Questionnaire (PSEQ) that measures both the strength and generality of a patient's beliefs about their ability to accomplish a range of activities despite their pain. It has 10 items each with a six-point Likert scale (scale score: 0–60) and higher scores indicate stronger self-efficacy beliefs [47,48].

## 2.4 Statistical analysis

Scores for each of the psychological constructs were calculated according to the methods specified by the questionnaire developers. The baseline sociodemographic, back pain specific and psychological scales (20 psychological constructs) are presented using simple descriptive statistics. The direct relationships between each of the psychological constructs and RMDQ scores at baseline are presented as Pearson correlation coefficients (with associated 95% confidence intervals) and the variance explained (expressed as % $R^2$ ).

A multi-stage linear regression modeling procedure was applied to determine the distinctiveness of the psychological obstacles to recovery as predictors of RMDQ score at 6 months follow-up.

Stage 1 assessed the importance of each of the individual psychological constructs in predicting outcome after adjusting for important baseline data (univariate models). For each of the 20 psychological constructs, three models were computed. Model 1 contained only the baseline RMDQ scores; Model 2 added the demographic data (gender, age group) and low back pain specific data (baseline data on average pain severity, duration of back pain and radiation of symptoms into the legs) to Model 1; Model 3 added the baseline psychological construct score to Model 2. The coefficients of interest were: (i) % $R^2$  and adjusted % $R^2$  for the overall linear regression models as the index of the percentage of the variance explained (Models 1–3), (ii) change ( $\Delta$ ) in % $R^2$  and associated  $p$ -value (from an  $F$ -test) for the comparisons of the models (Model 1 vs Model 2; Model 2 vs Model 3) to examine the additional percentage of the variance explained, and (iii) regression coefficient ( $B$ ) and

associated 95% confidence interval for the psychological construct for each individual model (Model 3).

The objective of Stage 2 was to develop a model (“initial multivariate model”) that included multiple psychological constructs that were found to be statistically significant at Stage 1. The statistical significance of each of the psychological constructs in Stage 1 was assessed by the *F*-test associated with the change in %*R*<sup>2</sup> from Model 2 to Model 3. As a large number of constructs were being examined, only constructs that were individually significant (*p*-value of *F*-test <0.01) were added into the next stage of the multivariate model. In addition to the significant psychological constructs, the multivariate model fitted also controlled for the baseline RMDQ score and the demographic and low back pain specific clinical factors included in Stage 1. This multivariate model was then inspected for constructs that were considered redundant in the presence of other constructs, i.e. their standardised  $\beta$  coefficient in the multivariate model had an associated *p*-value >0.01. This simpler multivariate model (“reduced multivariate model”) was then fitted.

Finally, in Stage 3 we investigated whether the power of the psychological constructs was influenced by baseline symptom duration (acute: <1 month, sub-acute: 1–6 months, chronic: 7+ months). A method similar to that used to derive models at Stage 1 was implemented with the addition of an interaction term between each psychological construct and the duration variable (“initial interaction multivariate model”). The psychological constructs from the univariate model stage that were put forward to the multivariate model were those that either (i) showed a significant change in %*R*<sup>2</sup> but no significant interaction or (ii) showed a significant change in %*R*<sup>2</sup> including a significant interaction. This initial “interaction multivariate model”, including any significant interactions, was assessed for redundancy, as described above, and a reduced multivariate model was fitted (“reduced interaction multivariate model”).

Although a comprehensive consideration of the psychological dimensions as potential mediators of outcome [45] was beyond the remit of this study, and not strictly appropriate since we do not have a clearly specified intervention, we also looked at the relationships between changes in the psychological constructs and changes in disability over 6 months.

### 3 Results

Details of the recruitment of this cohort are given in detail elsewhere [19]. In brief, questionnaires were posted to 3150 adults consulting their general practitioner during the study period. During the mailing, 131 exclusions were made to the database leaving an eligible study population of 3019 adults of which 1591 completed the baseline questionnaire (adjusted response of 52.7%). Of those, 1289 (81%) gave permission for further contact. Adjusted response to questionnaires at 6 months was 64.6% (*n* = 810) of the eligible population.

The 1591 patients had a mean (SD) age of 43.9 (10.3) years and 58.5% were women. The mean (SD) RMDQ score at baseline was 8.64 (6.0). A summary of baseline data is presented in Table 1.

#### 3.1 Baseline associations

Pearson correlations between the baseline psychological constructs and RMDQ scores are shown in Table 2. Only two of the 20 psychological construct scores measured at baseline were not significantly related to RMDQ scores at baseline: perceptions regarding timeline – cyclical (IPQ-R) and the coping sub-scale of re-interpretation (CSQ24). The factors that correlated most strongly with low back pain disability at initial presentation in primary care

were perceptions of consequences (IPQ-R), depression (HADS) and pain self-efficacy (PSEQ). The 20 individual psychological scales each accounted for between 0.04% and 33.3% of the variance in baseline RMDQ score.

