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Original Article

Predictors of Sickness Absence in Patients with a New Episode of Low Back Pain in Primary Care

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Abstract: This study examines predictors of sickness absence in patients presenting to a health practitioner with acute/ subacute low back pain (LBP). Aims of this study were to identify baseline-variables that detect patients with a new LBP episode at risk of sickness absence and to identify prognostic models for sickness absence at different time points after initial presentation. Prospective cohort study investigating 310 patients presenting to a health practitioner with a new episode of LBP at baseline, three-, six-, twelve-week and six-month follow-up, addressing work-related, psychological and biomedical factors. Multivariate logistic regression analysis was performed to identify baseline-predictors of sickness absence at different time points. Prognostic models comprised 'job control', 'depression' and 'functional limitation' as predictive baseline-factors of sickness absence at three and six-week follow-up with 'job control' being the best single predictor (OR 0.47; 95%CI 0.26–0.87). The six-week model explained 47% of variance of sickness absence at six-week follow-up (p<0.001). The prediction of sickness absence beyond six-weeks is limited, and health practitioners should re-assess patients at six weeks, especially if they have previously been identified as at risk of sickness absence. This would allow timely intervention with measures designed to reduce the likelihood of prolonged sickness absence.

Key words: Low back pain, Sickness absence, Prospective cohort study, Prognosis, Predictors, Risk factors, Resources

Introduction

Most people experience acute low back pain (LBP) at least once in their lifetime[1)]. The natural history of LBP is usually favourable and most individuals recover within two to four weeks; of the remainder, most resolve within twelve weeks[2, 3)]. Those developing persistent LBP[4)] contribute to increasing socio-economic costs, e.g. due to sickness absence[5, 6)]. According to Holtermann *et al.* approximately one fifth of those employees with a current episode of LBP will experience long-term sickness absence within the next two years due to LBP[7)], with a prevalence of LBP-related sickness absence in the first year after an acute episode of LBP of just under 10%[8)].

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There is common agreement about the necessity of an early identification of patients at risk of developing persistent LBP to prevent delayed recovery including LBP-related sickness absence[9, 10]. A wide range of screening instruments are available to identify patients at risk, such as the Örebro Musculoskeletal Pain Questionnaire[9] or its modified version, the Örebro Musculoskeletal Screening Questionnaire[11] which has been adapted for acute/ subacute LBP working populations.

According to van den Heuvel *et al.* LBP disability is a prognostic factor for LBP-related sickness absence[12], while IJzelenberg *et al.* found that LBP and LBP-related sickness absence are associated with different risk factors[13]. Moreover, sickness absence is a broader construct than LBP as it has multiple determinants. In longitudinal studies determinants of future sickness absences were previous sickness absence, work characteristics, negative life events, and personality traits (e.g. Kivimäki *et al.*[14]). Thus, critical time points for the identification of patients at risk of developing persistent LBP and for the identification of acute/ subacute LBP patients at risk of sickness absence may differ.

There is a need to distinguish prognostic risk factor analyses with reference to early and longstanding courses of symptoms over time, as preliminary evidence shows differences between onset and persistence of back pain in their predictors[15]. The repeated measurement of symptoms with more than one follow-up allows new insights into the reversibility of developments[3]. The transition phases into and out of a chronic pain status should be the focus of future research endeavours[1]. First evidence increases that specific types of psychosocial risk variables may relate to distinct developmental time frames, implying that assessment and intervention need to reflect these variables at a given time[16]. More research is needed that addresses such issues, that may help clinicians to screen those patients who are at risk of developing chronic, non-specific spinal disorders as early and valid as possible[17]. The goal is to improve the odds of getting the right patient to the right treatment at the right time. Then the next task is to translate best practice recommendations from high quality research into everyday clinical practice[18].

Although evidence for prognostic factors has increased and the need for screening on those at risk for permanent unemployment[17] is beyond controversy, research has failed to generate any widespread changes in clinical practice, i.e. patient screening and early intervention strategies.

The aims of this study were twofold: (1) To identify prognostic baseline-variables that detect patients with a new LBP episode at risk of sickness absence; (2) To identify multivariate prognostic models for sickness absence at three, six, twelve weeks and six months after initial presentation. Consequently, our research questions were, first, "What are the prognostic baseline-factors for sickness absence in acute/ subacute LBP patients?" and second, "Does a baseline-predictor model predict sickness absence at three, six, twelve weeks and six months?"

We hypothesised, that (1) the best predictive value for identifying patients with LBP-related sickness absence would be achieved by work-related factors[12, 19], especially 'fear-avoidance beliefs about work activity'[3, 5]. Furthermore, we hypothesised, that (2) a baseline-predictor model would most accurately predict short-term sickness absence.

Subjects and Methods

We performed a prospective cohort study investigating 310 patients presenting to a health practitioner with a new episode of acute/ subacute LBP, or with recurrent LBP[20]. Our study was conducted according to the recommendations of the Declaration of Helsinki (2008) and was approved by the local Lower South Regional Ethics Committee (LRS/08/03/008).

We defined acute LBP as LBP with a duration of up to six weeks, and subacute LBP as LBP lasting for no longer than twelve weeks[21]. Recurrent LBP was defined according to Stanton *et al.* as LBP with a minimum of 30 pain-free days between the last two LBP episodes and a pain score on the Visual Analogue Scale (VAS) higher than 20 out of a maximum of 100 points[22]. The protocol of our study has been published previously[20].

