The joint contribution of physical pathology, pain-related fear and catastrophizing to chronic back pain disability.

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Severeijns et al. (2001) studied a group of 211 patients with heterogenic pain complaints (54 of whom had back pain). The contribution of catastrophizing and physical pathology to pain intensity, pain interference, life control and psychological distress was examined. Catastrophizing proved to be the most potent predictor of each of the outcome variables but physical pathology did make a modest contribution to the explained variance in pain intensity and pain interference.

The present study further examines the contribution of physical pathology and pain-related fear/catastrophizing in explaining pain intensity and disability in low back pain patients. As a secondary issue, the interrelationship between physical pathology and pain-related fear and catastrophizing is examined. It may be proposed that knowing that one has a structural or functional abnormality can provoke fearful cognitions about pain (e.g. 'My pain will never go away'; 'I should avoid activities in order to prevent further damage to my body').

Pain-related fear, catastrophizing, pain intensity and disability were assessed with self-report questionnaires as part of the intake procedure. Physical pathology was scored from patients' medical charts.

2. Methods

2.1. Subjects

One hundred patients (44 males, 56 females) with non-specific low back pain who presented themselves to the outpatient's clinic for pain management of the University Hospital Maastricht enrolled in this study. Mean age of patients was 49.9 years (range 22–82), 81% were married or living together with a partner and 78% had children. Educational level was as follows: 55% of patients attended elementary school or lower vocational training, 19% attended lower secondary education, and 16% higher secondary education. Mean duration of pain complaints was 6.5 years (range 1–34 years).

2.2. Measures

2.2.1. Physical pathology

The Medical Evaluation and Diagnostic Information Coding System (MEDICS) was used to quantify biomedical signs and symptoms. The MEDICS consists of 18 biomedical procedures commonly used in the examination of chronic pain patients. Procedures were selected and given a weight according to their relevance in chronic pain on the basis of consensual judgement by physicians specialized in pain treatment (Rudy et al., 1988). Research on the reliability of the MEDICS demonstrated that the weighted aggregation of the 18 items into a total pathology index had an inter-rater reliability of >0.80 (Rudy et al., 1990).

For the present study, a medical student, supervised by a neurologist (W.E.J.W.), examined the medical chart of each patient and entered the absence or presence of positive findings in the MEDICS computer program (Rudy, 1993). In developing the instrument, Rudy and colleagues have demonstrated that

the dichotomous judgements that form the basis of the total pathology score can reliably be made from the patient chart without prior training (Rudy et al., 1990). The computer generated T-score of total pathology has a mean of 50 and SD of 10, based on 1604 MEDICS scores from a heterogeneous group of pain patients from the University of Pittsburg Pain Evaluation and Treatment Institute (Rudy, 1993).

2.2.2. Disability

Self-reported disability was measured by the Quebec Back Pain Disability Scale (QBPDS) (Kopeck et al., 1995). Patients score perceived difficulty with simple physical activities (e.g. getting out of bed, climbing a stair, standing for 30 min). The questionnaire consists of 20 items which are grouped into six areas: rest/bed, sit/stand, walk, range of motion, bending and lifting/carrying. Each activity is scored on a 6-point scale (0 = not difficult at all; 5 = unable to do), giving the QBPDS a theoretical range of 0–100. Higher scores denote more disability. Test–retest reliability and construct validity of the English, French and Dutch versions of the questionnaire are good (Kopeck et al., 1995; Schoppink et al., 1996; Yvanes Thomas et al., 2002). For the Dutch version, a test–retest reliability of 0.90 (ICC) was reported, and the agreement with the more widely used Roland Disability Questionnaire (Roland and Morris, 1983) was high, ranging from 0.80 to 0.91 (Schoppink et al., 1996).

2.2.3. Pain intensity

Present pain intensity was rated on a 10 cm visual analog scale (VAS) with the anchors 'no pain at all' and 'unbearable pain'.

2.2.4. Pain catastrophizing

A Dutch version of the Pain Catastrophizing Scale (PCS) was used, a 13-item questionnaire measuring exaggerated negative thoughts about the meaning of pain (Sullivan et al., 1995). Items are scored on a 5-point scale and scores range from 0 to 52. In addition to a total PCS scale, three subscale scores can be obtained: rumination, magnification and helplessness. The three subscales have been confirmed for the Dutch version of the PCS (Van Damme et al., 2002).