### 3.2 Linear regression models

Table 3 provides the results of the three stage linear regression modeling procedure. For each linear regression model fitted, the baseline RMDQ score (Model 1), shown in the first column of Table 3, explained a large amount of the variability in RMDQ score at 6 months (range: 42.5–43.4%). The addition of the demographic and back pain specific factors significantly increased the fit of the model as evidenced by a significant change in the % $R^2$  for each of the linear regression models (Model 2 in Table 3).

Of the 20 psychological constructs examined, only 11 resulted in significant changes in the % $R^2$  (Model 3 in Table 3). These constructs were: perceptions about consequences, emotional representations, personal control, treatment control, timeline – acute/chronic, illness identity, immunity attribution (all measured using the IPQ-R), depression (HADS), pain self-efficacy (PSEQ), fear avoidance (TSK) and catastrophising (CSQ24). The total variance explained by the demographic factors, the back pain related characteristics and the psychological constructs is shown as Model 3 in Table 3. The final column in Table 3 shows the specific incremental value of each of the psychological constructs.

The resulting “initial multivariate model” explained 55.8% of the variance in the 6-month RMDQ scores (Table 4). To investigate redundancy, all 11 significant psychological variables (along with the demographic and baseline clinical characteristics) were then entered together into the predictive model. The reduced multivariate model contained only four psychological constructs that remained independently statistically significant; timeline – acute/chronic, illness identity, personal control (all measured using the IPQ-R) and pain self-efficacy (measured using the PSEQ) (Table 4). Together these constructs explained 56.6% of back pain related disability 6 months after primary care consultation. Their relative influence on the final model can be gauged from comparison of the  $\beta$  values in Table 4.

When examining for interactions between back pain symptom duration (acute, sub-acute or chronic pain at presentation in primary care) and the psychological constructs only one, pain self-efficacy measured by the PSEQ, was shown to have a statistically significant different relationship with RMDQ score at 6 months across the three levels of symptom duration. When re-fitting the multivariate model to allow for this interaction, the only difference to the models fitted without interaction, both the initial and the reduced multivariate model, was the addition of an interaction term between pain self-efficacy and symptom duration. The interaction suggested that poorer self-efficacy has a greater effect on RMDQ score for those with chronic ( $B = -0.938$ ) or sub-acute symptom duration ( $B = -0.173$ ) compared to those with acute symptom duration ( $B = 0.004$ ).

When we looked at the relationships between changes in the psychological constructs and changes in disability, we found that changes in 8 of the 20 psychological constructs were independently associated with changes in disability. When considered in combination, in terms of ‘redundancy’, only three constructs remained; changes in illness identity (IPQ-R), pain self-efficacy (PSEQ) and depression (HADS) were associated with change in disability. Considered together, these three variables explained 42.4% (Adj % $R^2$ ) of the change in disability (results not tabled).

## 4 Discussion

### 4.1 Summary of key findings

A small number of psychological factors are most predictive of outcome in primary care low back pain patients. Of 20 potential psychological obstacles to recovery, four were most predictive of outcome 6 months after primary care consultation, explaining 56.6% of the variance in disability. Patients' perceptions that the problem will last well into the future, that many symptoms are related to their back problem, their weak beliefs about personal controllability and low confidence in their own ability to perform normal activities despite the pain were better predictors of disability at 6 months than fear avoidance, catastrophising or depression. The strongest predictors fit with two frameworks linking patients' cognitions, behaviours and outcomes; the self-regulatory model [41] and the self-efficacy model [4]. In both, perceptions of low personal control over the pain/poor self-efficacy and the inevitability of a future with pain could be hypothesized to lead to passivity, inactivity, reduction or cessation of coping attempts, avoidance of specific behaviours and poor adherence with advice to keep active despite the pain, all of which will lead to higher disability levels in the future. The four key predictors point to the possibility, in primary care back pain patients at least, that it is not only self-efficacy beliefs related to specific behaviours but more broadly that patients who are better able to cope in the face of adversity, who have a 'resilient self-belief system' in the face of obstacles as referred to by Bandura [4], who perceive themselves able to exercise control over their back problem, now and in the future, are less likely to develop longer-term disability.

Although comprehensive consideration of the psychological dimensions as potential mediators of outcome was beyond the remit of this study, we found that the change scores on a small number of psychological variables between baseline and 6 months were correlated with change in disability. The causal relationship between these changes would need further investigation.

