Pain Medicine 2017; 18: 2116–2125
doi: 10.1093/pm/pnx053

OXFORD

PRIMARY CARE & HEALTH SERVICES SECTION

Original Research Article

Resilience and Vulnerability Factors When Pain is Acute as Predictors of Disability: Findings From a Two-Year Longitudinal Study

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Funding sources: This study was supported by grants from the Spanish Ministry of Science and Innovation (PSI2008-01803/PSIC), the Ministry of Economy and Competitiveness (PSI2012-32662), and the Regional Government of Andalusia (HUM-566, P07-SEJ-3067).

Abstract

Objective. To investigate the predictive power of resilience and vulnerability factors in relation to pain-related disability.

Design. A two-year prospective study investigated whether back pain–related disability was predicted by the following variables, measured when pain was acute: 1) pain-related disability, 2) pain intensity, 3) depression, 4) fear avoidance beliefs, 5) anxiety sensitivity, and 6) resilience.

Methods. Two hundred thirty-two patients treated in five primary care centers participated in this study. They were assessed at baseline during an acute back pain episode and at six, 12, 18, and 24 months. Ninety-nine patients completed all the assessment sessions. Linear mixed models were used to examine the trajectory of disability across the measurement occasions and its association with the predictors.

Results. Individuals who had higher scores of disability and pain intensity when pain was acute also had higher scores of disability six months later; moreover, the increase in disability was greater over time in comparison with individuals with lower scores in disability and pain intensity when pain was acute. Individuals who had reported greater levels of fear avoidance beliefs when pain was acute also reported greater scores of disability six months later; however, no differences were found in the rate of change in disability. No associations were found between initial disability or rate of change and resilience, anxiety sensitivity, or depression.

Conclusions. Patients with acute back pain who show high levels of pain-related disability, pain intensity, and fear avoidance beliefs are at risk of developing back pain–related disability and should be the target of a preventive intervention.

Key Words. Pain-Related Disability; Back Pain; Chronic Pain; Fear Avoidance Beliefs; Resilience; Prospective Study

Introduction

Back pain is significantly associated with disability. Patients who are at risk of developing back pain–related disability should be identified at an early stage if prevention is to be effective [1–3].

Since 2000, the Fear Avoidance Model has been the leading paradigm to explain the development of chronic pain problems in certain individuals with acute musculoskeletal pain [4]. The model suggests that fear avoidance beliefs activate avoidance mechanisms, resulting in the avoidance of movement and activity that, in the long-term, will impair daily functioning and contribute to disability [4]. Although the results of some prospective

studies have cast doubt on the specific sequential interrelationships postulated by the model [5–9], several prospective studies have indicated that fear avoidance beliefs influence the transition from acute to chronic low back pain [10,11]. A systematic review has provided evidence that fear avoidance beliefs are a prognostic factor for work-related outcomes in patients with subacute low back pain [12]. It should be emphasized that these beliefs are common in the general population and culturally endorsed [13].

In 2003, Norton and Asmundson [14] proposed a reformulation of the Fear Avoidance Model in which anxiety sensitivity was conceptualized as the dispositional vulnerability variable that could explain individual differences in fear avoidance and disability [15]. Anxiety sensitivity is a trait-like personality construct defined as fear of anxiety-related sensations (i.e., the fear of bodily sensations). A meta-analytic review found that anxiety sensitivity was strongly associated with fearful appraisals of pain, whereas it was only moderately associated with pain tolerance/threshold and pain-related disability [16].

Several authors have critically discussed the initial formulation of the Fear Avoidance Model [13,17–20]. First, several authors have suggested that the Fear Avoidance Model underplays the role of pain intensity in perpetuating long-term disability [13,20] and have argued that because pain functions as a signal of bodily threat that will disrupt ongoing behavior, its association with avoidance should not be underestimated. Evidence regarding the prospective value of pain intensity is contradictory. Several studies have shown that pain intensity is a consistent and robust predictor of disability [7,9,21–24], whereas other longitudinal studies have found a modest association [25] or no association between them [26]. Moreover, Epping-Jordan et al. [27] and Grotle et al. [28] found that in the transition from acute to chronic pain, the initial level of disability played a more important role than pain intensity.