2.2.5. Pain-related fear

The Pain Anxiety Symptoms Scale (PASS) is a 40-item questionnaire (McCracken et al., 1992). Items are scored on a 6-point scale and a total PASS score and four subscales can be derived: fearful appraisal, cognitive anxiety, physiological anxiety and escape and avoidance, with each subscale ranging from 0 to 50. The psychometric properties of the Dutch version of the PASS were found to be satisfactory (Roelofs et al., 2004a).

The Tampa Scale of Kinesiophobia (TSK, Kori et al., 1990) is a 17-item questionnaire measuring fear of movement and (re)injury. Items are scored on a 4-point scale giving a theoretical range on the TSK of 17–68. Reliability and validity have been confirmed for the Dutch version of the TSK (Roelofs et al., 2004b).

2.2.6. Procedure

Self-report instruments were completed as part of the intake procedure. Patients referred to the university pain clinic received a set of questionnaires by mail that had to be returned before their first appointment at the clinic. Of the 642 consecutive referrals that returned the questionnaires, 583 gave permission to use their data

for research purposes by means of written informed consent. The total dataset included 219 patients with back pain as the primary complaint, and the medical charts of these patients were examined in order of appearance in the file until 100 valid cases for inclusion in the present study were found (i.e. patients for whom diagnostic procedures were completed and without indication of a specific condition, e.g. malignant disease, Bechterev disease). A total of 128 charts had to be screened to obtain 100 valid cases.

3. Results

3.1. Descriptive data

Patients reported a mean pain intensity of 69 on the VAS ($SD=20.3$). The mean disability score on the QBPDS was 61.5 ($SD=15.9$), which is considerably higher than previously reported for a sample of chronic low back pain patients in the Netherlands (Reneman et al., 2002: mean = 37.8, $SD=15.7$; Schoppink et al., 1996: mean = 33.0, $SD=18.5$). The score can be interpreted as signifying that patients experience 'a fair amount of difficulty' in performing simple tasks (mean item score of 3).

The average number of diagnostic procedures performed for the patients in the study was 12 (range 7–17), with an average of three procedures showing abnormal findings (range 0–7). The weighted total pathology score on the MEDICS was 41.1 ($SD=7.24$; range: 23–56) demonstrating that most patients in the present sample had a level of objectively identified pathology that was lower than that of a heterogeneous group of North American pain clinic patients, which constituted the original norm group (Rudy, 1993; T -score with mean = 50, $SD=10$) and lower than what has been found for fibromyalgia patients (mean = 50.7, $SD=11.1$; Turk and Okifuji, 1997).

There were no significant differences between male and female patients in pain intensity, disability or physical pathology.

3.2. Zero-order correlations

Table 1 shows simple correlations between physical pathology, pain intensity, disability and the psychological

Table 1
Zero-order correlations between physical pathology, disability, pain intensity and psychological variables

	Physical pathology (MEDICS)	Disability (QBPDS)	Present pain	PCS	PASS
Disability (QBPDS)	0.22*				
Present pain	0.20	0.44**			
PCS	0.04	0.33**	0.25*		
PASS	−0.01	0.40**	0.30**	0.77**	
TSK	−0.04	0.27**	0.12	0.63**	0.59**

* $P<0.05$.

variables. Physical pathology showed significant but modest correlations with disability but not with pain intensity, pain-related fear or pain catastrophizing. Disability was significantly associated with pain intensity and with the PCS, PASS and TSK.

3.3. Prediction of physical pathology

Linear regression analysis indicated that physical pathology was not significantly predicted by demographic variables (age, sex and education) or by duration of complaints.

3.4. Prediction of pain intensity

Hierarchical linear regression analysis was used to establish which factors contributed to present pain intensity. In the first step, control variables were entered (age, sex, education and pain duration). In the second step, the physical pathology score was added to the model and finally, in the last step the psychological predictors (TSK, PASS and PCS). Multicollinearity statistics ($VIF>3$) indicated a problem when PASS and PCS were entered simultaneously in a single analysis, and therefore in step 3 either PCS and TSK or PASS and TSK were entered. Table 2 shows the results of these analyses.