### 4.2 Comparison with other studies

The links between psychological factors and disability have been studied previously (e.g. [59]). Self-efficacy has been shown to correlate with disability related to musculoskeletal pain [64], to strongly predict back pain disability [74], and to better explain disability in back pain [3] and musculoskeletal pain patients [14], compared with fear avoidance. It has also been shown to mediate the relationship between pain-related fear and disability [75]. Beliefs about pain permanence, similar timeline perceptions in our study, have been shown to predict disability [76]. Our results are also in line with those showing that patients' illness perceptions are important determinants of function and outcome [24]. Illness perceptions have predicted outcomes at 12 months in patients with coronary heart disease (CHD) [1] and psoriasis [58], and predicted physical and mental health up to two years after primary care consultation [21].

### 4.3 Strengths and weaknesses

We included a large, consecutively sampled, cohort of primary care consulters with low back pain, a comprehensive set of psychological constructs and longitudinal data collection from general practice consultations in practices with high quality Read Coding. Back related disability scores were similar to other primary care cohorts [18,33] and we controlled for age, gender, pain severity and duration and radiation of symptoms in our analyses.

Not all patients who consulted took part in the study and so there is potential for bias. Those not completing the baseline questionnaire, and those who were lost to follow-up at 6 months, were slightly younger and more likely to be male. The 6 months follow-up period

is relatively short, although the data show that significant changes in clinical outcome do take place in the population within this period, and our previous cohort showed these outcomes to remain relatively stable between 6 and 12 months [18]. However, replication in other primary care samples would be beneficial. In trying to avoid overburden to patients, we did not measure all possible psychological factors, for example, patients' locus of control, nor did we capture social variables such as work dissatisfaction that have been previously shown to be important predictors [30]. In addition, across the validated tools we used to measure the 20 psychological constructs, there is the potential for some item overlap (semantic proximity) with some items on our dependent variable (the RMDQ). Future research could explore the specific importance of this.

#### 4.4 Implications

The results challenge some assumptions about key psychological obstacles to recovery in this population and should help focus future targeted interventions. Despite the plethora of psychological obstacles to recovery suggested, we found that a few (four out of a possible 20) were most predictive of outcome. Factors such as fear avoidance and depression have received much recent attention but we found better prediction with key illness perceptions and self-efficacy. Even though specific factors predict outcome, they may not be modifiable or they may be mediated by other factors. In the context of this primary care observational cohort, it was not appropriate to seek to tease out specific mediators of outcome although we did show that changes in a small number of constructs (including illness identity and self-efficacy) were highly associated with the changes in outcome. Importantly, there is evidence that pain self-efficacy is modifiable from studies using cognitive-behavioural approaches, exercise treatments and self-help groups [10,47]. There is also evidence, in conditions such as hypertension [65] and myocardial infarction [52], that targeting specific illness perceptions can improve adherence to medical advice and treatment, and thus outcome, but it remains to be seen if this holds true for patients with back pain in primary care.

This study provides support for two theoretical frameworks that could help to (a) better identify and (b) select patients for targeted treatments. While use of these models may not guarantee better outcomes for patients, they at least provide sound theoretical underpinning for the development and delivery of interventions. Such interventions are most likely to involve cognitive-behavioural approaches that aim to change the way patients think about their problem, challenge their beliefs about personal control and influence related activities and behaviours [44]. Interventions that facilitate personal achievements in the performance of activities, that use verbal persuasion and observation of improvements in relevant behaviours, fit with self-efficacy theory. It is likely that interventions are most beneficial when they successfully target treatment at groups of patients matched on modifiable clinical characteristics [67]. Our results could be used to guide which psychological factors to measure and target in practice and the development of screening procedures to systematically identify the patients with these key psychological obstacles to recovery.

Whilst other factors such as fear avoidance, catastrophising and depression did explain considerable proportions of the variance in disability at 6 months (49.9%, 51.8%, 50.3%, respectively, in the univariate regression model), we did not confirm their independent importance as predictors of outcome. There are a number of explanations for this, for example fear avoidance and depression could be moderated by personal control rather than being strong primary predictors of disability. Alternatively, some variables, such as fear avoidance, may be important earlier in the low back pain episode [20,36], while issues of personal control and confidence in their own ability to manage despite the pain are important overall.



The knowledge that few psychological obstacles to recovery are most predictive of outcome in primary care has practical utility. Medical advice to keep active and self-manage may not make much sense from the patient's perspective, for example, in an individual with low self-efficacy and weak perceptions of personal control. Some patients are likely to need more help than others with making sense of medical advice and prescribed treatment. Targets might include trying to improve patients' perceptions of their personal control and restructuring negative thoughts about the inevitability of their back problem. Further studies need to study the potential pathways of influence, including potential mediators and moderators, of psychological obstacles to recovery and clinical outcomes. We recognize that there are many factors influencing the pain experience and the progression to disability and that the key obstacles we have shown in this study are likely to influence other factors, for example, higher pain self-efficacy beliefs have previously been shown to be predictive of reductions in avoidance behaviours [2].