Outcome measure

Sickness absence was assessed by the question: "During the last week, how many days did low back pain or leg pain keep you from going to work or school?" The number of days (range 0–x) was recoded into 0 (=no day) and 1 (one or more days).

Patients were consecutively recruited from 14 health practitioners (twelve general practitioners and two physiotherapists) across New Zealand from all districts from both North and South Island. We included patients between 18 and 65 yr of age, being able to read and write in English, and having provided written consent. Patients were excluded from our study when they were retired, were suffering from chronic LBP (defined as LBP > twelve weeks at time of first presentation to a health practitioner)[23, 24],

had specific LBP (e.g. tumour, infection, etc.)[21], had a comorbidity compromising their overall well-being (e.g. severe osteoarthritis of hip or knee joint), were pregnant, were unable to complete questionnaires, or had no LBP at the time of the screening interview.

The patient sample was representative for the New Zealand population regarding occupation and employment status. The typical approach for acute LBP management in the clinical setting was pain medication in the first instance; the extent of physical therapy was 30%; other physical rehabilitation strategies included exercise therapy (20%), osteopathy (11%), acupuncture (6%) and chiropractic (5%).

First, all potential participants were screened using at standardised, structured telephone interview. If eligible they were sent a baseline questionnaire which they were asked to return within one week. Patients were followed up at three, six and twelve weeks and at six months by sending out questionnaires. Patients not returning a questionnaire were sent reminders after one and two weeks. Ten dollar grocery, fuel or book vouchers were provided as compensation for their time for each returned questionnaire.

Candidate predictor variables assessed

We accessed potential work-related ('fear-avoidance beliefs about work activity', 'job control', 'resigned attitude towards the job', 'social support at work'), psychological ('depression') and biomedical ('functional limitation', 'physical health') predictors of sickness absence.

The fear-avoidance beliefs questionnaire comprises a seven-item work scale (range 0–42) addressing patients' beliefs about how work activity affect their LBP; higher scores are associated with higher amounts of fear-avoidance beliefs[25].

A short self-report version of the Instrument for Stress Oriented Task Analysis (ISTA) was used to describe job control[26]. All items have a five-point Likert format, reflecting either intensity or frequency. Job control captures aspects of method control (three items, e.g. independently plan and organize one's own work) and time control (two items, e.g. influence on work pace and schedule).

Resigned attitude towards the job implies working in the current position only because of a lack of alternatives[27]. Resigned attitude towards one's job is based on Bruggemann's concept of 'resigned job satisfaction'[28]. For an English description see Büssing[29]. Items ask, how often one has thoughts like "my job is not ideal, but it could be worse", aiming at a defensive, or resentful, adaptation to working conditions that are unfavourable[30]. The scale that contains four items has been shown to be a good predictor of treatment outcome[27].

Social support at work was assessed using the scales by Caplan *et al.*[31]. Questions ask how much people can be relied on when things get tough at work, are willing to listen to work-related problems, are helpful for getting one's job done, and are willing to listen to personal problems. They had to be answered with regard to one's supervisor, closest colleague, other colleagues and spouse/partner. The answering format was a four-point scale ranging from 1 (not at all) to 5 (absolutely). The scale has been shown to predict occupational LBP before[32].

Depression was assessed using the modified self-rating Zung Depression Index (ZDI). The modified ZDI addresses moods and sense of wellbeing over the last few weeks in13 items on a three-point scale ranging from 0 (rarely or none of the time) to 3 (most of the time) and a maximum score of 69 points[33].

The Oswestry Disability Index (ODI) assesses limitations to various activities of daily living in ten categories: pain intensity, personal care, lifting, walking, sitting, standing, sleeping, sex life, social life and travelling[34]. The total possible score of the ODI is 100%, where 0% is no or 'minimal disability'.

Physical health was measured by the Physical Component Scale of the Short Form 12 Health Survey Questionnaire (SF-12). The SF-12 is a generic questionnaire measuring general health with two different scales, 'physical' and 'mental well-being'. The minimal possible score of the SF-12 is 0% with higher values meaning better well-being. The SF-12 has been derived from the SF-36 by Ware, *et al.*[35]. Fifty SF-12 points were selected as cut-off point for good health as fifty points equate to the average values for both components within the general population[36].

Selection of the seven predictor variables was oriented by own research and theoretical underpinnings[37]. Selection of predictors was also guided by the Socio-environmental Model for Influencing Health Care Utilization and Sickness Absence[38] that includes social support at work and other psychosocial factors, as precursors of sickness absence.

Covariates

We assessed age, gender, body mass index, blue and white-collar occupation, and sickness absence in days over the last year as covariates. Blue-collar occupations (technicians, agricultural or fishery workers, craft or trades worker, plant or machine operators, elementary workers

and armed forces) were recoded into 1; white-collar occupations (legislators, senior officials, managers, professionals, clerks and service or sales worker) were recoded into 0 according to the classification by the National Institute for Occupational Safety and Health (http://www.cdc.gov/niosh/docs/2002–148/pdfs/2002–148.pdf).