Secondly, it has also been suggested that one of the challenges to the Fear Avoidance Model is its ability to explain the dynamics underlying functional recovery [13,20]. Several studies have shown that resilience, conceptualized as a relatively stable personal trait characterized by the ability to adapt to adversity [29,30], appears to be significantly associated with successful adaptation to chronic pain [31–37]. It should be emphasized that evidence on the protective role of resilience has only been provided by cross-sectional studies on patients who were already experiencing chronic pain. The study of the trajectories that lead to disability and to recovery has fundamental theoretical and clinical implications. First, as suggested by Wideman [20], this kind of research could help to clarify the results of several studies that have suggested that many patients with chronic pain do not report significant levels of catastrophizing, fear, or disability. Second, as the aim of psychological interventions is not simply to eliminate maladaptive behaviors, this type of research could identify and promote the treatment factors that facilitate effective adaptation to chronic pain [38].

Finally, Pincus et al. [17,18] have critically discussed the Fear Avoidance Model and suggested that, as depression is associated with passivity, preexisting co-occurring depression in patients with back pain could result in general reduced activity that would lead to disability. As this suggestion is controversial, studies should be conducted on the possible role of preexisting depression in the transition from acute to chronic pain.

The present study investigated the predictive power of both resilience and vulnerability factors in relation to pain-related disability. Thus, this study addressed dispositional variables (anxiety sensitivity and resilience); fear avoidance beliefs (nonpathological beliefs that can be held by pain-free individuals but that could make them prone to chronification); and predisposing factors suggested by critical reviews (pain intensity, initial disability, and depression). As far as we know, no prospective research has addressed the joint predictive value of all the factors included in the present study, including the follow-up of patients from the time they experienced an acute pain episode. A sample of individuals who had acute back pain at the first measurement occasion was assessed at six-month intervals over a two-year follow-up period. Taking the foregoing into account, the following hypotheses were postulated: 1) higher initial pain-related disability, pain intensity, depression, fear avoidance beliefs, and anxiety sensitivity when pain is acute will predict higher pain-related disability; and 2) higher resilience when pain is acute will predict lower pain-related disability.

Methods

Participants

General practitioners in five primary care units recruited 254 patients who had acute back pain episodes between May 2008 and April 2010. Individuals were considered eligible for inclusion if they met the following criteria: age between 18 and 65 years, ability to understand the written and spoken Spanish language, back pain for at least one week but less than three months, no back pain during the six months preceding the current episode, and pain intensity equal to or higher than 3 on a 10-point scale. Exclusion criteria were being treated for a malignancy, terminal illness, or psychiatric disorder; the presence of back pain that was related to or secondary to a specific medical condition (e.g., tumors, trauma, infection, fractures, and inflammatory disorders); operations in the lumbar area; and pregnancy. Information related to the inclusion and exclusion criteria was obtained from the patients' clinical records. The participants' understanding of the Spanish language was checked in situ. Twenty-two of the participants (9%) who had been initially contacted were excluded from the study because they did not meet the inclusion criteria or one of the exclusion criteria was present.

In total, 232 patients participated in the study (157 women and 75 men). All the participants were Caucasian, and their average age was 45.41 years

(SD = 16.21 years). The majority of the participants were married (50%), followed by never married (30%), cohabiting (8%), widowed (4%), separated (4%), and divorced (3%). In total, 40% had completed high school, 31% had completed primary school, and 22% had a university degree. The largest single group of patients were employed full-time (46%), followed by homemakers (23%), unemployed (13%), retired (13%), and students (4%). At the time of the first measurement, the median pain duration was 24 days (SD = 26.41 days). The most common site of pain was cervical (45%), followed by vertebral-lumbar (37%), sacral (29%), thoracic (22%), and lumbar-renal (21%).

The participants were assessed on five occasions: The first assessment was conducted when pain duration was less than three months, and subsequently at six-month intervals. Ninety-nine patients completed all the assessment sessions. After screening for the eligibility of the participants, the overall response rate was 91% of the initial sample. The overall attrition rate was of 36% from wave 1 to wave 2, 12% from wave 2 to wave 3, 6% from wave 3 to wave 4, and 3% from wave 4 to wave 5. The reasons for attrition were as follows: 36% of the missing participants did not reply to the phone calls (wave 1 to 2: 28%; wave 2 to 3: 4%; wave 3 to 4: 2%; wave 4 to 5: 2%); 36% stated they "had no time" for the assessment session (wave 1 to 2: 31%; wave 2 to 3: 4%; wave 3 to 4: 1%); 14% expressly refused participation (wave 1 to 2: 11%; wave 2 to 3: 3%); 10% had made four appointments but did not attend them (wave 1 to 2: 5%; wave 2 to 3: 3%; wave 3 to 4: 2%); 3% moved away (wave 3 to 4: 2%; wave 4 to 5: 1%); and 0.8% died (wave 4 to 5).