## 5 Conclusion

Recent guidelines for the management of low back pain urge health care practitioners to consider and identify psychological obstacles to recovery. We compared how different psychological factors predict back pain outcome 6 months following primary care consultation. Supporting two theoretical frameworks (self-efficacy and self-regulation), patients who expect their back problem to last a long time, who hold weak beliefs and confidence in their own ability to control their back problem and who perceive that many symptoms are related to their back problem are more likely to have poor clinical outcomes. The results challenge some common assumptions about the most important psychological predictors of outcome. Future research needs to develop ways to translate this knowledge about the most predictive psychological obstacles to recovery into targeted interventions and improved outcomes for patients. Such studies will need to investigate carefully whether the intervention(s) changes the specific obstacles to recovery that are targeted.

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**Table 1**Summary of patients' baseline characteristics ( $n = 1591$ ).

Characteristic	Freq (%)
Gender	
Female	930 (58.5)
Male	661 (41.5)
Age (years)	
Mean (SD, range)	43.9 (10.3, 18–60)
Occupational group*	
Higher managerial/professional	140 (10.0)
Lower managerial/professional	302 (21.7)
Intermediate occupations	251 (18.0)
Self-employed	73 (5.2)
Lower supervisory/technical	76 (5.4)
Semi-routine occupations	318 (22.8)
Routine occupations	236 (16.9)
RMDQ <sup>a</sup> score at baseline	
Mean (SD)	8.64 (6.0)
Duration of low back pain at baseline*	
<1 month	579 (37.8)
1–6 months	592 (38.7)
7+ months	359 (23.5)
Radiating leg pain*	
No	651 (41.4)
Yes, to above the knee	385 (24.5)
Yes, to below the knee	537 (34.1)
IPQ-R <sup>b</sup> (mean (SD, possible range))	
Consequences	17.3 (5.5, 6–30)
Timeline – cyclical	13.0 (3.4, 4–20)
Emotional representations	16.7 (5.2, 6–30)
Illness coherence	13.8 (5.0, 5–25)
Personal control	20.5 (3.8, 6–30)

Characteristic	Freq (%)
Treatment control	17.0 (3.4, 5–25)
Timeline – acute/chronic	19.6 (5.8, 6–30)
Identity	4.0 (2.4, 0–14)
Cause	
Psychological attribution	11.9 (4.1, 6–30)
Risk factor attribution	15.0 (4.1, 7–35)
Immunity attribution	5.3 (1.9, 3–15)
Accident/chance attribution	6.0 (1.9, 2–10)

HADS<sup>c</sup> (mean (SD, possible range))

Anxiety	8.3 (4.6, 0–21)
Depression	6.5 (4.4, 0–21)

PSEQ<sup>d</sup> (mean (SD, possible range))

Self-efficacy	37.8 (14.6, 0–60)
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TSK<sup>e</sup> (mean (SD, possible range))

Fear avoidance	39.7 (6.9, 17–68)
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CSQ-24<sup>f</sup> (mean (SD, possible range))

Catastrophising	10.0 (8.0, 0–36)
Diversion	15.5 (8.2, 0–36)
Re-interpretation	7.8 (7.0, 0–36)
Cognitive coping	16.3 (6.4, 0–30)

\*Data do not add to totals due to missing information.

<sup>a</sup>Roland and Morris Disability Questionnaire.

<sup>b</sup>Illness Perceptions Questionnaire-Revised.

<sup>c</sup>Hospital Anxiety and Depression Scale.

<sup>d</sup>Pain Self-Efficacy Questionnaire.

<sup>e</sup>Tampa Scale of Kinesiophobia.

<sup>f</sup>Coping Strategies Questionnaire.

**Table 2**

Relationship between RMDQ<sup>a</sup> and the 20 psychological constructs at baseline: Pearson correlation coefficient and %R<sup>2</sup>.