Statistical analysis

Patients with self-reported sickness absence at three-, six- and twelve-week and at six-month follow-up were compared to patients without sickness absence at the same time points. However, due to restraints in study design in order to keep patients involved in the study, we could not assess all predictor variables at follow-ups. First univariate, then multivariate logistic regression analysis was performed for potential work-related, psychological and biomedical predictors of sickness absence, controlling for age, gender, body mass index, blue and white-collar occupation, and sickness absence in days over the last year. In the multivariate regression analysis all seven predictor variables entered the model simultaneously (enter modus). Sensitivity, specificity and overall predictive value for sickness absence were calculated for the final baseline-predictor model. Statistical analyses were conducted using IBM SPSS Statistics 19 (IBM Corp., Armonk, NY) and statistical significance was accepted at $p<0.05$ level.

Results

Between April 2008 and October 2010, 562 patients suffering from acute/ subacute or recurrent LBP were screened consecutively. We excluded 129 patients as ineligible for the following reasons: retired at the time of the screening interview (n=5); no LBP (n=10); chronic (n=93) or specific LBP (n=8); severe osteoarthritis of the hip or knee joint (n=2); pregnant (n=3); unavailable for follow-ups (n=2); or over 65 yr (n=6). Twenty-six patients chose not to participate; 97 did not return questionnaires.

In total, 310 were enrolled in the study; 146 were lost to follow-up. One-hundred-sixty-four patients participated over the whole study period of six months. All baseline characteristics between included patients and those lost to follow-up were similar except for a higher depression score according to the Zung self-rating depression scale ($F (1, 286) = 7.08$; $p<0.01$) and a lower mental health on the SF-12 Mental Component Scale ($F (1, 286) = 5.61$; $p<0.05$) in the group of patients lost to follow-up. Baseline characteristics of participating patients vs. patients lost to follow-up are presented in Table 1.

Characteristics of participating patients at baseline and all follow-up time points are given in Table 2. We asked whether patients did not start work again at all during each follow-up, because of LBP. The numbers are seven patients during three-week follow-up, six during six-week follow-up, seven during twelve-week follow up, and eleven during six-month follow-up. We added these numbers to Table 2. However, because of the small numbers we did not perform a statistical analysis.

Univariate analysis showed all included baseline-variables to be predictive for sickness absence at three weeks. The greater the interval between baseline-assessment and sickness absence, the smaller was the number of baseline-predictors found to be significant (Table 3).

In the multivariate logistic regression analysis, significant predictors were retained in the models at three and six-week follow-up. The odds ratios shown in Tables 4 and 5 are controlling for the other six variables in the models (to remove overlapping or redundant effects) and show unique prognostic contributions of each predictor variable.

The three-week model included 'job control' (OR 0.61; 95%CI 0.39–0.93) as the only significant predictive baseline-factor for sickness absence (sensitivity 42.9; specificity 94.7; overall predictive value 83.4). This model explained 43% of variance (Nagelkerke) of sickness absence ($p<0.001$; Table 4).

The six-week model comprised 'job control', 'depression' and 'functional limitation' as significant predictive baseline-factors for sickness absence (sensitivity 47.8; specificity 97.9; overall predictive value 90.9) with 'job control' being the best single predictor (OR 0.47; 95%CI 0.26–0.88). This model explained 47% of variance (Nagelkerke) of sickness absence ($p<0.001$; Table 5).

Despite some univariate associations of baseline variables with sickness absence at twelve weeks and six months (Table 3), there were no significant predictors retained in the multivariate models (data not shown).

Discussion

The best prognostic baseline-factors to predict sickness absence in patients with a new episode of LBP were 'job control', 'depression' and 'functional limitation'. This is in agreement with the common consensus on early identification of patients at risk of developing persistent LBP to prevent delayed recovery, including LBP-related sickness absence[9, 10].

Therefore, we could partially confirm Hypothesis 1 that the best predictive value for identifying acute/ subacute

Table 1. Baseline characteristics of participating patients vs. patients completed vs. patients lost to follow-up

	Variables	Participants (n=310)			Completed (n=164)			Lost to follow-up (n=146)		
		Mean	SD	(n[%])	Mean	SD	(n[%])	Mean	SD	(n[%])
Demographics	Age	34.7	12.3		33.6	11.9		35	12.6	
	BMI	28	6		28	6		28	6	
	Female			206 (67%)			102 (62%)			104 (71%)
	Ethnicity									
	NZ European			228 (74%)			124 (76%)			104 (72%)
	Maori			11 (4%)			4 (2%)			7 (5%)
	Maori/NZ European			18 (6%)			9 (5%)			9 (6%)
	Other			53 (17%)			27 (16%)			26 (17%)
Lifestyle factors	Smoking (pack/years)	61	69		54	69		72	68	
Sick leave (days) over last year		10	41		9	40		11	41	
Pain	Sensory pain	28	18		27	18		29	18	
	Affective pain	9	13		7	9		11	16	
Pain history	Duration LBP (in days)									
	Overall duration LBP	1774	2732		1853	2727		1706	2741	
	Duration present LBP episode	21	15		21	15		21	15	
	Recurrent LBP			92 (29%)			47 (29%)			45(31%)
General health	SF-12-PCS	45	9		45	9		45	9	
	SF-12-MCS	45	11		43	11		47	10	
Functional limitation	ODI	22	13		21	12		23	13	
	Minimal disability (0–20)			166 (54%)			91 (55%)			75 (51%)
	Moderate disability (21–40)			118 (38%)			62 (38%)			56 (38%)
	Severe disability (41–60)			25 (8%)			10 (6%)			15(10%)
	Crippled (>61)			1 (0.3%)			1 (1%)			0 (1%)
Occupation	N/A			55 (18%)			22 (13%)			33 (23%)
	Legislator/senior official/manager			23 (7%)			13 (8%)			10 (7%)
	Professional			81 (26%)			47 (29%)			34 (23%)
	Technician			19 (6%)			11 (7%)			8 (5%)
	Clerk			52 (17%)			27 (17%)			25 (17%)
	Service/sales			7 (2%)			3 (2%)			4 (3%)
	Agricultural/ fishery			11 (4%)			8 (5%)			3 (2%)
	Craft/trades			28 (9%)			14 (8%)			14 (10%)
	Plant/machine operator			19 (6%)			11 (7%)			8 (6%)
	Elementary worker			11 (4%)			8 (5%)			3 (2%)
	Armed forces			4 (1%)			0 (0%)			4 (1%)
Psychological factors	Depression (ZUNG)	22	11		20	11		25	11	
	Fear-avoidance beliefs (FAB)									
	Work activity	13	10		13	10		13	10	
	Physical activity	14	6		13	6		13	6	
Work-related factors	Job satisfaction	4.3	1		4.2	1.3		4.3	1.4	
	Resigned attitude job	3.3	1.5		3.3	1.4		3.2	1.6	
	Job control	3.4	1.1		3.4	1.2		3.4	1.1	
	Social support at work	3.6	1.1		3.7	1.0		3.5	1.1	