Table 2
Results of hierarchical regression analysis with pain intensity as dependent variable

	Stand. β	P
Step 1 $R^2=0.11$, $F=2.82$, $P=0.030$		
Sex	−0.04	0.699
Age	−0.27	0.010
Education	−0.20	0.053
Pain duration	−0.09	0.362
Step 2 $R^2=0.16$, $F=3.24$, $P=0.010$		
Sex	0.01	0.952
Age	−0.29	0.005
Education	−0.21	0.036
Pain duration	−0.07	0.490
MEDICS	0.22	0.037
Step 3a $R^2=0.22$, $F=4.06$, $P=0.001$		
Sex	0.01	0.937
Age	−0.32	0.002
Education	−0.16	0.131
Pain duration	−0.08	0.452
MEDICS	0.22	0.029
PCS	0.24	0.023
Step 3b $R^2=0.25$, $F=4.67$, $P<0.001$		
Sex	0.02	0.812
Age	−0.32	0.001
Education	−0.13	0.197
Pain duration	−0.04	0.698
MEDICS	0.23	0.018
PASS	0.31	0.002

Age and education were significantly related to pain intensity (step 1). The physical pathology score significantly added to total explained variance (step 2: R^2 -change = 0.044, $P=0.034$). In step 3, both the PCS and PASS added unique variance to the model (6 and 10%, respectively; R^2 -change for step 3 = 0.049, $P=0.023$ for PCS and R^2 -change = 0.088, $P=0.002$ for PASS). TSK score did not significantly contribute to the explanation of pain intensity and was removed from the model. The other significant variables in the final model were age and total physical pathology, explaining 10 and 5% of total variance in pain intensity.

Analyses were repeated for the subscales of the PCS and PASS separately. All PCS subscales had about equal predictive power for pain intensity (β s = 0.21–0.24; $P < 0.05$). For the PASS, there were small differences in predictive power between the four subscales, with the fearful appraisal and physiological anxiety subscales showing the strongest association ($\beta=0.30$; $P < 0.05$ for both subscales) and cognitive anxiety and avoidance the least association with pain intensity (respective β s = 0.25 and 0.24; $P < 0.05$).

3.5. Prediction of disability

The next series of hierarchical regression analyses tested which variables predicted disability as measured with the QBPDS. Step 1 again included demographic variables and pain duration, step 2 the physical pathology score and in step 3, present pain intensity was added to the model. Finally, in step 4 the psychological predictors (PCS, PASS and TSK) were entered. Again, to avoid multicollinearity PCS and PASS were entered in separate analyses. Results are shown in Table 3. In steps 1 and 2, only education was significantly related to disability. Physical pathology showed a trend towards significance in step 2, but when in pain intensity was added to the model in step 3, the association between physical pathology and disability disappeared. In step 4, the TSK contributed 4% additional explained variance to the model, but pain intensity remained the strongest predictor of disability, explaining 17% of total variance in disability.

Neither PCS nor PASS significantly contributed to total explained variance and these variables were removed from the final model.

4. Discussion

The present study replicated previous findings that catastrophizing and pain-related fear are important predictors of present pain intensity and disability in patients with low back pain, after adjusting for relevant demographic and biomedical variables. For pain intensity, four significant predictors were identified: age (younger patients reported more pain), objectively assessed physical pathology, pain catastrophizing and fear of pain. Age and fear of pain

Table 3

Results of hierarchical regression analysis with disability as dependent variable

	Stand. β	P
Step 1		
$R^2=0.10$, $F=2.51$, $P=0.047$		
Sex	0.10	0.315
Age	0.10	0.341
Education	−0.20	0.049
Pain duration	−0.17	0.108
Step 2		
$R^2=0.14$, $F=2.78$, $P=0.022$		
Sex	0.15	0.161
Age	0.08	0.416
Education	−0.22	0.036
Pain duration	−0.14	0.160
MEDICS	0.19	0.062
Step 3		
$R^2=0.30$ $F=6.07$, $P < 0.001$		
Sex	0.15	0.111
Age	0.21	0.038
Education	−0.12	0.216
Pain duration	−0.11	0.245
MEDICS	0.10	0.304
Pain intensity	0.43	0.000
Step 4		
$R^2=0.33$, $F=6.09$, $P < 0.001$		
Sex	0.18	0.054
Age	0.16	0.104
Education	−0.05	0.601
Pain duration	−0.08	0.389
MEDICS	0.11	0.237
Pain intensity	0.41	0.000
TSK	0.21	0.033

appeared to be the most potent predictors, each explaining about 10% of the variance in pain intensity. Self-reported disability was mainly determined by pain intensity and fear of movement, with pain intensity explaining the largest part (i.e. 17%) of total variance in disability. Fear of movement contributed an additional 4%. There was no association between objective physical pathology and either pain-related fear or catastrophizing.