Psychological obstacles	Pearson correlation coefficient (95% CI; <i>p</i> -value)	%R <sup>2</sup>
<b>IPQ-R<sup>b</sup></b>		
Consequences	0.61 (0.59, 0.65; <i>p</i> < 0.001)	30.7%
Timeline – cyclical	0.03 (–0.01, 0.07; <i>p</i> = 0.21)	0.04%
Emotional representations	0.52 (0.49, 0.55; <i>p</i> < 0.001)	19.8%
Illness coherence	0.12 (0.08, 0.17; <i>p</i> < 0.001)	1.7%
Personal control	–0.25 (–0.29, –0.21; <i>p</i> < 0.001)	11.8%
Treatment control	–0.25 (–0.29, –0.21; <i>p</i> < 0.001)	10.5%
Timeline – acute/chronic	0.37 (0.34, 0.41; <i>p</i> < 0.001)	23.5%
Identity	0.53 (0.50, 0.56; <i>p</i> < 0.001)	21.1%
<b>Cause</b>		
Psychological attribution	0.19 (0.15, 0.23; <i>p</i> < 0.001)	2.7%
Risk factor attribution	0.13 (0.09, 0.17; <i>p</i> < 0.001)	1.1%
Immunity attribution	0.13 (0.09, 0.17; <i>p</i> < 0.001)	1.9%
Accident/chance attribution	0.12 (0.08, 0.17; <i>p</i> < 0.001)	0.7%
<b>HADS<sup>c</sup></b>		
Anxiety	0.50 (0.47, 0.53; <i>p</i> < 0.001)	12.3%
Depression	0.64 (0.61, 0.66; <i>p</i> < 0.001)	24.2%
<b>PSEQ<sup>d</sup></b>		
Self-efficacy	–0.68 (–0.71, –0.66; <i>p</i> < 0.001)	33.3%
<b>TSK<sup>e</sup></b>		
Fear avoidance	0.49 (0.46, 0.52; <i>p</i> < 0.001)	15.3%
<b>CSQ24<sup>f</sup></b>		
Catastrophising	0.56 (0.53, 0.59; <i>p</i> < 0.001)	24.8%
Diversion	0.19 (0.15, 0.23; <i>p</i> < 0.001)	2.7%
Re-interpretation	0.05 (0.01, 0.09; <i>p</i> = 0.07)	0.2%
Cognitive coping	–0.23 (–0.27, –0.19; <i>p</i> < 0.001)	3.4%

<sup>a</sup>Roland and Morris Disability Questionnaire.

<sup>b</sup>Illness Perceptions Questionnaire-Revised.

<sup>c</sup>Hospital Anxiety and Depression Scale.

<sup>d</sup>Pain Self-Efficacy Questionnaire.



<sup>e</sup>Tampa Scale of Kinesiophobia.

<sup>f</sup>Coping Strategies Questionnaire.

**Table 3**

Identifying the specific influence of each of the baseline psychological constructs\* on RMDQ score at 6 months: linear regression models.