Procedure

The research project was approved by the Regional Hospital Ethics Committee. At the end of their visit to their doctor, the patients who fulfilled the eligibility criteria were informed of the study aims and their participation was requested. Written informed consent was obtained prior to data collection. Each participant had a semistructured interview to obtain demographic, social, or medical history data. A battery of questionnaires was also completed by each participant. The approximate length of the session was 45 minutes. The following variables were assessed in the first session: 1) the initial level of pain-related disability, 2) pain intensity, 3) depression, 4) fear avoidance beliefs, 5) anxiety sensitivity, and 6) resilience. After this initial session, the patients were contacted four times every six months to make an appointment for further evaluation.

Measures

Demographic and Clinical Pain-Related Variables

Participants were interviewed and provided information on a number of demographic and pain-related variables including age, sex, marital status, education, work status, pain duration, pain location, medications, and other medical treatments.

Anxiety Sensitivity

The Anxiety Sensitivity Index (ASI) is a 16-item questionnaire (item score 1–6) in which respondents indicate the degree to which they fear the negative consequences of anxiety symptoms [39]. Validation studies have provided cross-cultural evidence for the reliability and validity of the Spanish adaptation [40]. The instrument showed high reliability in this study ($\alpha = 0.92$).

Fear Avoidance Beliefs

The Fear Avoidance Beliefs Questionnaire (FABQ) [41] consists of 15 items (item score 0–6) related to beliefs that physical activity and work influence pain intensity [42]. The instrument showed high internal consistency in the present study ($\alpha = 0.84$).

Pain Intensity

The numerical rating scale rates pain intensity. Patients were asked to rate their least, average, and worst pain during the past two weeks, as well as their current pain, on a scale ranging from 0 to 10, with a 0 indicating "no pain" and 10 indicating pain as "intense as you could imagine." A composite pain intensity score was calculated for each participant by calculating the average of the least, average, worst, and current pain. Composites of the 0–10 ratings are very reliable measures of pain intensity in patients with chronic pain [43]. The index showed high reliability in this study ($\alpha = 0.81$).

Depression

We applied the Depression subscale of the Hospital Anxiety and Depression Scale (HADS), which is a self-reporting scale comprising seven items (item score 1–4) [44]. The Spanish version of the scale shows appropriate reliability and validity [45]. In the present study, the subscale showed high reliability ($\alpha = 0.81$).

Resilience

The Resilience Scale (RS) consists of 25 items (item score 1–7) arranged in two subscales: personal competence (17 items) and acceptance of self and life (eight items) [46]. The total score alone was used in the present study. The RS has been adapted to the Spanish-speaking population [47] and for patients with chronic musculoskeletal pain [48]. This version showed good internal consistency, test-retest reliability, and good

concurrent validity with measures of adjustment to chronic pain. In the present study, this instrument showed high internal consistency ($\alpha = 0.88$).

Disability

The Roland-Morris Disability Questionnaire (RMDQ) [49] consists of 24 items (item score 0–1) that reflect limitations in different daily activities attributed by the patient to low back pain. The patient has to mark each item that applies to his or her current status. It must be noted that in the present study the scores were transformed by adding 10 points to the original score to make the results easier to interpret (total scores range from 10–34). The Spanish version showed good concurrent validity with measures of pain intensity and quality of life and has adequate internal consistency ($\alpha = 0.83$ to 0.94) [50]. In the present study, the RMDQ showed high internal consistency ($\alpha = 0.89$).

Data Analyses

Descriptive statistics and correlation analyses were performed with SPSS statistical software, version 22.0 for Windows. Missing data patterns were analyzed, and the expectation maximization algorithm was used to perform multiple imputation [51]. There were no significant differences between the initial sample and the participants who completed the five assessments in any of the demographic variables, clinical pain-related variables, or the variables included in the model. The results were based on multiple imputations [52,53], except for descriptive and correlational data, which were presented based on complete case analyses according to the recommendations of Sterne et al. [54].