Our results are in accordance with the findings of a previous study by Severeijns et al. (2001) who also reported that both physical pathology as assessed by MEDICS and pain catastrophizing were significantly related to pain intensity. Our study also showed that fear of pain (PASS) was an even stronger predictor of present pain intensity than catastrophizing, while fear of movement/(re)injury was unrelated to present pain. This corresponds to the results reported by McCracken et al. (1996) that the PASS but not the Fear Avoidance Beliefs Questionnaire—which is rather similar in content to the TSK—was significantly related to pain intensity (McCracken et al., 1996). With regard to the four subscales of the PASS, the association with pain intensity was somewhat stronger for the fearful appraisal and physiological anxiety subscales than for the cognitive anxiety and avoidance subscales, which is also in accordance with previous studies (McCracken et al., 1992, 1996).

For disability, a somewhat different pattern of association was found than for pain intensity. Physical pathology was not significantly related to disability, while fear of movement/(re)injury did contribute to total explained variance, replicating the results by Vlaeyen et al. (1995). Also similar to this study, fear of movement/(re)injury proved to be a better predictor than catastrophizing, which had a non-significant contribution to disability. Other studies which have directly compared the predictive power of catastrophizing and fear of movement/(re)injury as measured by the TSK (Crombez et al., 1999) or fear-avoidance beliefs as measured by the FABQ (Woby et al., 2004) have similarly found that with simultaneous entry of both predictors in the regression analysis, only the fear measures were significantly related to disability.

The strongest predictor of disability proved to be pain intensity, explaining 17% of the variance in disability after adjusting for demographic variables and physical pathology. There is some controversy in the literature concerning the relation between pain intensity and disability in non-specific low back pain. Some studies have found only a very modest association (Vlaeyen et al., 1995; Waddell et al., 1992, 1993) and it has been claimed that in general pain intensity accounts for not more than 10% of the variance in self-reported disability (Waddell, 2004b). However, other studies have reported that pain intensity does account for a relatively large proportion of variance in disability with percentages close to what we found in the present study (Mannion et al., 2001; van den Hout et al., 2001; Woby et al., 2004). Nevertheless, independent of the exact degree of association between pain intensity and disability, the large majority of studies, including the present one, demonstrate that pain-related fear explains additional variance and is indeed an important predictor of disability (Crombez et al., 1999; Mannion et al., 2001; McCracken et al., 1992, 1996; Pflingsten et al., 2000; Vlaeyen et al., 1995; Woby et al., 2004).

It should be noted that whereas physical pathology was significantly related to pain intensity, it was not a significant predictor of disability in the regression analysis. However, simple correlations did show an association between physical pathology and disability, and also in the second step of the hierarchical regression analysis a trend towards an association was found. After pain intensity was added to the model, this association disappeared. Therefore, it may be proposed that the (modest) contribution of physical pathology to disability is mediated by pain intensity.

We found no associations between PCS, PASS or TSK and physical pathology. It was speculated that knowing one has a structural or physiological abnormality could be a stimulus for inducing fearful cognitions about the meaning of pain (e.g. 'movement sustains the harm to my body'). One study has indeed found findings from physical examination and catastrophizing were significantly related to each other (Main and Waddell, 1991), but the two previous studies using the MEDICS procedure did not find an association between physical pathology and catastrophizing or fear of movement

(Severeijns et al., 2001; Vlaeyen et al., 1995). It may be proposed that the difference between studies can be traced back to the different methodology of assessing physical pathology. The method used by Main and Waddell includes both structural (e.g. spinal fractures, nerve compression) and functional (lumbar flexion, straight leg raising) characteristics, while MEDICS includes relatively little performance based assessment procedures. Functional performance based measures probably rely just as much on people's cognitive and emotional reactions towards pain, and on motivation and effort, than on the underlying physical or physiological disorder (Waddell, 2004b).