	Model 1		Model 2		Model 3		Change from Model 2 to Model 3	
	RMDQ at baseline	Model 1 + demographic and low back pain factors	Model 1 + demographic and low back pain factors	Additional variance explained by demographic and low back pain factors	Model 2 + psychological construct	Additional variance explained by psychological construct	Model 2 + psychological construct	Additional variance explained by psychological construct
<i>IPQ-R</i>								
Consequences ( <i>n</i> = 768)	% <i>R</i> <sup>2</sup> = 43.4Adj % <i>R</i> <sup>2</sup> = 43.3	% <i>R</i> <sup>2</sup> = 49.8Adj % <i>R</i> <sup>2</sup> = 49.2	Δ % <i>R</i> <sup>2</sup> = 6.4 <i>p</i> -value <0.001	% <i>R</i> <sup>2</sup> = 52.2Adj % <i>R</i> <sup>2</sup> = 51.6 <i>B</i> <sup>†</sup> = 0.23 (0.16, 0.30)	Δ % <i>R</i> <sup>2</sup> = 2.5 <i>p</i> -value <0.001			
Timeline – cyclical ( <i>n</i> = 765)	% <i>R</i> <sup>2</sup> = 43.4Adj % <i>R</i> <sup>2</sup> = 43.3	% <i>R</i> <sup>2</sup> = 49.8Adj % <i>R</i> <sup>2</sup> = 49.2	Δ % <i>R</i> <sup>2</sup> = 6.4 <i>p</i> -value <0.001	% <i>R</i> <sup>2</sup> = 50.0Adj % <i>R</i> <sup>2</sup> = 49.3 <i>B</i> = 0.10 (−0.001, 0.19)	Δ % <i>R</i> <sup>2</sup> = 0.3 <i>p</i> -value = 0.05			
Emotional representations ( <i>n</i> = 767)	% <i>R</i> <sup>2</sup> = 43.2Adj % <i>R</i> <sup>2</sup> = 43.2	% <i>R</i> <sup>2</sup> = 49.8Adj % <i>R</i> <sup>2</sup> = 49.2	Δ % <i>R</i> <sup>2</sup> = 6.6 <i>p</i> -value <0.001	% <i>R</i> <sup>2</sup> = 51.4Adj % <i>R</i> <sup>2</sup> = 50.8 <i>B</i> = 0.17 (0.11, 0.24)	Δ % <i>R</i> <sup>2</sup> = 1.6 <i>p</i> -value <0.001			
Illness coherence ( <i>n</i> = 765)	% <i>R</i> <sup>2</sup> = 43.4Adj % <i>R</i> <sup>2</sup> = 43.3	% <i>R</i> <sup>2</sup> = 49.8Adj % <i>R</i> <sup>2</sup> = 49.2	Δ % <i>R</i> <sup>2</sup> = 6.4 <i>p</i> -value <0.001	% <i>R</i> <sup>2</sup> = 49.9Adj % <i>R</i> <sup>2</sup> = 49.3 <i>B</i> = 0.05 (−0.01, 0.11)	Δ % <i>R</i> <sup>2</sup> = 0.2 <i>p</i> -value = 0.11			
Personal control ( <i>n</i> = 766)	% <i>R</i> <sup>2</sup> = 43.2Adj % <i>R</i> <sup>2</sup> = 43.2	% <i>R</i> <sup>2</sup> = 49.7Adj % <i>R</i> <sup>2</sup> = 49.1	Δ % <i>R</i> <sup>2</sup> = 6.5 <i>p</i> -value <0.001	% <i>R</i> <sup>2</sup> = 52.1Adj % <i>R</i> <sup>2</sup> = 51.4 <i>B</i> = −0.26 (−0.34, −0.17)	Δ % <i>R</i> <sup>2</sup> = 2.3 <i>p</i> -value <0.001			
Treatment control ( <i>n</i> = 764)	% <i>R</i> <sup>2</sup> = 43.0Adj % <i>R</i> <sup>2</sup> = 43.0	% <i>R</i> <sup>2</sup> = 49.4Adj % <i>R</i> <sup>2</sup> = 48.8	Δ % <i>R</i> <sup>2</sup> = 6.3 <i>p</i> -value <0.001	% <i>R</i> <sup>2</sup> = 51.3Adj % <i>R</i> <sup>2</sup> = 50.6 <i>B</i> = −0.27 (−0.36, −0.17)	Δ % <i>R</i> <sup>2</sup> = 1.9 <i>p</i> -value <0.001			
Timeline – acute/chronic ( <i>n</i> = 768)	% <i>R</i> <sup>2</sup> = 43.4Adj % <i>R</i> <sup>2</sup> = 43.3	% <i>R</i> <sup>2</sup> = 49.8Adj % <i>R</i> <sup>2</sup> = 49.2	Δ % <i>R</i> <sup>2</sup> = 6.4 <i>p</i> -value <0.001	% <i>R</i> <sup>2</sup> = 54.6Adj % <i>R</i> <sup>2</sup> = 54.0 <i>B</i> = 0.26 (0.20, 0.31)	Δ % <i>R</i> <sup>2</sup> = 4.9 <i>p</i> -value <0.001			
Identity ( <i>n</i> = 770)	% <i>R</i> <sup>2</sup> = 43.2Adj % <i>R</i> <sup>2</sup> = 43.1	% <i>R</i> <sup>2</sup> = 49.8Adj % <i>R</i> <sup>2</sup> = 49.2	Δ % <i>R</i> <sup>2</sup> = 6.6 <i>p</i> -value <0.001	% <i>R</i> <sup>2</sup> = 50.6Adj % <i>R</i> <sup>2</sup> = 49.9 <i>B</i> = 0.28 (0.12, 0.45)	Δ % <i>R</i> <sup>2</sup> = 0.8 <i>p</i> -value = 0.006			
Psychological attribution ( <i>n</i> = 756)	% <i>R</i> <sup>2</sup> = 43.1Adj % <i>R</i> <sup>2</sup> = 43.0	% <i>R</i> <sup>2</sup> = 49.3Adj % <i>R</i> <sup>2</sup> = 48.7	Δ % <i>R</i> <sup>2</sup> = 6.3 <i>p</i> -value <0.001	% <i>R</i> <sup>2</sup> = 49.6Adj % <i>R</i> <sup>2</sup> = 49.0 <i>B</i> = 0.09 (0.01, 0.17)	Δ % <i>R</i> <sup>2</sup> = 0.3 <i>p</i> -value = 0.03			
Risk factor attribution ( <i>n</i> = 757)	% <i>R</i> <sup>2</sup> = 42.8Adj % <i>R</i> <sup>2</sup> = 42.8	% <i>R</i> <sup>2</sup> = 49.2Adj % <i>R</i> <sup>2</sup> = 48.6	Δ % <i>R</i> <sup>2</sup> = 6.4 <i>p</i> -value <0.001	% <i>R</i> <sup>2</sup> = 49.5Adj % <i>R</i> <sup>2</sup> = 48.8 <i>B</i> = 0.06 (−0.02, 0.13)	Δ % <i>R</i> <sup>2</sup> = 0.2 <i>p</i> -value = 0.07			
Immunity attribution ( <i>n</i> = 758)	% <i>R</i> <sup>2</sup> = 42.9Adj % <i>R</i> <sup>2</sup> = 42.80	% <i>R</i> <sup>2</sup> = 49.3Adj % <i>R</i> <sup>2</sup> = 48.7	Δ % <i>R</i> <sup>2</sup> = 6.4 <i>p</i> -value <0.001	% <i>R</i> <sup>2</sup> = 49.8Adj % <i>R</i> <sup>2</sup> = 49.1 <i>B</i> = 0.22 (0.05, 0.39)	Δ % <i>R</i> <sup>2</sup> = 0.5 <i>p</i> -value = 0.001			
Accident/chance attribution ( <i>n</i> = 742)	% <i>R</i> <sup>2</sup> = 43.0Adj % <i>R</i> <sup>2</sup> = 43.0	% <i>R</i> <sup>2</sup> = 49.3Adj % <i>R</i> <sup>2</sup> = 48.7	Δ % <i>R</i> <sup>2</sup> = 6.2 <i>p</i> -value <0.001	% <i>R</i> <sup>2</sup> = 49.4Adj % <i>R</i> <sup>2</sup> = 48.7 <i>B</i> = 0.09 (−0.08, 0.25)	Δ % <i>R</i> <sup>2</sup> = 0.07 <i>p</i> -value = 0.31			
<i>HADS</i>								
Anxiety ( <i>n</i> = 767)	% <i>R</i> <sup>2</sup> = 43.2Adj % <i>R</i> <sup>2</sup> = 43.1	% <i>R</i> <sup>2</sup> = 49.8Adj % <i>R</i> <sup>2</sup> = 49.2	Δ % <i>R</i> <sup>2</sup> = 6.6 <i>p</i> -value <0.001	% <i>R</i> <sup>2</sup> = 49.9Adj % <i>R</i> <sup>2</sup> = 49.3 <i>B</i> = 0.05 (−0.03, 0.13)	Δ % <i>R</i> <sup>2</sup> = 0.1 <i>p</i> -value = 0.18			
Depression ( <i>n</i> = 767)	% <i>R</i> <sup>2</sup> = 43.2Adj % <i>R</i> <sup>2</sup> = 43.1	% <i>R</i> <sup>2</sup> = 49.8Adj % <i>R</i> <sup>2</sup> = 49.2	Δ % <i>R</i> <sup>2</sup> = 6.6 <i>p</i> -value <0.001	% <i>R</i> <sup>2</sup> = 50.3Adj % <i>R</i> <sup>2</sup> = 49.7 <i>B</i> = 0.14 (0.04, 0.23)	Δ % <i>R</i> <sup>2</sup> = 0.5 <i>p</i> -value = 0.005			
<i>PSEQ</i>								
Self-efficacy ( <i>n</i> = 765)	% <i>R</i> <sup>2</sup> = 43.0Adj % <i>R</i> <sup>2</sup> = 42.9	% <i>R</i> <sup>2</sup> = 49.7Adj % <i>R</i> <sup>2</sup> = 49.1	Δ % <i>R</i> <sup>2</sup> = 6.7 <i>p</i> -value <0.001	% <i>R</i> <sup>2</sup> = 51.5Adj % <i>R</i> <sup>2</sup> = 50.8 <i>B</i> = −0.08 (−0.11, −0.05)	Δ % <i>R</i> <sup>2</sup> = 1.8 <i>p</i> -value <0.001			
<i>TSK</i>								
Fear avoidance ( <i>n</i> = 748)	% <i>R</i> <sup>2</sup> = 42.5Adj % <i>R</i> <sup>2</sup> = 42.5	% <i>R</i> <sup>2</sup> = 49.2Adj % <i>R</i> <sup>2</sup> = 48.6	Δ % <i>R</i> <sup>2</sup> = 6.7 <i>p</i> -value <0.001	% <i>R</i> <sup>2</sup> = 49.9Adj % <i>R</i> <sup>2</sup> = 49.3 <i>B</i> = 0.09 (0.03, 0.14)	Δ % <i>R</i> <sup>2</sup> = 0.7 <i>p</i> -value = 0.001			

