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# Self-efficacy is more important than fear of movement in mediating the relationship between pain and disability in chronic low back pain

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ABSTRACT

Pain self-efficacy and fear of movement have been proposed to explain how pain can lead to disability for patients with chronic low back pain. However the extent to which pain self-efficacy and fear of movement mediate the relationship between pain and disability over time has not been investigated. This study aimed to investigate whether pain self-efficacy and/or fear of movement mediate the relationship between pain intensity and disability in patients with recent onset chronic low back pain. In a two-wave longitudinal design, 184 chronic low back pain patients completed measures for pain intensity, disability, pain self-efficacy and fear of movement at baseline and 12 months after the onset of chronic low back pain. Regression analyses were used to test the mediational hypothesis. We found that, when measured at the same time, both pain self-efficacy and fear of movement beliefs partially mediated the effects of pain intensity on disability at the onset of chronic low back pain. However, in the longitudinal analyses, only improvements in self-efficacy beliefs partially mediated the relationship between changes in pain and changes in disability over a 12 months period. We found no support for the theory that fear of movement beliefs mediate this relationship. Therefore, we concluded that pain self-efficacy may be a more important variable than fear of movement beliefs in terms of understanding the relationship between pain and disability.



## 1. Introduction

Many patients who have persisting low back pain have difficulty performing their usual activities. There is considerable individual variation in the extent of low back disability and despite considerable attention researchers have had only limited success in identifying the factors that might be responsible for this. Support for the role of psychological factors in explaining the development and maintenance of chronic low back pain and disability has grown due largely to their ability to influence the problem of pain and many of the related symptoms. One of the ways in which these factors have been proposed to explain the relationship between pain and disability is by mediation (Vlaeyen et al., 2005).

A mediational hypothesis aims to identify the mechanism that underlines an observed relationship between two variables (MacKinnon et al., 2000). This is achieved by including a third variable in the model, known as a mediator variable, whose influence explains how the two variables are related. The mediator variable therefore provides critical information regarding the identification of potential targets for interventions. In the low back pain literature two factors that are frequently proposed to mediate the relationship between pain intensity and disability are pain self-efficacy and fear of movement.

Based on the theory of social learning, self-efficacy describes the confidence the person has in his or her own ability to achieve a desired outcome (Bandura, 1977). Higher levels of self-efficacy have been found to be associated with lower levels of pain and disability in patients with chronic pain (Reid et al., 2003; Denison et al., 2004; Dohnke et al., 2005). Nicholas et al. (1992) and Altmaier et al. (1993) also demonstrated that pain-related self-efficacy ratings are likely to change following cognitive behavioural management of low back pain and that these changes were associated with better outcomes such as reduced disability.

The fear avoidance model was proposed to explain why patients who are experiencing noxious or threatening stimuli reduce their

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activities (Lethem et al., 1983). In this model, initial adaptive responses to threat become, over time, maladaptive and are termed avoidance behaviours which have the potential to increase fear and pain and limit activity. Based on this theory Vlaeyen and Linton (2000) proposed a model of chronic low back pain where patient's catastrophic thoughts and fear of movement beliefs can lead to low back disability.

Both of these models have been proposed to explain how pain can lead to disability for patients with low back pain (Arnstein et al., 1999; Arnstein, 2000; Vlaeyen and Linton, 2000). However the extent to which pain self-efficacy and fear of movement mediate the relationship between pain and disability over time in an inception cohort of patients with chronic low back pain has not been investigated. We therefore aimed to investigate the role of pain self-efficacy and fear of movement in mediating the relationship between pain intensity and disability in patients with recent onset chronic low back pain.

## 2. Methods

### 2.1. Hypotheses

The specific hypotheses we tested were:

(1) Pain self-efficacy beliefs and/or beliefs about fear of movement mediate the relationship between pain intensity and disability at the onset of chronic low back pain.
(2) Changes in pain self-efficacy beliefs and/or changes in beliefs about fear of movement mediate the relationship between changes in pain intensity and changes in disability after 12 months from the onset of chronic low back pain.