It should be admitted that the total amount of variance in pain intensity and disability that could be explained by the variables included in the present study is still modest, i.e. 25% for pain intensity and 33% for disability. Other variables and complex interactions between variables are likely to be involved. Nevertheless, the present study testifies to the interplay of biological and psychological variables in determining low back pain complaints. Both objectively assessed physical pathology as well as pain-related fear and catastrophizing influenced pain intensity. Functional disability was affected by pain intensity and by fear of movement/(re)injury. The differential pattern of prediction we found for the psychological variables may indicate that catastrophizing about pain and fear of pain lead to a preoccupation with pain and a heightened awareness of pain signals, thereby directly increasing pain perception (cf. Sullivan et al., 2001). Fear of movement and getting (re)injured on the other hand may have mainly behavioral consequences, namely avoidance of movement to prevent the occurrence of harmful consequences to the body, finally leading to a state of disuse and increased disability (Lethem et al., 1983; Vlaeyen and Linton, 2000).

This study once more underscores the importance of cognitive behavioral interventions for chronic pain, and suggests that targeting maladaptive pain cognitions and affective responses to pain may impact both on the level of pain and on functional limitations.

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References

- Burton AK, Tillotson KM, Main CJ, Hollis S. Psychosocial predictors of outcome in acute and subchronic low back trouble. *Spine* 1995;20: 722–8.
- Crombez G, Vlaeyen JW, Heuts PH, Lysens R. Pain-related fear is more disabling than pain itself: evidence on the role of pain-related fear in chronic back pain disability. *Pain* 1999;80:329–39.
- Fritz JM, George SZ, Delitto A. The role of fear-avoidance beliefs in acute low back pain: relationships with current and future disability and work status. *Pain* 2001;94:7–15.