Linear mixed models [55] were performed to examine the trajectory of disability over four measurement occasions during two years, with a six-month interval between each measurement and its possible association with relevant variables in its acute phase. These models are a commonly used statistical approach to analyze longitudinal data [56] and consist of two levels of analysis that allow researchers to explore how individuals change over time (level 1) and how these changes vary between individuals (level 2). The main advantages of using linear mixed models are that they allow researchers to include random factors (i.e., account for interindividual variability) and to model the covariance structure of their data prior to testing the treatment effects. In the present study, intercept and slope were random, which allows for interindividual variability at baseline and in the rate of change. An unstructured (UN) covariance structure, which allows every term to be different, was assumed. All the variables were normally distributed. In addition, a procedure resistant to violations of normality in small samples was adopted to ensure that type I error rates would not be artificially inflated. Specifically, we applied Kenward-Roger's procedure to adjust the degrees of freedom [57] in linear mixed models. This procedure has been found to be robust to slight and moderate deviations of normality, with total sample sizes equal to 45, and to severe deviations of normality, with total sample sizes equal to 60 [58–61].

First, linear and quadratic unconditional models were examined. Time was measured in terms of duration of pain in months and was centered at three months. Linear models assume that the rate of change over time is constant, whereas quadratic models assume that acceleration in the rate of change over time can occur. The most common and parsimonious procedure is to first test an unconditional linear model and then an unconditional quadratic model. Both models are nested, and therefore their fit can be compared using the Bayesian Information Criterion (BIC) [62], which is an index that combines information on a model's goodness of fit and parsimony. Models with lowest BIC are preferred. We used the BIC to compare the fit of the models. Secondly, conditional models were examined that included predictor variables that were measured when pain was acute. The variables included were disability, pain intensity, depression, fear avoidance beliefs, anxiety sensitivity, and resilience. All these variables were assessed when the duration of pain was less than three months. Forward stepwise procedures [63] were followed when building the models (i.e., between-person variables are added to a model and checked for significance; if the coefficient for an individual variable is not significant, the variable is deleted). SAS (PROC MIXED) [64]. software was used to estimate these models. To make it easier to interpret the results, only significant parameter estimates were reported when assessing the association between the predictor variables that were measured when pain was acute with disability across time.

Sensitivity analyses were performed by comparing multiple imputed data and complete cases; it was found that the results based on multiple imputations were in line with the results of the complete cases.

Results

Descriptive Statistics and Correlation Analyses

Table 1 shows the descriptive statistics and correlation analyses of the predictor variables. Descriptive statistics for the successive measurement occasions of disability were as follows: disability_1: $M = 16.21$, $SD = 5.78$; disability_2: $M = 15.42$, $SD = 5.35$; disability_3: $M = 15.71$, $SD = 5.31$; disability_4: $M = 14.92$, $SD = 5.25$.

Correlations were assessed following the guidelines proposed by Cohen [65], where low correlations range from 0.10 to 0.29, moderate correlations from 0.30 to 0.49, and high correlations from 0.50 to 1. Pain intensity showed moderate correlations with fear avoidance beliefs, disability at the baseline assessment, and depression and low correlations with anxiety sensitivity and

Table 1 Means, standard deviations, and Pearson correlation coefficients for all predictor variables

Time-invariant variables First measurement	M (SD)	2	3	4	5	6
1. Pain intensity	5.46 (1.75)	0.339**	0.222*	0.141	0.244*	0.249*
2. Fear avoidance beliefs	38.66 (16.81)		0.272**	0.110	0.301*	0.180
3. Anxiety sensitivity	34.35 (12.71)			−0.053	0.298**	0.323**
4. Resilience	147.77 (15.08)				−0.095	−0.218*
5. Disability at pain onset	19.74 (5.66)					0.412**
6. Depression	10.58 (3.71)					

*$P < 0.05$.
**$P < 0.01$.

resilience. Fear avoidance beliefs showed low correlations with resilience and depression and moderate correlations with disability and anxiety sensitivity (baseline assessment). Anxiety sensitivity showed low correlations with resilience and moderate correlations with disability and depression. Resilience showed a small negative correlation with depression. Finally, disability at the baseline assessment showed moderate correlations with depression.