### 2.2. Participants

This study is part of a larger project studying low back pain in primary care (Henschke et al., 2008; Stanton et al., 2008; Costa et al., 2009; Henschke et al., 2009a,b). Consecutive patients with acute low back pain of less than 6 weeks duration who consulted a primary care practitioner (general medical practitioners, physiotherapists and chiropractors) in the Sydney metropolitan area of Australia were invited to participate in the original study (Henschke et al., 2008). To be eligible the patients had to be at least 14 years old, provide written consent to participate in the study, be able to speak and read English, and present with pain anywhere in the region of the lower back bounded superiorly by T12 and inferiorly by the buttock crease (Watson et al., 2003). The duration of the pain episode had to be more than 24 h but less than 6 weeks, and the episode had to be preceded by a period of at least 1 month without low back pain (de Vet et al., 2002). Patients were excluded from the study if they had serious spinal pathology (such as cancer, spinal infection, spinal fracture, and inflammatory arthritis) or radiculopathy. We decided to recruit only patients with recent onset of chronic low back pain as the influence of modifiable factors such as pain self-efficacy and fear avoidance beliefs is likely to be different in patients with varying durations of low back pain.

Participating practitioners screened all patients with acute low back pain (from November 2004 to July 2005) according to the eligibility criteria. All patients who met the study criteria were considered potential participants in the current study. After a period of 3 months all patients were followed-up by telephone interview and those who had not recovered by 3 months (i.e. continued to report pain) were classified as chronic low back pain patients and were invited to participate in the current study.

### 2.3. Procedures

Data on socio-demographic characteristics, general health, current and previous low back history, and work-related questions were collected during the first consultation with the primary care clinician. Three months after the onset of acute low back pain, patients who met the criteria for chronic low back pain (i.e. continued to report pain) were contacted by telephone and requested to complete a set of self-report measures (time 1). One year after the patients had been classified as having chronic low back pain, they were requested to complete the same set of self-report measures (time 2).

### 2.4. Measurement of outcomes and mediators

#### 2.4.1. Disability

The Roland Morris Disability Questionnaire (RMDQ) (Roland and Morris, 1983) was developed to measure perceived disability in individuals with low back pain. The RMDQ consists of 24 items with the score ranging from 0 to 24 points. A higher score indicates a higher level of disability.

#### 2.4.2. Pain intensity

Pain intensity was measured with an adaptation of item 7 of the SF-36 (Ware and Sherbourne, 1992). To reflect our specific interest in low back pain we changed the original wording from 'bodily pain' to 'low back pain'. The participants were asked: "How much low back pain have you had in the past week?" This item had six response options and was scored from 1 (none) to 6 (very severe). A higher score indicates a higher level of pain.

#### 2.4.3. Pain self-efficacy

The pain self-efficacy questionnaire (P-SE) (Nicholas, 1989, 2007) consists of 10 questions about the patient's confidence in carrying out various normal activities despite the pain. There are seven response options ranging from 0 (not at all confident) to 6 (very confident). The total score ranges from 0 to 60 points with higher scores indicating higher perceived pain self-efficacy.

#### 2.4.4. Fear of movement/(re)injury

The Tampa Scale for Kinesiophobia (TSK) (Miller et al., 1991) was designed to measure fear of movement/(re)injury in individuals with pain. The TSK consists of 17 items scored on a four-grade format ranging from 1 (strongly disagree) to 4 (strongly agree). The individual scores of items 4, 8, 12, and 16 are reversed, and then a total score, ranging from 17 to 68 points is calculated. A higher score indicates a higher level of fear.

### 2.5. Statistical analyses

Pearson's product moment correlation was used to examine the relationships among the outcomes and putative mediators. The criteria proposed by Baron and Kenny (1986) were used to test whether pain self-efficacy beliefs and/or beliefs about fear of movement were mediators in the relationship between pain intensity and disability. According to these criteria, four conditions should be met to establish mediation and we outline these conditions using our specific hypothesis that pain self-efficacy mediates the relationship between pain and disability as an example. The first condition is that pain is directly related to disability. Second, pain has a direct effect on the mediator (pain self-efficacy). Third, pain self-efficacy has a direct effect on disability, when pain is controlled. Fourth, if pain self-efficacy mediates the pain–disability relationship, the direct effect of pain on disability is reduced or eliminated after controlling for pain self-efficacy.