Figures are given as mean ± SD or numbers (percentages) where appropriate; BMI=body mass index; NZ=New Zealand; LBP=low back pain; SF-12-PCS/MCS=Short Form 12 Health Survey Questionnaire physical and mental component scale; ODI=Oswestry Disability Index; ZUNG=modified Zung Depression Index.

LBP patients with LBP-related sickness absence would be achieved by work-related factors, emphasized by our findings that 'job control' was the was the only variable that had a statistically significant association with sickness absence after controlling for other predictors.

'Job control' was found to be a significant predictor of sickness absence at three- and six-week follow-up. High 'job control' can be a powerful work resource against

Table 2. Patient characteristics at baseline and different time points of follow-up

Variables	Baseline (n=310)			3wk FU (n=252)			6wk FU (n=220)			12wk FU (n=191)			6mth FU (n=164)		
	M	SD	(n[%])	M	SD	(n[%])	M	SD	(n[%])	M	SD	(n[%])	M	SD	(n[%])
Sick leave days due to LBP last wk	N/A			0.6	1.5		0.4	1.2		0.3	1.2		0.4	1.4	
Did not start work again due to LBP						7 (3%)			6 (3%)			7 (4%)			11 (7%)
ODI	22	13		20	13		18	14		17	15		15	15	
Minimal disability (0–20)			166 (54%)			156 (62%)			137 (62%)			131 (69%)			124 (75%)
Moderate disability (21–40)			118 (38%)			77 (31%)			65 (30%)			42 (22%)			27 (16%)
Severe disability (41–60)			25 (8%)			17 (7%)			16 (7%)			15 (8%)			12 (7%)
Crippled (>61)			1 (0.3%)			2 (1%)			2 (1%)			3 (2%)			2 (1%)
Fear-avoidance beliefs about work	13	10		12	17		11	9		10	9		9	9	
Depression by ZUNG	22	11		21	12		20	13		18	12		16	12	

Figures are given as mean ± SD or numbers (percentages) where appropriate; LBP=low back pain; ODI=Oswestry Disability Index; ZUNG=modified Zung Depression Index.

Table 3. Prognostic variables for sickness absence in univariate regression analysis

	B	*SE*	Wald	*p*	OR	CI (OR)
Sickness absence at three weeks						
Job control	–0.53	0.15	11.60	0.001	0.59	0.44–0.80
Resigned attitude towards the job	0.46	0.13	13.09	0.001	1.59	1.24–2.04
Fear-avoidance beliefs about work	0.08	0.02	18.66	≤0.001	1.08	1.04–1.12
Social support at work	–0.36	0.16	5.39	0.020	0.70	0.51–0.95
Depression	0.07	0.02	15.16	≤0.001	1.07	1.03–1.10
Functional limitation	0.08	0.02	27.09	≤0.001	1.09	1.05–1.12
Physical health	–0.10	0.02	23.01	≤0.001	0.90	0.87–0.94
Sickness absence at six weeks						
Job control	–0.83	0.21	16.07	≤0.001	0.43	0.29–0.65
Resigned attitude towards the job	0.49	0.16	9.83	0.002	1.63	1.20–2.21
Fear-avoidance beliefs about work	0.07	0.02	9.32	0.002	1.07	1.03–1.12
Social support at work	–0.22	0.20	1.17	0.280	0.81	0.55–1.19
Depression	0.09	0.02	14.54	0.001	1.09	1.04–1.14
Functional limitation	0.08	0.02	17.97	≤0.001	1.09	1.05–1.15
Physical health	–0.08	0.03	9.58	0.002	0.93	0.88–0.97
Sickness absence at twelve weeks						
Job control	–0.33	0.25	1.84	0.175	0.72	0.44–1.16
Resigned attitude towards the job	0.34	0.20	2.78	0.095	1.40	0.94–2.08
Fear-avoidance beliefs about work	0.07	0.03	5.24	0.022	1.07	1.01–1.13
Social support at work	–0.56	0.28	3.91	0.048	0.57	0.33–0.99
Depression	0.09	0.03	8.07	0.004	1.10	1.03–1.17
Functional limitation	0.15	0.04	16.37	0.001	1.16	1.08–1.24
Physical health	–0.14	0.04	13.23	0.001	0.87	0.80–0.94
Sickness absence at six months						
Job control	–0.49	0.24	4.23	0.040	0.61	0.38–0.98
Resigned attitude towards the job	0.26	0.20	1.68	0.195	1.29	0.88–1.90
Fear-avoidance beliefs about work	0.01	0.03	0.13	0.717	1.01	0.96–1.07
Social support at work	–0.31	0.28	1.27	0.260	0.73	0.42–1.26
Depression	0.10	0.03	9.67	0.002	1.10	1.04–1.17
Functional limitation	0.06	0.02	9.11	0.003	1.07	1.02–1.11
Physical health	–0.06	0.03	3.82	0.051	0.94	0.88–1.00

