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Predicting the transition from acute to persistent low back pain

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Background	Most people experience low back pain (LBP) at least once in their lifetime. Only a minority of them go on to develop persistent LBP. However, the socioeconomic costs of persistent LBP significantly exceed the costs of the initial acute LBP episode.
Aims	To identify factors that influence the progression of acute LBP to the persistent state at an early stage.
Methods	Prospective inception cohort study of patients attending a health practitioner for their first episode of acute LBP or recurrent LBP after a pain free period of at least 6 months. Patients were assessed at baseline addressing occupational and psychological factors as well as pain, disability, quality of life and physical activity and followed up at 3, 6, 12 weeks and 6 months. Variables were combined to the three indices 'working condition', 'depression and maladaptive cognitions' and 'pain and quality of life'.
Results	The index 'depression and maladaptive cognitions' was found to be a significant baseline predictor for persistent LBP up to 6 months (OR 5.1; 95% CI: 1.04–25.1). Overall predictive accuracy of the model was 81%.
Conclusions	In this study of patients with acute LBP in a primary care setting psychological factors at baseline correlated with a progression to persistent LBP up to 6 months. The benefit of including factors such as 'depression and maladaptive cognition' in screening tools is that these factors can be addressed in primary and secondary prevention.
Key words	Back pain; biopsychosocial; predictors; prognosis; prospective cohort study; risk factors.

Introduction

The socioeconomic costs of persistent low back pain (LBP) significantly exceed the costs of the initial acute LBP episode [1]. Therefore, the early identification of patients at risk of developing persistent LBP is crucial [2].

The Multinational Musculoskeletal Inception Cohort Study (MMICS) Statement recommends internationally accepted core measures in predicting outcome [3]. According to a recently published review on prognostic factors for persistent LBP, occupational and psychological factors have the highest reliability and should be part of a minimum core set of predictor measures [4]. Consequently, this study focused on these factors and additionally, possible, influences of pain, disability, quality of life and physical activity.

Based on findings from the literature we hypothesized that:

(1) Work dissatisfaction, job insecurity, concentration requirements, work organizational problems and interruptions, time pressure, single-sided physical stress and emotional dissonance (discrepancy between organisational sanctioned emotions and actual emotions of employees) would be occupational risk factors [5–10], while social support as well as method control and time control (employee influence on work pace and schedule) would be protective factors [7,8],
(2) Depression and somatization [11], a resigned attitude towards the job [12,13], fear-avoidance and catastrophizing [14] as well as negative expectations on return to work [15] would be psychological risk factors for developing persistent LBP and
(3) Pain intensity and duration [14], recurrent pain [8], disability, limitations in quality of life and low physical activity [16] would be additional risk factors.

Methods

Our research was conducted complying with recommendations outlined by the Declaration of Helsinki (2008) and has been approved by the local Lower South Regional Ethics Committee (LRS/08/03/008). The protocol for this study has been published previously [17].

We recruited an inception cohort of consecutive patients in primary care settings from across New Zealand. Patients were invited to participate when attending a health practitioner for their first episode of acute LBP or for recurrent LBP after a pain-free period of at least 6 months.

To be eligible, they had to be between 18 and 65 years of age, be able to read and write in English and provide written consent. Patients were excluded if they had chronic LBP (defined as LBP continuing for >12 weeks at the time of the first visit to a health practitioner) [18,19], specific LBP (infection, tumour, osteoporosis, ankylosing spondylitis, fracture, deformity, inflammatory process, cauda equina syndrome) [20], a severe comorbidity determining overall well-being (e.g. painful disabling arthritic hip joints), were pregnant or unwilling to complete questionnaires.

Potential participants were screened employing a standardized structured telephone interview. If eligible, patients were sent a baseline questionnaire by mail and asked to return it in a stamped addressed envelope within 1 week. Follow-up questionnaires were sent out after 3, 6, 12 weeks and 6 months. If not returned, a first reminder was sent out after one and a second after 2 weeks. Participants received $NZ10 vouchers for each returned questionnaire as compensation for their time. Baseline and follow-up questionnaires were based on the recommendations of the MMICS Statement [3] addressing occupational and psychological factors as well as pain, disability, quality of life and physical activity.

Patients with persistent LBP during 6-month follow-up were compared to patients who recovered better. Persistent LBP was determined by functional limitation measured by the Oswestry Disability Index (ODI) [21]. We defined patients suffering from persistent LBP by functional limitation that is disabling at baseline or 3-week follow-up (>10 ODI points) and still severely impacts after 6 weeks of treatment or beyond. The normal value for the ODI in a general population is 10 points [22]. Therefore, patients with an ODI score ≤ 10 points after 6 weeks were considered to show non-persistent LBP.