To test the first hypothesis that pain self-efficacy beliefs and/or beliefs about fear of movement mediate the relationship between pain intensity and disability in patients with recent onset of chronic low back pain we conducted a series of regression analyses using the putative mediators and outcomes assessed at time 1. Two separate sets of regression analyses were performed, one using pain self-efficacy as the mediator and the other using fear of movement. The regression equations were of the form:

$$\text{disability}_{t1} = A * \text{pain intensity}_{t1} \quad (1)$$

$$\text{pain self-efficacy}_{t1} = A * \text{pain intensity}_{t1} \quad (2)$$

$$\text{disability}_{t1} = A * \text{pain intensity}_{t1} + B * \text{pain self-efficacy}_{t1} \quad (3)$$

The subscript $t1$ refers to time 1. Eq. (3) was used to assess the 3rd and 4th condition required for mediation described above. We repeated the same steps using fear of movement, rather than pain self-efficacy, as the putative mediator.

To test the second hypothesis that changes in pain self-efficacy beliefs and/or changes in beliefs about fear of movement mediate the relationship between changes in pain intensity and changes in disability over the period of 12 months a series of regression analysis were performed. First we calculated the change scores between the outcomes and putative mediators assessed at time 1 and time 2. The change scores for pain, disability and the putative mediators were then entered in the equations presented below. The regression equations were calculated as follows:

$$\Delta\ \text{disability} = A * \Delta\ \text{pain intensity} \quad (4)$$

$$\Delta\ \text{pain self-efficacy} = A * \Delta\ \text{pain intensity} \quad (5)$$

$$\Delta\ \text{disability} = A * \Delta\ \text{pain intensity} + B * \Delta\ \text{pain self-efficacy} \quad (6)$$

where $\Delta$ is the change score calculated by subtracting time 1 from time 2. We repeated the same steps using fear avoidance, rather than pain self-efficacy, as a putative mediator.

Finally, to test the significance of mediation effect, which is called indirect effect, Sobel's test (Aroian, 1947; Sobel, 1982; MacKinnon et al., 2002) was calculated. The indirect effect is defined as the product of the independent variable to mediation path and the mediation path to dependent variable path. Sobel's test determines the significance of the mediation effect by testing the null hypothesis that the indirect effect coefficient is zero (i.e. whether the indirect effect of the independent variable on the dependent variables is significantly different from zero).

## 3. Results

### 3.1. Participants

A total of 549 patients with acute low back pain of less than 6 weeks duration were identified from primary care clinicians from November 2004 to July 2005. Of these patients, 328 patients recovered from their acute episode by 3 months, 14 patients were classified as having nerve root compromise, three patients were classified as having potential serious spinal pathology (two fractures and one cancer) and were excluded from the current study. From the 204 patients who had not recovered by 3 months, 10 patients declined to participate and 10 patients were unable to be contacted, leaving a final sample of 184 participants for the analysis of mediation at onset of chronic low back pain. During the study 12 patients declined to answer the 12 months follow-up, therefore 172 participants were included in the analysis of mediation in change scores 12 months after onset of chronic low back pain. We found no differences on the baseline characteristics between the patients who were followed-up and those who were not. The participant's characteristics at onset of chronic low back pain and 12 months later are described in Table 1.

### 3.2. Pearson's correlations among the self-report measures

The correlation matrix for disability, pain intensity, pain self-efficacy and fear of movement at the onset of chronicity and the correlations among changes in disability, changes in pain intensity, changes in pain self-efficacy and changes in fear of movement are presented in Table 2. Correlations among variables supported the presence and direction of proposed relationships.

### 3.3. Is the effect of pain intensity on disability mediated by pain self-efficacy beliefs at the onset of chronic LBP?

The first set of regression analyses evaluated the hypothesis that pain self-efficacy mediates the relationship between pain intensity and disability at the onset of chronic low back pain. The results of these analyses are presented in Table 3. All four criteria to establish mediation were met, that is, (1) pain intensity was significantly associated with disability; (2) pain intensity was significantly associated with pain self-efficacy; (3) pain self-efficacy was significantly associated with disability after controlling for pain intensity; and finally (4) the coefficient for the relationship between pain intensity and disability decreased after controlling