Disability Trajectory and Acute Pain Predictors

Examination of linear and quadratic unconditional models showed that the quadratic model was not significantly better than the linear model ($\chi^2(1, N = 232) = 1.6$; $P = 0.21$). Therefore, the change in disability during the two-year follow-up can be better described by a linear trajectory (i.e., changes at a constant rate over time) than by a quadratic trajectory. As shown in Table 2, there was a slight increase in disability over time.

The results showed that individuals who had higher scores of disability when pain was acute also had higher scores of disability six months later. Moreover, the rate of change in disability was faster in these individuals than in those who reported lower scores of disability when pain was acute. This suggests that those who reported greater levels of disability when the pain was acute also reported a faster increase in disability over time compared with those individuals who reported lower levels of disability when the pain was in its acute phase. The same pattern was found for pain intensity when pain was acute. Individuals who had reported greater levels of pain intensity when pain was acute had greater scores of disability six months later, and the rate of change in disability was faster over time. Therefore, greater levels of pain-related disability and pain intensity in the acute phase are predictors of the greater increases of disability during the follow-up.

It was found that individuals who had reported greater levels of fear avoidance beliefs when pain was acute also reported greater scores of disability six months later. However, no differences were found in the rate of change in disability. That is, the level of fear avoidance beliefs when pain was acute only predicted the level of disability six months later, but there were no differences in the speed of increase in disability over time according to the level of fear avoidance beliefs when pain was acute. Finally, no significant associations were found between either the intercept or the slope and any of the other predictor variables (depression, anxiety sensitivity, and resilience) that were measured when pain was acute.

Discussion

The purpose of the present study was to investigate the predictive power of both resilience and vulnerability factors in relation to pain-related disability. In summary, the results showed that patients with acute back pain who show high levels of pain-related disability, pain intensity, and fear avoidance beliefs are at risk of developing back pain–related disability.

The results supported the proposals of the Fear Avoidance Model [4], highlighting the relevance of fear avoidance beliefs when pain is acute to predict future disability. The results showed that individuals who had reported greater levels of fear avoidance beliefs when pain was acute also reported greater scores of disability six months later; however, there were no differences in the speed of increase in disability over time according to the level of fear avoidance beliefs when pain was acute. The latter result could be explained by the fact that fear avoidance beliefs were measured using the Fear Avoidance Beliefs Questionnaire [41,42], which includes beliefs that physical activity and work influence pain intensity, beliefs that could be held by any person without pain, but which does not include an explicit measurement of fear of pain [18]. It may be the case that fear avoidance beliefs could be associated with disability at the early stages of pain chronification, whereas other variables, such as pain catastrophizing or fear of pain (not measured in the present study), could predict disability once pain is chronic. The results suggest that when pain is acute it is essential to assess the patients' beliefs on the relationship between physical activity and

Table 2 Significant parameter estimates and fit indexes for linear mixed models

	Model	
	Estimate (SE)	95% CI
Intercept	6.53 (1.02)**	4.51–8.56
Time	0.23 (0.05)**	0.11–0.35
$Disability_1$	0.44 (0.05)**	0.33–0.55
Perceived pain intensity	0.68 (0.17)*	0.33–1.02
Fear avoidance beliefs	0.03 (0.01)*	0.009–0.05
Slope		
$Disability_1$	−0.009 (0.003)*	−0.01 to − 0.002
Perceived pain intensity	−0.03 (0.01)*	−0.05 to − 0.01
Variance		
Intercept	16.82 (1.88)*	
Slope	0.06 (0.007)*	
Residual	16.79 (0.34)*	
-2LL	29,657.1	
BIC	29,717	

Only significant estimates were included.
-2LL = deviance statistic; BIC = Bayesian Information Criterion; CI = confidence interval; $Disability_1$ = disability at the first measurement occasion.
*$P < 0.01$.
**$P < 0.0001$.

pain. According to a systematic review [66], patients with high fear avoidance beliefs seem more likely to improve when fear avoidance beliefs are addressed during treatment than when these beliefs are ignored.

Contrary to expectations, anxiety sensitivity measured when pain was acute did not predict pain-related disability over time, although at baseline it showed moderate positive correlations with fear avoidance beliefs, disability, and depression. To fully understand the implications of our results, it should be recalled that, to the best of our knowledge, evidence showing that anxiety sensitivity is strongly associated with fearful appraisals of pain and moderately associated with pain-related disability was derived from cross-sectional studies [16]. On the other hand, according to the "amended" Fear Avoidance Model of chronic pain [14], it could be argued that anxiety sensitivity is a variable that predisposes to pain catastrophizing; however, catastrophizing was not measured in this study.