	Model 1	Model 2	Change from Model 1 to Model 2	Model 3	Change from Model 2 to Model 3
	RMDQ at baseline	Model 1 + demographic and low back pain factors	Additional variance explained by demographic and low back pain factors	Model 2 + psychological construct	Additional variance explained by psychological construct
<i>CSQ24</i>					
Catastrophising ( <i>n</i> = 762)	% <i>R</i> <sup>2</sup> = 43.1Adj % <i>R</i> <sup>2</sup> = 43.0	% <i>R</i> <sup>2</sup> = 49.7Adj % <i>R</i> <sup>2</sup> = 49.1	Δ % <i>R</i> <sup>2</sup> = 6.6 <i>p</i> -value <0.001	% <i>R</i> <sup>2</sup> = 51.8Adj % <i>R</i> <sup>2</sup> = 51.1 <i>B</i> = 0.14 (0.09, 0.19)	Δ % <i>R</i> <sup>2</sup> = 2.1 <i>p</i> -value <0.001
Distraction ( <i>n</i> = 757)	% <i>R</i> <sup>2</sup> = 42.7Adj % <i>R</i> <sup>2</sup> = 42.6	% <i>R</i> <sup>2</sup> = 49.3Adj % <i>R</i> <sup>2</sup> = 48.7	Δ % <i>R</i> <sup>2</sup> = 6.6 <i>p</i> -value <0.001	% <i>R</i> <sup>2</sup> = 49.4Adj % <i>R</i> <sup>2</sup> = 48.8 <i>B</i> = 0.03 (-0.01, 0.07)	Δ % <i>R</i> <sup>2</sup> = 0.1 <i>p</i> -value = 0.18
Re-interpretation ( <i>n</i> = 761)	% <i>R</i> <sup>2</sup> = 42.9Adj % <i>R</i> <sup>2</sup> = 42.9	% <i>R</i> <sup>2</sup> = 49.5Adj % <i>R</i> <sup>2</sup> = 48.9	Δ % <i>R</i> <sup>2</sup> = 6.6 <i>p</i> -value <0.001	% <i>R</i> <sup>2</sup> = 49.5Adj % <i>R</i> <sup>2</sup> = 48.8 <i>B</i> = 0.01 (-0.03, 0.06)	Δ % <i>R</i> <sup>2</sup> = 0.02 <i>p</i> -value = 0.59
Cognitive coping ( <i>n</i> = 763)	% <i>R</i> <sup>2</sup> = 43.3Adj % <i>R</i> <sup>2</sup> = 43.2	% <i>R</i> <sup>2</sup> = 49.7Adj % <i>R</i> <sup>2</sup> = 49.1	Δ % <i>R</i> <sup>2</sup> = 6.4 <i>p</i> -value <0.001	% <i>R</i> <sup>2</sup> = 49.7Adj % <i>R</i> <sup>2</sup> = 49.1 <i>B</i> = -0.02 (-0.07, 0.03)	Δ % <i>R</i> <sup>2</sup> = 0.04 <i>p</i> -value = 0.44