Because of the small sample size, the comparably large number of predictor variables and multi-collinearity between predictor variables, analysis that included all predictor variables had to account for type I error. Therefore, the number of predictor variables was reduced by combining variables to three indices. According to Hypothesis 1 to Hypothesis 3, predictor variables were z-standardized and assigned to three indices.

Index 1 'working conditions' included *work dissatisfaction*, *job insecurity*, *concentration requirements*, *work organisational problems* and *interruptions*, *time pressure* as well as *single-sided physical* and *emotional stress, lack of social support* as well as lack of *method control* and lack of *time control.*

Index 2 'depression and maladaptive cognitions' contained *depression, somatization*, a *resigned attitude towards the job*, *fear-avoidance*, *rumination*, *helplessness*, *catastrophizing*, and *negative expectations on return to work.*

Index 3 'pain and quality of life' consisted of *baseline pain intensity* and *duration*, *disability*, *limitations in quality of life*, and *physical inactivity.*

The three indices were tested in a multiple logistic regression analysis and the overall predictive accuracy calculated for the regression model. Data were analysed using SPSS Version 17 (SPSS Inc., Chicago, IL). Statistical significance was set at the $P < 0.05$ level, two tailed.

Results

A total of 127 consecutive patients with acute LBP were screened between April 2008 and September 2009. Twenty-seven potential participants were ineligible because they were pain free at the time of the screening interview (eight); had been suffering from chronic LBP for >12 weeks [16] or from specific LBP (one); declared not to be available for follow-ups (one) or were older than 65 years (one). Thirteen patients declined to participate and a further 25 did not send back the baseline questionnaire and/or consent form despite two reminders. Sixty-two patients enrolled, 9 patients were lost to follow-up and 53 patients participated over the 6-month period (follow-up rate 85%).

Forty-three out of 53 respondents had a first episode of LBP—10 were suffering from recurrent LBP defined as LBP within the last 6 months after onset of the current episode. In the group of patients with a first episode of LBP, 9 (21%) developed persistent LBP at 6-week follow-up compared with four (40%) patients in the recurrent group. Baseline characteristics of the participants and the individuals lost to follow-up are shown in Table 1.

Forty patients at 6-week follow-up were classified as non-persistent, 13 (25%) as persistent—defined by an ODI score ≥ 10 points at baseline and 6-week follow-up. ODI scores in the non-persistent LBP group decreased over time, whereas scores in the persistent LBP group remained ≥ 10 points even after 6 months in seven patients, remained ≥ 10 points after 12 weeks in one patient and remained ≥ 10 points after 6 weeks in five patients. ODI baseline scores in the non-persistent group ranged between 0 and 18 points (median = 8 points), scores in the persistent group between 6 and 27 points (median = 14 points), with one patient who reported only 6 points at baseline but 10 points after 3 weeks.

Multiple logistic regression analysis with three indices as predictor variables and age, sex and body mass index as control variables revealed Index 2 'depression and maladaptive cognitions' to be a significant baseline predictor for persistent LBP (OR 5.1; 95% CI: 1.04–25.1) (Table 2). The other two indices did not show statistically meaningful odd ratios. The logistic regression explained 40% of variance for the development of persistent LBP (Nagelkerke R^2).

The diagnostic accuracy of the predictor model had a sensitivity of 0.54 indicating that 54% of patients at risk of developing persistent LBP were detected. The specificity was 0.90 signifying that 90% of LBP patients recovering within 6 weeks could be identified with this model. Positive likelihood ratio was moderate with 5.3, negative likelihood ratio 0.5. Overall accuracy of the model was 81%.

The area under the curve in ROC analysis represents the quality of discrimination (true positive rate versus false positive rate), that is, the ability of the test to correctly classify those with and without persistent LBP. Index 2 'depression and maladaptive cognitions' had an area under the curve of 0.78 (95% CI: 0.65–0.92) that can be considered fair.

Table 1. Baseline characteristics of participants

Independent variables	Patients (n = 53)	Non-persistent group (n = 40)	Persistent disability group (n = 13)	Patients lost to follow-up (n = 9)
Females (n [%])	27 (51)	20 (50)	7 (54)	2 (22)
Age (median)	39	37.4	43.9	39.4
Age groups (n [%])				
18-–35 years	27 (51)	22 (55)	5 (39)	4 (44)
36–45 years	9 (17)	7 (18)	2 (15)	1 (11)
46–55 years	9 (17)	5 (13)	4 (31)	2 (22)
56–65 years	8 (15)	6 (15)	2 (15)	2 (22)
Marital status (n [%])				
Single	12 (23)	12 (30)	0	2 (22)
Married or cohabiting	32 (60)	22 (55)	10 (77)	7 (78)
Widowed	2 (4)	1 (3)	1 (8)	0
Divorced	7 (13)	5 (13)	2 (15)	0
BMI (n [%])				
<18.5	1 (2)	1 (3)	0	0
18.5–24.9	1 (38)	15 (38)	5 (39)	3 (33)
≥25	32 (60)	24 (60)	8 (62)	6 (67)
Physical activity (n [%])				
Low	2 (4)	1 (3)	1 (8)	4 (44)
Moderate	14 (26)	10 (25)	4 (31)	2 (22)
High	37 (70)	29 (73)	8 (62)	3 (33)
Smoking (n [%])	22 (42)	17 (43)	5 (39)	6 (67)
Higher level of education (n [%])	23 (43)	19 (48)	4 (31)	5 (56)
Full-time employed (n [%])	25 (47)	17 (43)	8 (62)	5 (56)