Criterion: Results are controlled for age, gender, body mass index, blue and white-collar occupation, and sickness absence in days over the last year; *B*=logistic regression coefficient; *SE*=standard error; Wald=logistic regression coefficient divided by *SE*, squared; *p*=significance level of Wald; OR=odds ratio; CI(OR)=95% confidence interval of odds ratio.

Table 4. Baseline-predictor model of sickness absence at three weeks

Baseline-predictor model	*B*	*SE*	Wald	*p*	OR	CI (OR)
Job control	–0.50	0.22	5.24	0.022	0.61	0.39–0.93
Resigned attitude towards the job	0.18	0.17	1.25	0.263	1.20	0.87–1.66
Fear-avoidance beliefs about work	0.04	0.02	2.78	0.095	1.04	0.99–1.09
Social support at work	–0.25	0.20	1.46	0.227	0.78	0.52–1.17
Depression	0.02	0.03	0.91	0.340	1.03	0.98–1.08
Functional limitation	0.03	0.03	1.72	0.190	1.03	0.98–1.09
Physical health	–0.06	0.03	3.21	0.073	0.94	0.89–1.01
R^2 = 0.43 (Nagelkerke)						
Model χ^2=62.8**, *df*=12						

Criterion: Results are controlled for age, gender, body mass index, blue and white-collar occupation, and sickness absence in days over the last year; *B*=logistic regression coefficient; *SE* = standard error; Wald = logistic regression coefficient divided by *SE*, squared; *p*=significance level of Wald; OR=odds ratio; CI(OR)=95% confidence interval of odds ratio; *df* =degree of freedom; ** = $p<0.001$; two-tailed.

Table 5. Baseline-predictor model of sickness absence at six weeks

Baseline-predictor model	*B*	*SE*	Wald	*p*	OR	CI (OR)
Job control	–0.75	0.31	5.67	0.017	0.47	0.26–0.88
Resigned attitude towards the job	0.22	0.24	0.82	0.365	1.25	0.77–2.02
Fear–avoidance beliefs about work	0.06	0.03	2.74	0.098	1.06	0.99–1.13
Social support at work	0.24	0.34	0.50	0.478	1.27	0.66–2.45
Depression	0.08	0.04	4.46	0.035	1.09	1.01–1.17
Functional limitation	0.07	0.03	3.99	0.046	1.07	1.01–1.14
Physical health	0.04	0.05	0.73	0.392	1.04	0.95–1.14
R^2 = 0.47 (Nagelkerke)						
Model χ^2=50.1**, *df*=12						

Criterion: Results are controlled for age, gender, body mass index, blue and white–collar occupation, and sickness absence in days over the last year; *B*=logistic regression coefficient; *SE*=standard error; Wald=logistic regression coefficient divided by *SE*, squared; *p*=significance level of Wald; OR=odds ratio; CI(OR)=95% confidence interval of odds ratio; *df* =degree of freedom; ** = $p<0.001$; two–tailed.

the development of persistent LBP. It includes both time control[39] and method control[40]. Time control captures the influence of work pace and schedule; method control focuses on job decision latitude containing such items as the ability to independently plan and organize one's own work[40]. Time and method control are considered to be background variables influencing the response to stressful events[40], such as an acute LBP episode that may go on to persistent LBP and prolonged sickness absence. Hence, our findings on 'job control' being the strongest predictive factor for sickness absence highlight the impact of low 'job control' on sickness absence in an acute/ subacute LBP population.

However, Meier *et al.* recently reported on the double meaning of 'job control'[41]. In individuals with an internal locus of control, 'job control' predicted lower musculoskeletal pain, whereas in persons with an external locus of control, 'job control' was associated with higher musculoskeletal pain. In contrast, in a study by Elfering *et al.* employees in adult education with high 'job control' were experiencing high musculoskeletal pain[42]. In the present study we did not assess locus of control, but we speculate that our study participants had a more internal locus of control and consequently, low 'job control' predicted LBP and LBP-related sickness absence.

Furthermore, psychological ('depression') and biomedical factors ('functional limitation') proved to be significant predictors of sickness absence. Wynne-Jones *et al.* showed in a general practitioner setting in the UK, that LBP consulters had higher depression scores when being on sick leave[43]. This association between 'depression' and sickness absence was confirmed recently by Lexis *et al.*'s findings of a high relative risk for long-term sickness absence in depressed employees from a large general working population[44]. Moreover, the association between 'functional limitation' and LBP-related sickness absence is

in accordance with findings from the literature[5, 12].