- Klennerman L, Slade PD, Stanley IM, Pennie B, Reilly JP, Atchison LE, Troup JD, Rose MJ. The prediction of chronicity in patients with an acute attack of low back pain in a general practice setting. *Spine* 1995; 20:478–84.
- Kopec JA, Esdaile JM, Abrahamowicz M, Abenheim L, Wood-Dauphinee S, Lamping DL, Williams JI. The Quebec Back Pain Disability Scale: measurement properties. *Spine* 1995;20:341–52.
- Kori SH, Miller RP, Todd DD. Kinesiophobia: a new view of chronic pain behavior. *Pain Manag* 1990;Jan/Feb:35–43.
- Lethem J, Slade PD, Troup JD, Bentley G. Outline of a fear-avoidance model of exaggerated pain perception: I. *Behav Res Ther* 1983;21: 401–8.
- Main CJ, Waddell G. A comparison of cognitive measures in low back pain: statistical structure and clinical validity at initial assessment. *Pain* 1991; 46:287–98.
- Mannion AF, Junge A, Taimela S, Muntener M, Lorenzo K, Dvorak J. Active therapy for chronic low back pain. Part 3. Factors influencing self-rated disability and its change following therapy. *Spine* 2001;26: 920–9.
- McCracken LM, Zayfert C, Gross RT. The Pain Anxiety Symptoms Scale: development and validation of a scale to measure fear of pain. *Pain* 1992;50:67–73.
- McCracken LM, Gross RT, Aikens J, Carnrike Jr CLM. The assessment of anxiety and fear in persons with chronic pain: a comparison of instruments. *Behav Res Ther* 1996;34:927–33.
- Novy DM, Nelson DV, Francis DJ, Turk DC. Perspectives of chronic pain: an evaluative comparison of restrictive and comprehensive models. *Psychol Bull* 1995;118:238–47.
- Pfingsten M, Kroner Herwig B, Leibing E, Kronshage U, Hildebrandt J. Validation of the German version of the Fear-Avoidance Beliefs Questionnaire (FABQ). *Eur J Pain* 2000;4:259–66.
- Picavet HS, Vlaeyen JWS, Schouten JS. Pain catastrophizing and kinesiophobia: predictors of chronic low back pain. *Am J Epidemiol* 2002;156:1028–34.
- Reneman MF, Jorritsma W, Schellekens JMH, Goecken LNH. Concurrent validity of questionnaire and performance-based disability measurements in patients with chronic nonspecific low back pain. *J Occup Rehabil* 2002;12:119–29.
- Roelofs J, McCracken L, Peters ML, Crombez G, van Breukelen G, Vlaeyen JWS. Psychometric evaluation of the Pain Anxiety Symptoms Scale (PASS) in chronic pain patients. *J Behav Med* 2004a;27:167–83.
- Roelofs J, Goubert L, Peters ML, Vlaeyen JWS, Crombez G. The Tampa Scale of Kinesiophobia: further examination of psychometric properties in patients with chronic low back pain and fibromyalgia. *Eur J Pain* 2004b;8:495–502.
- Roland M, Morris R. A study of the natural history of back pain. Part I. Development of a reliable and sensitive measure of disability in low-back pain. *Spine* 1983;8:141–4.
- Rudy TE. In: User's manual MEDICS microcomputer program. University of Pittsburgh; 1993.
- Rudy TE, Turk DC, Brena SF. Differential utility of medical procedures in the assessment of chronic pain patients. *Pain* 1988;34:53–60.
- Rudy TE, Turk DC, Brena SF, Stieg RL, Brody MC. Quantification of biomedical findings of chronic pain patients: development of an index of pathology. *Pain* 1990;42:167–82.
- Schoppink LEM, van Tulder MW, Koes BW, Beurskens AJHM, de Bie R. Reliability and validity of the Dutch adaptation of the Quebec Back Pain Disability Scale. *Phys Ther* 1996;76:268–75.
- Severeijns R, Vlaeyen JWS, van den Hout MA, Weber WEJ. Pain catastrophizing predicts pain intensity, disability, and psychological distress independent of the level of physical impairment. *Clin J Pain* 2001;17:165–72.
- Sullivan MJL, Bishop SR, Pivik J. The Pain Catastrophizing Scale: development and validation. *Psychol Assess* 1995;7:524–32.
- Sullivan MJL, Thorn B, Haythornthwaite JA, Keefe F, Martin M, Bradley LA, Lefebvre JC. Theoretical perspectives on the relation between catastrophizing and pain. *Clin J Pain* 2001;17:52–64.
- Turk DC, Okifuji A. Evaluating the role of physical, operant, cognitive, and affective factors in the pain behaviors of chronic pain patients. *Behav Mod* 1997;21:259–80.
- Turk DC, Okifuji A. Psychological factors in chronic pain: evolution and revolution. *J Consult Clin Psychol* 2002;70:678–90.
- Van Damme S, Crombez G, Bijttebier P, Goubert L, Van Houdenhove B. A confirmatory factor analysis of the Pain Catastrophizing Scale: invariant factor structure across clinical and non-clinical populations. *Pain* 2002;96:319–24.
- van den Hout JHC, Vlaeyen JWS, Heuts PHTG, Sillen WJT, Willen AJEHL. Functional disability in nonspecific low back pain: the role of pain-related fear and problem-solving skills. *Int J Behav Med* 2001;8:134–48.
- Vlaeyen JWS, Linton SJ. Fear-avoidance and its consequences in chronic musculoskeletal pain: a state of the art. *Pain* 2000;85:317–32.
- Vlaeyen JWS, Koe Snijders AMJ, Rotteveel AM, Ruesink R, Heuts PHTG. The role of fear of movement/(re)injury in pain disability. *J Occup Rehab* 1995;5:235–52.
- Waddell G. The biopsychosocial model. In: Waddell G, editor. *The epidemiology of back pain*. Edinburgh: Churchill Livingstone; 2004. p. 265–82.
- Waddell G. In: *The epidemiology of back pain*. Edinburgh: Churchill Livingstone; 2004.
- Waddell G, Somerville D, Henderson I, Newton M. Objective clinical evaluation of physical impairment in chronic low back pain. *Spine* 1992;17:617–28.
- Waddell G, Newton M, Henderson I, Somerville D, Main CJ. A Fear-Avoidance Beliefs Questionnaire (FABQ) and the role of fear-avoidance beliefs in chronic low back pain and disability. *Pain* 1993; 52:157–68.
- Woby SR, Watson PJ, Roach NK, Urmston M. Are changes in fear-avoidance beliefs, catastrophizing, and appraisals of control, predictive of changes in chronic low back pain and disability? *Eur J Pain* 2004;8: 201–10.
- Yvanes Thomas M, Calmels P, Bethoux F, Richard A, Nayme P, Payre D, Laurent B. Validity of the French-language version of the Quebec back pain disability scale in low back pain patients in France. *Joint Bone Spine* 2002;69:397–405.