**Table 1**
Patient characteristics.

| Patients characteristics | Onset of chronic LBP ($n$ = 184) | 12 months ($n$ = 172) |
|---|---|---|
| *Socio-demographic*[a] | | |
| Age (years) | 43.9 (13.99) | |
| Male gender (%) | 96 (52.2%) | |
| No education beyond secondary school[b] | 118 (64.1%) | |
| Exercising regularly | 76 (41.3%) | |
| *Self rated health* | | |
| Poor | 1 (0.5%) | |
| Fair | 19 (10.3%) | |
| Good | 89 (48.4%) | |
| Very Good | 64 (34.8%) | |
| Excellent | 11 (6.0%) | |
| *Details of lower back pain*[a] | | |
| Previous episode | 143 (77.7%) | |
| Previous sick leave | 67 (36.4%) | |
| Previous surgery | 7 (3.8%) | |
| Sudden onset | 148 (80.4%) | |
| Compensation case | 44 (23.9%) | |
| Currently taking medication | 55 (29.9%) | |
| *Self-report measures* | | |
| Pain intensity[c] | 3.1 (1.02) | 2.6 (1.25) |
| RMDQ[d] | 7.5 (5.33) | 5.0 (4.65) |
| P-SE[e] | 44.4 (11.69) | 49.0 (9.80) |
| TSK[f] | 40.5 (7.35) | 39.1 (6.58) |

Continuous variables are mean (standard deviations); categorical variables are $n$ (%).

[a] Collected at the beginning of the acute episode of low back pain.

[b] In Australia secondary school education is complete after 13 years of school.

[c] Pain intensity scale: 1 = none, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe, 6 = very severe. This is based upon modified item 7 from SF-36 (we have changed the original wording from 'bodily pain' to 'low back pain' to reflect our specific interest in LBP).

[d] Roland Morris disability questionnaire is rated on a scale from 0 to 24, with higher scores indicating a higher level of disability.

[e] Pain self-efficacy questionnaire is rated on a scale from 0 to 60, with higher scores indicating higher perceived pain self-efficacy.

[f] Tampa Scale for Kinesiophobia is rated o a scale from 17 to 68, with higher scores indicating higher levels of fear.

**Table 2**
Pearson correlations among the self-report measures at time 1 and among the changes in the self-report measures.

| | Disability time 1 | Pain intensity time 1 | Pain self-efficacy time1 | Fear of movement time 1 |
|---|---|---|---|---|
| Disability time 1 | – | 0.47[b] | −0.70[b] | 0.59[b] |
| Pain intensity time 1 | 0.47[b] | – | −0.39[b] | 0.19[a] |
| Pain self-efficacy time1 | −0.70[b] | −0.39[b] | – | −0.57[b] |
| Fear of movement time 1 | 0.59[b] | 0.19[a] | −0.57[b] | – |
| | Δ Disability | Δ Pain intensity | Δ Pain self-efficacy | Δ Fear of movement |
| Δ Disability | – | 0.43[b] | −0.52[b] | 0.40[b] |
| Δ Pain intensity | 0.43[b] | – | −0.32[b] | 0.13[NS] |
| Δ Pain self-efficacy | −0.52[b] | −0.32[b] | – | −0.42[b] |
| Δ Fear of movement | 0.40[b] | 0.13[NS] | −0.42[b] | – |

NS – non-significant.
Δ Changes scores time 2 – time 1 measures.
[a] $p < 0.05$.
[b] $p < 0.001$.