When patients with acute/ subacute LBP go on to develop persistent LBP some, though not all, of the significant prognostic factors of sickness absence change. Young *et al.* showed, in a recent study on patients attending a general practitioner with persistent LBP lasting three months or longer, that 'physical health' was the strongest predictor for interference with sickness absence[45]. Another significant factor in the previous study was 'depression', a factor also found as baseline-predictor for sickness absence at six weeks in our study. Unlike the current study, Young *et al.* did not identify 'functional limitation' as a predictor for sickness absence, whereas both studies concurred that 'social support' was not a predictor. The other three variables assessed in our study ('job control', 'resigned attitude towards the job', 'fear-avoidance beliefs') had not been by investigated by Young *et al.*[45]. This comparison of the influence of acute/ subacute and persistent LBP on sickness absence underlines the paramount importance of 'depression' for LBP-related sickness absence, disregarding the duration of the LBP episode.

The baseline-predictor model accurately predicted short-term (≤ six weeks) sickness absence. Thus, Hypothesis 2 could be confirmed. This finding is in agreement with a framework and formal mathematical model of aggregation times in which the duration of a condition such as LBP determines the appropriate aggregation period: "Increasing aggregation time enhances the size of the chronic LBP-absence connection (positive moderator), but reduces the acute LBP-absence connection"[46]; i.e. for patients with acute/ subacute LBP defined by LBP up to twelve weeks duration baseline-assessment can predict sickness absence up to twelve-week time point (or short-term aggregation time).

One might argue that this categorisation is arbitrary[47]. However, the currently most commonly used categorisation of LBP into acute, subacute and chronic LBP is arbitrary as well, and matches the proposed time frames of the aggregation periods, with acute/ subacute LBP corresponding with the short-term aggregation period and chronic LBP being equivalent to mid-term[47]. Therefore, it appears reasonable to use the model by Harrison and Martocchio[47]. In the present study, no significant baseline-predictorscould be identified in the multivariate model for sickness absence at a time point beyond the six-week follow-up. According to Harrison and Martocchio[47] work stressors have their greatest effect on sickness absence in the short-term interval. With the established link between stress and 'job control' (as previously stated) it seems reasonable that 'job control' was found to be the strongest predictor of short-term sickness absence.

Hence, health practitioners have an important role to play at their initial contact with patients reporting with an acute/ subacute episode of LBP, to identify those at risk of sickness absence. As there was less support for baseline-prediction of mid- or long-term sickness absence in our study compared to short-term prediction, health practitioners should monitor risk factors during treatment. For instance, further assessment of risk factors at twelve weeks may be warranted, with health practitioners balancing the additional time requirements against prolonged sickness absence, which is an important cost driver for indirect health care costs associated with LBP-related sickness absence [48]. Indirect health care costs could be even higher when accounting for reduced work productivity due to LBP-related presenteeism[49, 50].

Additional practical implications of our findings are that an early identification of acute/ subacute LBP patients with LBP-related sickness absence allows early intervention to prevent future sickness absence. This strategy has proven effectiveness from a meta-analysis[46], and a recent study on employees with depressive complaints and a high risk of long-term sickness absence[51].

A limitation of this study is potential attrition bias. Posthoc power calculations with df=11 and largest follow-up sample size of 252 after three weeks and smallest sample size of 165 after six months for the first predictor variable job control reveal power that is lower than recommended 0.80, but ranges between (0.55 and 0.66). Thus, given the study attrition, the power of the study was a limitation and some predictors might have failed to show significant contributions to prediction of WA because of the small sample size. A further limitation is bias from common source variance that may have boosted correlations in this study. All assessments were done by questionnaire. Thus, employees may have perceived more absence days in the same way as they perceived their work characteristics to be more negative − just because they are more pessimistic than others about everything in their life[52]. Therefore, further studies should also refer to organizational documents of absenteeism and observation of work characteristics. Another limitation to take into consideration is that we did not collect cumulative data on sickness absence between baseline and different time points of follow-up. This has implications on the reliability of any predictions and has to be accounted for when drawing conclusions from our findings.

A strength of our study is that baseline characteristics of

participants and individuals lost to follow-up did not show significant differences, except for a higher depression score and lower mental health for those individuals lost to follow-up. This is typical for study populations where the healthier individuals stay in the study. Without this bias that caused variance restriction in depression within prediction of sickness absence, it is likely that the predictive value of depression would have been even higher.

Further research is warranted investigating assessment at different time points, to identify the optimal time at which to re-assess at risk acute/ subacute LBP patients in order to accurately predict sickness absence.

Conclusions

The best prognostic baseline-factors to predict sickness absence in patients with a new episode of LBP were 'job control', 'depression' and 'functional limitation'. For patients with acute/ subacute LBP, models have predictive ability for sickness absence at three and six weeks after initial presentation to a health practitioner. The prediction of sickness absence beyond six weeks is limited, and health practitioners should re-assess patients before that time point, especially if they have previously been identified as at risk of sickness absence. However, this should be considered with caution as no cumulative data on sickness absence between baseline and different time points of follow-up were collected in the present study. Should further research confirm our preliminary findings that the prediction of sickness absence beyond six weeks is limited, this would ask for timely interventions with measures designed to reduce the likelihood of prolonged sickness absence.