BMI, body mass index. Figures are numbers (percentages) of patients; classification of physical activity into 'low', 'moderate' and 'high' according to International Physical Activity Questionnaire [26] score.

Table 2. Baseline predictor variables of persistent LBP in multivariate logistic regression analysis

Logistic regression model						
Predictors at baseline	B	SE	Wald	P	OR	CI (OR)
Index 1 'Working conditions'	0.76	0.71	1.15	NS	2.14	0.53–8.6
Index 2 'Depression and maladaptive cognitions'	1.63	0.81	4.02	<0.05	5.10	1.04–25.1
Index 3 'Pain and quality of life'	0.72	0.70	1.06	NS	2.05	0.52–8.0
R^2 = 0.396 (Nagelkerke). Model χ^2 = 16.18*, df = 6						

B, logistic regression coefficient; Wald, logistic regression coefficient divided by SE, squared; P, significance level of Wald; CI (OR), 95% confidence interval of odds ratio; df, degree of freedom; *$P < 0.05$; two tailed; criterion of logistic regression model: results are controlled for age, sex and body mass index.

Discussion

This study found that 'depression and maladaptive cognitions' (Index 2) were a risk factor for the development of persistent LBP at 6-month follow-up after the onset of acute LBP in a primary care setting.

A strength of the present study is that only validated and common instruments were used. By implementing outcome measures recommended by the MMICS Statement [3], encompassing occupational and psychological factors as well as pain, disability, quality of life and physical activity, the findings facilitate a comparison of our results with future studies following the same recommendations.

There are a number of limitations as a result of the small sample size of this study. Conclusions on constellations, interactions and weightings of baseline predictors of persistent LBP cannot be drawn. Therefore, this study requires replication with a larger sample size.

The presented predictor model comprising the Index 'depression and maladaptive cognitions' as baseline predictor for the development of persistent LBP should be interpreted cautiously. The predictor model explained 40% of variance of the development of persistent LBP. The model has some applicability to rule out patients with a low risk of developing persistent LBP (specificity 0.90; negative likelihood ratio 0.5) and is fairly appropriate to rule in patients with a high risk of developing persistent LBP (sensitivity 0.54; positive likelihood ratio 5.3) [23].

Within the Index 'depression and maladaptive cognitions', *depression* as measured with the Zung scale ($r = 0.38$, $P < 0.01$) and *somatization* ($r = 0.34$, $P < 0.05$) as measured with the Modified Somatic Perception Questionnaire were most strongly associated with persistent LBP. In a systematic review on psychological factors as predictors of chronic LBP, Pincus *et al.* [11] emphasized the significance of *depression* and *somatization*.

These findings confirmed Hypothesis 2 of this study that psychological variables would be risk factors for developing persistent LBP. Hence, measurement of psychological factors should be included in screening tools for patients at risk of developing persistent LBP. Early identification of these patients will facilitate the provision of necessary treatment to reduce the societal and financial burden of persistent LBP and avoid major loss in enjoyment of life.

In this study of patients with acute LBP from a primary care setting psychological factors at baseline correlated with a progression to persistent LBP. The benefit of including factors such as 'depression and maladaptive cognition' in screening tools is that these factors can be addressed in primary [24] and secondary [25] prevention.

Key points

- Findings from this study confirm the requirement for measurement of 'depression and maladaptive cognitions' in screening tools for patients at risk of developing persistent low back pain.
- Psychological factors at baseline correlated with a progression to persistent low back pain up to 6 months.
- The benefit of including factors such as 'depression and maladaptive cognitions' in screening tools is that these factors can be addressed in primary and secondary prevention.

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Conflicts of interest

None declared.