**Table 3**
Regression models and Sobel's test.

| Dependent variable | Independent variable(s) | Regression model | | | | | Sobel's test | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Unstandardized coefficient (CI) | SE | Standardized coefficient | *P* value | Adj $R^2$ (%) | Indirect effect (CI) | Test statistic | *P* value |
| *Regression analyses with self-efficacy as a mediator of the pain–disability relationship at onset of chronic low back pain* | | | | | | | | | |
| 1. Disability time 1 | Pain intensity time 1 | 2.44 (1.77 to 3.12) | 0.34 | 0.47 | <0.0001 | 21.4 | | | |
| 2. Pain self-efficacy time 1 | Pain intensity time 1 | −4.46 (−6.00 to −2.92) | 0.78 | −0.39 | <0.0001 | 14.7 | | | |
| 3. Disability time 1 | Pain intensity time 1 | 1.20 (0.63 to 1.76) | 0.29 | 0.23 | <0.0001 | 53.1 | 1.24 (0.76 to 1.72) | 5.077 | <0.0001 |
| | Pain self-efficacy time 1 | −0.28 (−0.33 to −0.23) | 0.03 | −0.61 | <0.0001 | | | | |
| *Regression analyses with fear of movement as a mediator of the pain–disability relationship at onset of chronic low back pain* | | | | | | | | | |
| 1. Disability time 1 | Pain intensity time 1 | 2.44 (1.77 to 3.12) | 0.34 | 0.47 | <0.0001 | 21.4 | | | |
| 2. Fear of movement time 1 | Pain intensity time 1 | 1.34 (0.30 to 2.37) | 0.52 | 0.19 | 0.01 | 2.9 | | | |
| 3. Disability time 1 | Pain intensity time 1 | 1.94 (1.37 to 2.50) | 0.29 | 0.37 | <0.0001 | 47.5 | 0.51 (0.11 to 0.91) | 2.462 | 0.01 |
| | Fear of movement time 1 | 0.38 (0.30 to 0.46) | 0.04 | 0.52 | <0.0001 | | | | |
| *Regression analyses with changes pain self-efficacy as a mediator 12 months after the onset of chronic low back pain* | | | | | | | | | |
| 1. Δ Disability | Δ Pain intensity | 1.15 (0.79 to 1.52) | 0.19 | 0.43 | <0.0001 | 17.9 | | | |
| 2. Δ Pain self-efficacy | Δ Pain intensity | −1.64 (−2.37 to −0.92) | 0.37 | −0.32 | <0.0001 | 9.9 | | | |
| 3. Δ Disability | Δ Pain intensity | 0.78 (0.43 to 1.13) | 0.18 | 0.29 | <0.0001 | 34.0 | 0.37 (0.17 to 0.57) | 3.67 | <0.001 |
| | Δ Pain self-efficacy | −0.23 (−0.30 to −0.16) | 0.04 | −0.43 | <0.0001 | | | | |
| *Regression analyses with changes in fear avoidance beliefs as a mediator 12 months after the onset of chronic low back pain* | | | | | | | | | |
| 1. Δ Disability | Δ Pain intensity | 1.15 (0.79 to 1.52) | 0.19 | 0.43 | <0.0001 | 17.9 | | | |
| 2. Δ Fear of movement | Δ Pain intensity | 0.41 (−0.08 to 0.90) | 0.25 | 0.13 | 0.10 | 1.0 | | | |

Δ Changes score time 2 – time 1 measures.

for the influence of pain self-efficacy. Complete mediation could not be assumed because the path (4) remained statistically significant; supporting a partial mediation effect exerted by pain self-efficacy (Fig. 1). The Sobel's test supported the conclusion that pain self-efficacy partially mediates the relationship between pain intensity and disability in patients with chronic low back pain.

### 3.4. Is the effect of pain intensity on disability mediated by beliefs about fear of movement at the onset of chronic LBP?

The above set of regression analyses was repeated using fear of movement as the mediator (Table 3). The criteria for establishing mediation were also met, that is, (1) pain intensity was significantly associated with disability; (2) pain intensity was significantly associated with fear of movement; (3) fear of movement was significantly associated with disability after controlling for pain intensity; and finally (4) the coefficient for the relationship between pain intensity and disability decreased when the influence of fear of movement was controlled (Fig. 2). Similar to the pain self-efficacy model, results supported a partial mediation effect exerted by fear of movement. The Sobel's test was statistically significant; supporting the conclusion that fear of movement partially mediates the relationship of pain intensity and disability in patients with recent onset chronic low back pain.

### 3.5. Is the effect of change in pain intensity on change in disability mediated by change in pain self-efficacy beliefs?