The results showed that greater levels of pain intensity when pain was acute were predictive of higher disability six months later and of greater increases of disability during the subsequent two years. This finding is in line with the results of previous studies that found that pain intensity at baseline significantly predicted long-term disability [7,8,22–24], and it also highlights the role of pain intensity in perpetuating long-term disability. However, this finding runs against one of the assumptions of the Fear Avoidance Model according to which physiological processes are important to acute pain; nevertheless, they have a limited role in perpetuating long-term pain and disability, which are maintained by cognitive-behavioral factors [13,20].

The results also showed that individuals who had higher scores of disability when pain was acute also had higher scores of disability six months later; also, greater levels of pain-related disability in the acute phase were predictive of greater increases of disability during the subsequent two years. These results are similar to those of other prospective studies [27,28], which found that the early "failure to adapt" to pain (i.e., disability) played a prominent role in the transition from acute to chronic pain. It has been suggested that acute disability provides opportunities for the reinforcement of pain behaviors, which could lead to long-term disability [27]. There is increasing evidence that the extent to which pain interferes with daily life pursuits (i.e., pain-related disability) is the primary reason to consult health care providers [67,68]. It has also been proposed that the cognitive, behavioral, and emotional responses within the Fear Avoidance Model could be understood as being triggered by the level of such interference [20].

Given that clinical depression is associated with passivity, Pincus et al. [17,18] suggested that pain-related disability may develop via concurrent clinical depression (not necessarily related to pain). Although several studies have supported this suggestion [24,69–73], the results of the present study did not show that depression at pain onset was significantly associated with disability over time. It should be emphasized that despite the fact

that depression and disability showed a positive moderate correlation at baseline, depression did not prospectively predict disability. Thus, the results of the present study do not support the suggestion [17,18] that depression is an, alternative pathway to pain-related functional disability; however, fear avoidance beliefs were demonstrated to be a significant prospective factor.

Finally, in addition to vulnerability factors, the present study included resilience as a predictive factor in order to develop the trajectory of the Fear Avoidance Model that leads to functional recovery. In contrast to our predictions and previous evidence showing that resilience may foster adaptation to chronic pain [30,36], resilience was not associated with pain-related disability over time. It must be taken into account that evidence on the protective role of resilience has been provided by cross-sectional studies alone or from studies in which the patients already had chronic pain; thus, it may be the case that resilience plays a protective role once pain has become chronic, although it does not predict disability at pain onset. It should also be taken into account that the outcome variable in this study was pain-related disability. A previous study [33] on a sample of patients with chronic pain showed that vulnerability and resilience only predicted outcome variables of the same valence. Similarly, another recent study showed that, above vulnerability factors, resilience factors mainly predicted mental health–related outcomes [74].

The present study has a number of limitations. First, self-reporting was the only method used, and shared method variance may have contributed to the results. Future research should replicate the present study and include different assessment methods; however, good correspondence between self-reports of disability and objective functional performance has been described [75]. Second, the attrition rate was high, and although no significant differences were found between the participants who completed the five assessment sessions and the participants who did not complete follow-up, it may be the case that there were differences in unmeasured variables. For example, the patients who refused to take further part in the study may have been those whose symptoms had improved. Third, it should be acknowledged that even with longitudinal data, it is not possible to identify causality with the same certitude as with experimental methods. Finally, the findings indicated that there was a slight increase in disability over a two-year period.

Future studies should investigate the trajectory of pain-related disability over a longer period given that during the first stages of pain chronification patients normally show an "acute pain response" and focus on seeking medical solutions to their pain. Subsequently, the course of pain-related disability will depend more on the strategies that they apply to adapt to pain [76]. A potentially valuable line of research would be to examine recovery trajectories in people who are at high risk of developing pain-related disability. In addition, screening cutoffs for the variables that predicted disability in the present study could be developed to help physicians identify at-risk patients.

In summary, patients with acute back pain who need specialized clinical attention have a profile that is characterized by high levels of pain intensity, initial disability, and fear avoidance beliefs. These patients are at high risk of developing pain-related disability in the following months and would definitely benefit from close follow-up and preventive measures aimed at preserving daily functioning and promoting a healthy pattern of activities.

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