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References

1) Elfering A, Mannion AF (2008) Epidemiology and risk factors of spinal disorders. In: Spinal disorders − fundamentals of diagnosis and Treatment, Boos N and Aebi M (Eds.), 153–73, Springer, Berlin.
2) Andersson GB (1998) Epidemiology of low back pain. Acta Orthop Scand **(**Suppl) **281**, 28–31.
3) Elfering A, Mannion AF, Jacobshagen N, Tamcan O, Muller U (2009) Beliefs about back pain predict the recovery rate over 52 consecutive weeks. Scand J Work Environ Health **35**, 437–45.
4) Schultz IZ, Crook J, Berkowitz J, Milner R, Meloche GR (2005) Predicting return to work after low back injury using the Psychosocial Risk for Occupational Disability Instrument: a validation study. J Occup Rehabil **15**, 365–76.
5) Du Bois M, Szpalski M, Donceel P (2009) Patients at risk for long-term sick leave because of low back pain. Spine J **9**, 350–9.
6) Iles RA, Davidson M, Taylor NF (2008) Psychosocial predictors of failure to return to work in non-chronic non-specific low back pain: a systematic review. Occup Environ Med **65**, 507–17.
7) Holtermann A, Hansen JV, Burr H, Sogaard K (2010) Prognostic factors for long-term sickness absence among employees with neck-shoulder and low-back pain. Scand J Work Environ Health **36**, 34–41.
8) Grotle M, Brox JI, Glomsrod B, Lonn JH, Vollestad NK (2007) Prognostic factors in first-time care seekers due to acute low back pain. Eur J Pain **11**, 290–8.
9) Linton SJ, Boersma K (2003) Early identification of patients at risk of developing a persistent back problem: the predictive validity of the Orebro Musculoskeletal Pain Questionnaire. Clin J Pain **19**, 80–6.
10) Melloh M, Elfering A, Egli Presland C, Roeder C, Barz T, Rolli Salathe C, Tamcan O, Mueller U, Theis JC (2009) Identification of prognostic factors for chronicity in patients with low back pain: a review of screening instruments. Int Orthop **33**, 301–13.
11) Gabel CP, Melloh M, Yelland M, Burkett B, Roiko A (2011) Predictive ability of a modified Orebro Musculoskeletal Pain Questionnaire in an acute/subacute low back pain working population. Eur Spine J **20**, 449–57.
12) van den Heuvel SG, Ariens GA, Boshuizen HC, Hoogendoorn WE, Bongers PM (2004) Prognostic factors related to recurrent low-back pain and sickness absence. Scand J Work Environ Health **30**, 459–67.
13) IJzelenberg W, Molenaar D, Burdorf A (2004) Different risk factors for musculoskeletal complaints and musculoskeletal sickness absence. Scand J Work Environ Health **30**, 56–63.