Table 3 shows the result of regression analyses evaluating the hypothesis that changes in pain self-efficacy beliefs mediate the association between changes in pain intensity and changes in disability 12 months after the onset of chronic low back pain. Again, all four criteria proposed by Baron and Kenny (1986) were met. Changes in pain intensity were statistically significantly associated with changes in disability and with changes in pain self-efficacy (criteria 1 and 2). Changes in pain self-efficacy were significantly

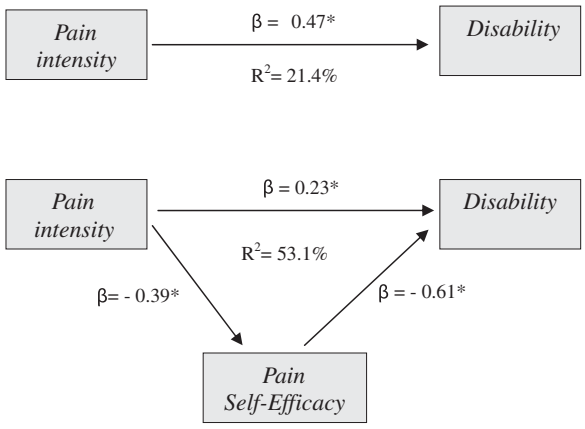


**Fig. 1.** Pain self-efficacy partially mediates the relationship between pain and disability at the onset of chronic low back pain ($^{*}p < 0.0001$; $\beta$ = standardized coefficients).

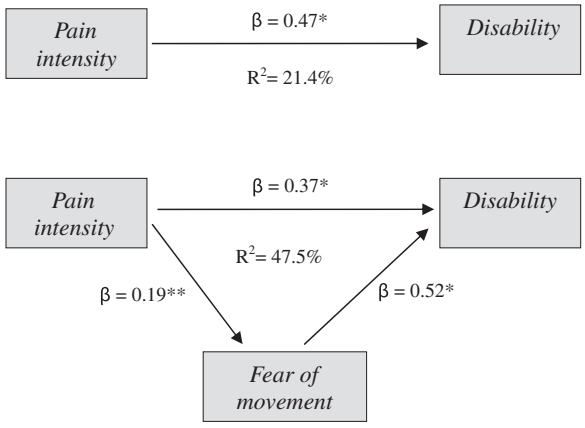


**Fig. 2.** Fear of movement partially mediates the relationship between pain and disability at the onset of chronic low back pain ($^{*}p < 0.0001$; $^{**}p = 0.01$; $\beta$ = standardized coefficients).

associated with changes in disability after controlling for changes in pain intensity (criterion 3). And finally, the coefficient for the relationship between changes in pain intensity and changes in disability decreased ($\beta$ = 0.43 to 0.29) when changes in pain self-efficacy was added in the model (criterion 4) (Fig. 3). Partial mediation was supported by the Sobel's test that confirms that changes in

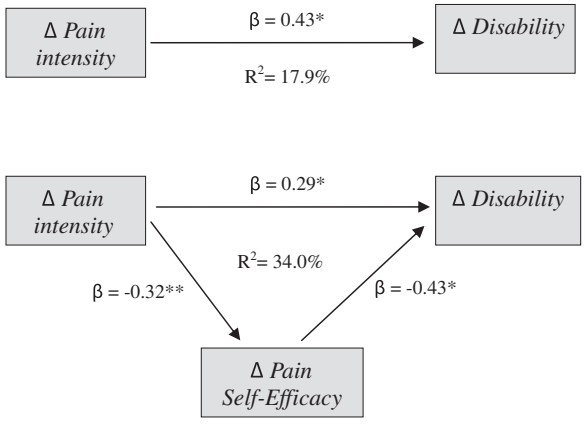


**Fig. 3.** Changes in pain self-efficacy beliefs partially mediates the relationship between changes in pain and changes in disability 12 months after the onset of chronic low back pain ($^{*}p < 0.0001$; $^{**}p = 0.01$; $\beta$ = standardized coefficients).

pain self-efficacy beliefs is a mediator in the relationship between changes in pain and changes in disability over a period of 12 months after the onset chronic low back pain.

### *3.6. Is the effect of change in pain intensity on change in disability mediated by change in beliefs about fear of movement?*

The results from regression analysis did not support the hypothesis that changes in beliefs about fear of movement is a mediator of the association between changes in pain intensity and changes in disability over a period of 12 months of chronic low back pain. The first criterion proposed by Baron and Kenny (1986) that changes in pain intensity are statistically significantly associated with changes in disability was met. However the path coefficient between changes in pain intensity and changes in fear of movement beliefs (second criterion) was not statistically significant calling for a rejection of the proposed fear avoidance model (Table 3).