Psychological constructs with regression coefficients significant at *p* < 0.01 are in bold.

\*Scores for each of the psychological constructs are subject to missing data and hence the models are fitted in different numbers of responders.

<sup>†</sup>*B* – regression coefficient associated with the psychological construct in the model.

**Table 4**

Identifying the independent baseline psychological constructs\* related to RMDQ<sup>a</sup> score at 6 months: multivariate linear regression models.

	Regression coefficient (95% CI)	Standardised $\beta$ coefficient (95% CI)
Initial multivariate model – all 11 univariately significant constructs ( $n = 724$ )		
Initial multivariate model	$R^2 = 55.8$ Adj $\%R^2 = 54.5$	
IPQ-R		
Consequences	0.06 (–0.03, 0.16)	0.06
Emotional representations	–0.004 (–0.09, 0.09)	–0.003
Personal control	<b>–0.17 (–0.27, –0.08)</b>	–0.11
Treatment control	0.05 (–0.07, 0.18)	0.03
Timeline – acute/chronic	<b>0.21 (0.14, 0.28)</b>	0.20
Identity	<b>0.17 (0.002, 0.34)</b>	0.06
Immunity attribution	0.10 (–0.07, 0.27)	0.03
HADS: depression	–0.01 (–0.12, 0.09)	0.01
PSEQ: pain self-efficacy	<b>–0.04 (–0.08, –0.01)</b>	–0.09
TSK: fear avoidance	–0.05 (–0.11, 0.02)	–0.05
CSQ24: catastrophising	0.04 (–0.02, 0.10)	0.05
Reduced multivariate model – all 4 constructs still significant in multivariate model ( $n = 761$ )		
Reduced multivariate model	$R^2 = 56.6$ Adj $\%R^2 = 55.9$	
IPQ-R		
Personal control	<b>–0.16 (–0.24, –0.07)</b>	–0.10
Timeline – acute/chronic	<b>0.21 (0.15, 0.27)</b>	0.20
Identity	<b>0.19 (0.04, 0.35)</b>	0.07
PSEQ: pain self-efficacy	<b>–0.05 (–0.08, –0.02)</b>	–0.11

Psychological constructs with regression coefficients significant at  $p < 0.01$  are in bold.

\*Scores for each of the psychological constructs are subject to missing data and hence the models are fitted in different numbers of responders.

<sup>a</sup>Roland and Morris Disability Questionnaire.