14) Kivimäki M, Vahtera J, Thomson L, Griffiths A, Cox T, Pentti J (1997) Psychosocial factors predicting employee sickness absence during economic decline. J Appl Psychol **82**, 858–72.
15) Smith BH, Elliott AM, Hannaford PC, Chambers WA, Smith WC (2004) Factors related to the onset and persistence of chronic back pain in the community: results from a general population follow-up study. Spine **29**, 1032–40.
16) Linton SJ (2000) A review of psychological risk factors in back and neck pain. Spine **25**, 1148–56.
17) Waddell G, Burton AK, Main CJ (2003) Screening to identify people at risk of long-term incapacity for work. Royal Society of Medicine Press, London.
18) Foster NE (2011) Barriers and progress in the treatment of low back pain. BMC Med **9**, 108.
19) Alavinia SM, van den Berg TI, van Duivenbooden C, Elders LA, Burdorf A (2009) Impact of work-related factors, lifestyle, and work ability on sickness absence among Dutch construction workers. Scand J Work Environ Health **35**, 325–33.
20) Melloh M, Aebli N, Elfering A, Roder C, Zweig T, Barz T, Herbison P, Hendrick P, Bajracharya S, Stout K, Theis JC (2008) 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 **9**, 167.
21) van Tulder M, Becker A, Bekkering T, Breen A, del Real MT, Hutchinson A, Koes B, Laerum E, Malmivaara A (2006) Chapter 3. European guidelines for the management of acute nonspecific low back pain in primary care. Eur Spine J **15** (Suppl 2), S169–91.
22) Stanton TR, Latimer J, Maher CG, Hancock MJ (2011) A modified Delphi approach to standardize low back pain recurrence terminology. Eur Spine J **20**, 744–52.
23) Airaksinen O, Brox JI, Cedraschi C, Hildebrandt J, Klaber-Moffett J, Kovacs F, Mannion AF, Reis S, Staal JB, Ursin H, Zanoli G (2006) Chapter 4. European guidelines for the management of chronic nonspecific low back pain. Eur Spine J **15** (Suppl 2), S192–300.
24) Balagué F, Mannion AF, Pellise F, Cedraschi C (2007) Clinical update: low back pain. Lancet **369**, 726–8.
25) Waddell G, Newton M, Henderson I, Somerville D, Main CJ (1993) A Fear-Avoidance Beliefs Questionnaire (FABQ) and the role of fear-avoidance beliefs in chronic low back pain and disability. Pain **52**, 157–68.
26) Semmer NK, Zapf D, Dunckel H (1995) Assessing stress at work: a framework and an instrument. In: Work and health − Scientific basis of progress in the working environment, Svane O and Johansen C (Eds.), 105–113, Office for Official Publications of the European Communities, Luxembourg.
27) Schade V, Semmer N, Main CJ, Hora J, Boos N (1999) The impact of clinical, morphological, psychosocial and work-related factors on the outcome of lumbar discectomy. Pain **80**, 239–49.
28) Bruggemann A (1974) Zur Unterscheidung verschiedener Formen von "Arbeitszufriedenheit" [Different forms of job satisfaction]. Arbeit Leistung **28**, 281–4.
29) Büssing A (1992) A dynamic view of job satisfaction in psychiatric nurses in Germany. Work Stress **6**, 239–59.
30) Semmer NK (2003) Individual differences, work stress and health. In: Handbook of work and health psychology, Schabracq MJJ, Winnubst AM and Cooper CL (Eds.), 83–120, Wiley, Chichester.
31) Caplan RD, Cobb S, French JRP Jr., van Harrison R, Pinneau SR, Jr. (1975) Job demands and worker health. NIOSH, Washington, DC.
32) Elfering A, Semmer NK, Schade V, Grund S, Boos N (2002) Supportive colleague, unsupportive supervisor: the role of provider-specific constellations of social support at work in the development of low back pain. J Occup Health Psychol **7**, 130–40.
33) Main CJ, Waddell JP (1984) The detection of psychological abnormality in chronic low back pain using four simple scales. Curr Concepts Pain **2**, 10–5.
34) Fairbank JC, Couper J, Davies JB, O'Brien JP (1980) The Oswestry low back pain disability questionnaire. Physiotherapy **66**, 271–3.
35) Ware J, Kosinski M, Keller D (1996) A 12-item short-form health survey: construction of scales and preliminary tests of reliability and validity. Med Care **34**, 220–33.
36) Oesch P HIlfiker R, Keller S, Kool J, Schädler S, Tal-Akabi A (2007) Assessments in der muskuloskeletalen Rehabilitation. Huber, Bern.
37) Elfering A (2006) Work-related outcome assessment instruments. Eur Spine J **15** (Suppl 1), S32–43.
38) Tamers SL, Beresford SA, Thompson B, Zheng Y, Cheadle AD (2011) Exploring the role of co-worker social support on health care utilization and sickness absence. J Occup Environ Med **53**, 751–7.
39) Elfering A, Grebner S, Semmer NK, Gerber H (2002) Time control, catecholamines and back pain among young nurses. Scand J Work Environ Health **28**, 386–93.
40) Elfering A, Grebner S, Semmer N, Kaiser-Freiburghaus D, Lauper-Del Ponte S, Witschi I (2005) Chronic job stressors and job control: Effects on event-related coping success and well-being. J Occup Organ Psychol **78**, 237–52.
41) Meier LL, Semmer NK, Elfering A, Jacobshagen N (2008) The double meaning of control: three-way interactions between internal resources, job control, and stressors at work. J Occup Health Psychol **13**, 244–58.
42) Elfering A, Grebner S, Gerber H, Semmer NK (2008) Workplace observation of work stressors, catecholamines and musculoskeletal pain among male employees. Scand J Work Environ Health **34**, 337–44.
43) Wynne-Jones G, Dunn KM, Main CJ (2008) The impact of low back pain on work: a study in primary care consulters. Eur J Pain **12**, 180–8.
44) Lexis MA, Jansen NW, van Amelsvoort LG, Huibers MJ,

Berkouwer A, Tjin ATG, van den Brandt PA, Kant IJ (2012) Prediction of long-term sickness absence among employees with depressive complaints. J Occup Rehabil **22**, 262–9.
45) Young RA, Benold T, Whitham J, Burge S (2011) Factors influencing work interference in patients with chronic low back pain: A Residency Research Network of Texas (RRNeT) study. J Am Board Fam Med **24**, 503–10.
46) Martocchio JJ, Harrison DA, Berkson H (2000) Connections between lower back pain, interventions, and absence from work: A time-based meta-analysis. Person Psychol **53**, 595–624.
47) Harrison DA, Martocchio JJ (1998) Time for absence: A 20-year review of origins, offshoots, and outcomes. J Manage **24**, 305–50.
48) Göbel H (2001) [Epidemiology and costs of chronic pain syndromes exemplified by specific and unspecific low back pain]. Schmerz **15**, 92–8 (in German).
49) Mannion AF, Horisberger B, Eisenring C, Tamcan O, Elfering A, Muller U (2009) The association between beliefs about low back pain and work presenteeism. J Occup Environ Med **51**, 1256–66.
50) Wieser S, Horisberger B, Schmidhauser S, Eisenring C, Brugger U, Ruckstuhl A, Dietrich J, Mannion AF, Elfering A, Tamcan O, Muller U (2011) Cost of low back pain in Switzerland in 2005. Eur J Health Econ **12**, 455–67.
51) Lexis MA, Jansen NW, Huibers MJ, van Amelsvoort LG, Berkouwer A, Tjin ATG, van den Brandt PA, Kant I (2011) Prevention of long-term sickness absence and major depression in high-risk employees: a randomised controlled trial. Occup Environ Med **68**, 400–7.
52) Semmer NK, Grebner S, Elfering A (2004) Beyond self-report: using observational, physiological, and situation-based measures in research on occupational stress. In: Emotional and physiological processes and positive intervention strategies, Research in Occupational Stress and Well-being, Perrewé PL and Ganster DC (Eds.), Vol iii. JAI, Amsterdam.