## 4. Discussion

### *4.1. Principal findings*

The objective of this study was to investigate whether pain self-efficacy and/or fear of movement mediate the relationship between pain intensity and disability in patients with recent onset chronic low back pain. We found that, when measured at the same time, both pain self-efficacy and fear of movement beliefs partially mediated the effects of pain intensity on disability at the onset of chronic low back pain. However, only improvements in pain self-efficacy beliefs partially mediated the relationship between changes in pain and changes in disability over a 12 months period. We found no support that fear of movement beliefs mediate this relationship. Therefore, we conclude that pain self-efficacy may be a more important variable in terms of understanding the relationship between pain and disability.

### *4.2. Consideration of the findings in relation to other studies*

Our results are consistent with previous cross-sectional studies that pain demonstrated that pain self-efficacy partially mediates the relationship between pain and disability in patients with chronic pain (Arnstein et al., 1999; Arnstein, 2000). Both studies found that the coefficient for the relationship between pain intensity and disability decreased after controlling for the influence of pain self-efficacy, with the coefficient decreasing from 0.57 to 0.39 in one study (Arnstein et al., 1999) and from 0.44 to 0.20 in another (Arnstein, 2000), while in our study the coefficient decreased from 0.47 to 0.23.

In terms of fear of movement our analysis corroborates the results from Gheldof et al. (2006), where fear of movement partially mediated the relationship between pain severity and functional and social disability in a cross-sectional study of working employees with low back pain. The total path coefficients were reduced by 29% for functional disability and 30% for social disability. To our knowledge this is the only study that compared similar variables to those presented in our study. Most of the literature on this topic investigated fear avoidance as a predictor of future disability and chronicity in a range of musculoskeletal conditions rather than as a mediator (Mannion et al., 2001; Buer and Linton, 2002; Woby et al., 2004; Peters et al., 2005). A systematic review investigating fear avoidance as a predictor of poor prognosis in patients with back pain found weak evidence that links fear of pain at early stages with poor prognosis, they also found that fear may play a role when pain becomes persistent (Pincus et al., 2006). Finally

there are some studies investigating fear avoidance as a potential mediator in different relationships between catastrophizing and disability (Nieto et al., 2009).

In a uniform population with recent onset of chronic low back patients we found that pain self-efficacy beliefs were a stronger mediator of the relationship between pain intensity and disability than fear avoidance beliefs. When the analysis was performed cross-sectionally (time 1) pain self-efficacy beliefs tended to contribute more to the model than fear of movement and in the longitudinal analysis changes in fear avoidance beliefs were not found to be a mediator (Baron and Kenny, 1986). Our finding that pain self-efficacy is a stronger mediator than fear avoidance is in agreement with two cross-sectional studies that investigated these relationships in patients with subacute, chronic or recurring musculoskeletal pain from a primary care sample (Denison et al., 2004) and in patients with chronic low back pain who were receiving working compensation benefits (Ayre and Tyson, 2001). A recent analysis of a prospective cohort of low back pain patients in primary care (Foster et al., 2010) demonstrated that low confidence in ability to perform normal activities was a better predictor of disability at 6 months after primary care consultation than fear avoidance and other psychological factors. Although the objectives of this study (Foster et al., 2010) did not include investigating these factors as mediators they did find that the change scores between baseline and 6 months were correlated with changes in disability.

The mean baseline scores for pain self-efficacy in our study population can be considered high (i.e. 44.4 ± 11.7), which is usually desirable. In contrast our participants also had high fear avoidance beliefs (i.e. 40.5 ± 7.4). The TSK scores in our sample are very similar to the ones found by Nicholas et al. (2008) (41.2 ± 9.4), Vlaeyen et al. (1995) (40.8 ± 7.7) and Foster et al. (2010) (39.7 ± 6.9). But the PSE scores in our population are higher than ones found in previous studies (for example Nicholas found 25.5 ± 13.8 and Foster found 37.8 ± 14.6). These higher pain self-efficacy in our study could be explained by the shorter duration of LBP compared to other studies. The average pain duration in our study was 3 months, while Nicholas' study was 80 months and 77% of Foster's sample had less than 6 months duration. Although we treated both pain self-efficacy and fear avoidance beliefs as independent variables we acknowledge that some interaction between these two variables is likely to occur.