References

1. Katz JN. Lumbar disc disorders and low-back pain: socioeconomic factors and consequences. *J Bone Joint Surg Am.* 2006;**88(Suppl. 2):**21–24.
2. Hilfiker R, Bachmann LM, Heitz CAM, Lorenz T, Joronen H, Klipstein A. Value of predictive instruments to determine persisting restriction of function in patients with subacute non-specific low back pain. Systematic review. *Eur Spine J* 2007;**16:**1755–1775.
3. Pincus T, Santos R, Breen A, Burton AK, Underwood M. A review and proposal for a core set of factors for prospective cohorts in low back pain: a consensus statement. *Arthritis Rheum* 2008;**59:**14–24.
4. Melloh M, Elfering A, Egli Presland C *et al.* Identification of prognostic factors for chronicity in patients with low back pain: a review of screening instruments. *Int Orthop* 2009;**33:**301–313.
5. Elfering A. Work-related outcome assessment instruments. *Eur Spine J* 2006;**15(Suppl. 1):**S32–S43.
6. Elfering A, Mannion AF. Epidemiology and risk factors of spinal disorders. In: Boos N, Aebi M, ed. *Spinal*

Disorders—Fundamentals of Diagnosis and Treatment. Berlin, Germany: Springer, 2008; 153–173.
7. Linton SJ. Occupational psychological factors increase the risk for back pain: a systematic review. *J Occup Rehabil* 2001;**11:**53–66.
8. Waddell G, Burton AK. Occupational health guidelines for the management of low back pain at work: evidence review. *Occup Med (Lond)* 2001;**51:**124–135.
9. Abraham R. The role of job control as a moderator of emotional dissonance and emotional intelligence-outcome relationships. *J Psychol* 2000;**134:**169–184.
10. Hochschild A. *The Managed Heart: Commercialization of Human Feeling*. Berkeley, CA: University of California Press, 1983.
11. Pincus T, Burton AK, Vogel S, Field AP. A systematic review of psychological factors as predictors of chronicity/disability in prospective cohorts of low back pain. *Spine* 2002;**27:**E109–E20.
12. Mannion AF, Elfering A. Predictors of surgical outcome and their assessment. *Eur Spine J* 2006;**15(Suppl. 1):**S93–S108.
13. Schade V, Semmer N, Main CJ, Hora J, Boos N. The impact of clinical, morphological, psychosocial and work-related factors on the outcome of lumbar discectomy. *Pain* 1999;**80:**239–249.
14. Leeuw M, Goossens ME, Linton SJ, Crombez G, Boersma K, Vlaeyen JW. The fear-avoidance model of musculoskeletal pain: current state of scientific evidence. *J Behav Med* 2007;**30:**77–94.
15. Rolli Salathé C, Melloh M, Mannion AF *et al*. Low back pain-related work absenteeism in Switzerland: a test of prognostic factors from work and other life domains. *J Occup Health*, in press.
16. Vuori IM. Dose-response of physical activity and low back pain, osteoarthritis, and osteoporosis. *Med Sci Sports Exerc* 2001;**33(6 Suppl):**S551–86; discussion 609–610.
17. Melloh M, Aebli N, Elfering A *et al*. Development of a screening tool predicting the transition from acute to chronic low back pain for patients in a GP setting: protocol of a multinational prospective cohort study. *BMC Musculoskelet Disord* 2008;**9:**167.
18. Balague F, Mannion AF, Pellise F, Cedraschi C. Clinical update: low back pain. *Lancet* 2007;**369:**726–8.
19. Airaksinen O, Brox JI, Cedraschi C *et al*. Chapter 4. European guidelines for the management of chronic nonspecific low back pain. *Eur Spine J* 2006;**15(Suppl. 2):** S192–S300.
20. van Tulder M, Becker A, Bekkering T *et al*. Chapter 3. European guidelines for the management of acute nonspecific low back pain in primary care. *Eur Spine J* 2006;**15(Suppl. 2):**S169–S91.
21. Fairbank JC, Couper J, Davies JB, O'Brien JP. The Oswestry low back pain disability questionnaire. *Physiotherapy* 1980;**66:**271–273.
22. Fairbank JC, Pynsent PB. The Oswestry Disability Index. *Spine*. 2000;**25:**2940–2952; discussion 52.
23. Bossuyt PM, Reitsma JB, Bruns DE *et al*. Towards complete and accurate reporting of studies of diagnostic accuracy: the STARD initiative. *Fam Pract* 2004;**21:**4–10.
24. Buchbinder R, Jolley D, Wyatt M. Population based intervention to change back pain beliefs and disability: three part evaluation. *BMJ* 2001;**322:**1516–1520.
25. Burton AK, Waddell G, Tillotson KM, Summerton N. Information and advice to patients with back pain can have a positive effect. A randomized controlled trial of a novel educational booklet in primary care. *Spine (Phila Pa 1976)* 1999;**24:**2484–2491.
26. Craig CL, Marshall AL, Sjostrom M *et al*. International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc* 2003;**35:** 1381–1395.