### 4.3. Strengths and weaknesses of the study

An important strength of our study is that we have enrolled an inception cohort of consecutive patients from primary care settings using a strict definition of chronic low back pain in a longitudinal design. To our knowledge this is the first study with these features. Most of the previous studies of mediation analysis, as mentioned before, have a cross-sectional design and have enrolled patients with variable durations of their condition. We believe that assembling an inception cohort has the advantage of measuring the psychosocial factors at the beginning of the condition in all patients, moreover it avoids the potential limitation that relationships between psychosocial factors and pain and disability could be different at different levels of chronicity of their conditions.

As well as the cross-sectional analyses, our two-wave design allowed us to address more complex questions which can only be determined using longitudinal data (MacKinnon, 2008). Although we acknowledge that three or more waves of data collection are generally preferable as this provides more precise representations of the temporal order of change over time, we believe that our results provide a clearer explanation of these relationships than studies that have only used cross-sectional designs (Arnstein et al., 1999; Arnstein, 2000; Ayre and Tyson, 2001; Buer and Linton, 2002; Denison et al., 2004).

There are some limitations that require attention. Firstly while the concepts of disability and pain self-efficacy are conceptually distinguishable, there may be overlap between the items contained within the measures used for disability (i.e. RMDQ) and pain self-efficacy (PSEQ) in this study. Although the RMDQ asks respondents whether or not (in a yes/no format) 24 specific activities that are currently disrupted because of their back pain and the PSEQ asks the respondents to rate their confidence (on a 0–6 scale) in their ability to perform a more general range of activities/tasks despite their pain (i.e. how confident do they think they can perform the tasks while in pain), it is possible that patients found it difficult to differentiate between these constructs measured. This may partly explain the high correlations that we found between these two measures ($r = -0.70$ $p < 0.001$). Secondly although our design was longitudinal our analysis was not able to verify the direction of a cause–effect relationship as path analysis permits only the testing of unidirectional relationships. Although models with three or more waves are more complex, they provide potentially more accurate information regarding the temporal relations among variables (MacKinnon, 2008). Alternatively the changes observed for the pain self-efficacy beliefs as potential mediator occurred due to the clinical course in this cohort and arguably a more elegant approach for determining causality would be to provide targeted interventions in order to increase pain self-efficacy beliefs in these patients.

Another important point to consider is that although most studies (including ours) treat pain self-efficacy and fear of movement as independent variables, we acknowledge that possible interactions between these two variables are likely to occur in some patients, which increases the complexity of the understanding of these relationships. As a consequence the relative balance of these two variables may influence significance for disability due to low back pain in certain groups of patients.

### 4.4. Meaning of the study: possible explanations and implications for clinicians

The results of this study provide some insights that may lead to better care for patients with recent onset chronic low back pain. Although fear of movement has been receiving much of the attention from the low back pain literature (Buchbinder et al., 2001; Leeuw et al., 2007), our study identified pain self-efficacy, rather than fear of movement, as the key mediator in the relationship between pain and disability in patients with recent onset chronic of low back pain. This suggests that it may be more fruitful to focus on therapies that aim to enhance pain self-efficacy rather than reduce pain-related fear.

Given our finding that pain self-efficacy mediates the relationship between pain and disability, it would make sense for treatment providers to consider interventions aiming to increase pain self-efficacy rather than only targeting reductions in pain intensity. In this case, the identification of patients with low levels of pain self-efficacy would be relevant, as this group of patients would logically be expected to benefit more from specific interventions such as psychological interventions that could enhance pain self-efficacy, as well as approaches designed to control pain such as medicines, acupuncture and spinal manipulation.

To build the case for this approach we firstly need new studies in similar settings to our own to replicate our mediation analyses as well as studies that explore the extent that these relationships hold in other cultural settings. Finally we would encourage clinical trials evaluating therapies testing our conclusion that optimised outcomes might be achieved by good pain control combined with specific psychological interventions designed to increase pain self-efficacy but not fear avoidance beliefs.

In summary, our results show that pain self-efficacy and fear of movement beliefs are partial mediators at the onset of chronic low

back pain. Pain self-efficacy explains more variability in disability than fear of movement in a cross-sectional analysis. We also found that changes in self-efficacy, but not changes in fear of movement mediate the relationship between changes in pain intensity and changes in disability after 1 year. The results of this study highlight the potential importance of interventions aiming to increase levels of pain self-efficacy in the management of chronic low back patients.

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