International Journal of Occupational Safety and Ergonomics (*JOSE*) 2013, Vol. 19, No. 1, 29–40

Occupational, Personal and Psychosocial Resources for Preventing Persistent Low Back Pain

Markus Melloh

Western Australian Institute for Medical Research, University of Western Australia, Nedlands, Australia

Cornelia Rolli Salathé
Achim Elfering
Anja Käser

Institute of Psychology, University of Berne, Berne, Switzerland

Thomas Barz

Department of Orthopaedic Surgery, Asklepios Klinikum Uckermark, Schwedt/Oder, Germany

Emin Aghayev
Christoph Röder

MEM Research Center, University of Berne, Berne, Switzerland

Jean-Claude Theis

Dunedin School of Medicine, University of Otago, Dunedin, New Zealand

The aim of this prospective cohort study was to identify modifiable protective factors of the progression of acute/subacute low back pain (LBP) to the persistent state at an early stage to reduce the socioeconomic burden of persistent LBP. Patients attending a health practitioner for acute/subacute LBP were assessed at baseline addressing occupational, personal and psychosocial factors, and followed up over 12 weeks. Pearson correlations were calculated between these baseline factors and the presence of nonpersistent LBP at 12-week follow-up. For those factors found to be significant, multivariate logistic regression analyses were performed. The final 3-predictor model included job satisfaction, mental health *and* social support. *The accuracy of the model was 72%, with 81% of nonpersistent and 60% of persistent LBP patients correctly identified. Further research is necessary to confirm the role of different types of social support regarding their prognostic influence on the development of persistent LBP.*

occupational health outcomes low back pain predictors prognosis prospective cohort study

Correspondence should be sent to Markus Melloh, Western Australian Institute for Medical Research (WAIMR), University of Western Australia, Nedlands, WA 6009, Australia. E-mail: markus.melloh@uwa.edu.au.

1. INTRODUCTION

Socioeconomic costs of persistent low back pain (LBP) exceed the costs of acute and subacute LBP by far [1, 2]. This makes the early identification of modifiable factors of the progression of acute/subacute LBP to the persistent state essential, especially in working populations [3, 4, 5]. The differentiation of these modifiable factors into protective versus risk factors for the development of persistent LBP should be considered [6, 7]. Thereby, modifiable protective and risk factors could be addressed proactively, e.g., in workplace interventions, to limit the associated socioeconomic burden.

According to a recently published systematic review on prognostic factors for persistent LBP, there is strong evidence for depression as a predictor for persistent LBP [8]. Thus, it can be speculated that good mental health as an antagonist of depression may be a resource for preventing the development of persistent LBP. This assumption is partially supported by findings from a review on ill mental health that could show that improved mental health leads to a reduction in work absenteeism [9], the biggest cost driver in persistent LBP. In comparison, there is conflicting evidence on the role of social support as resource with a buffer effect on stress [10, 11, 12]. However, stress is associated with musculoskeletal pain [13] and might, consequently, contribute to the development of persistent LBP. Finally, there is good evidence on the positive effect of job satisfaction on the prevention of persistent LBP [14].

The Multinational Musculoskeletal Inception Cohort Study (MMICS) Statement recommends the use of internationally accepted measures within broader domains [15]. According to this review on prognostic factors for persistent LBP, occupational, personal and psychosocial factors are among those factors with the highest reliability. These factors should be part of a minimum set of prognostic measures [4]. Consequently, this study focused on occupational, personal and psychosocial prognostic factors for preventing the development of persistent LBP.

On the basis of these findings from the literature and own research [16, 17, 18, 19], we hypothesised that (a) job satisfaction would be an occupational resource for the prevention of persistent LBP, (b) mental health would be a personal resource and (c) social support would be a psychosocial resource to prevent the development of persistent LBP.

2. SUBJECTS AND METHODS

Our study was performed according to the recommendations of the Declaration of Helsinki [20] and was approved by the local Lower South Regional Ethics Committee (LRS/08/03/008). An inception cohort of 315 patients was consecutively recruited from 14 health practitioners' clinics across New Zealand from all districts from both North and South Island with equally distributed low, medium and high socioeconomic status. The patient sample was representative for the New Zealand population regarding demographic characteristics, occupational and employment status. According to the classification by the National Institute for Occupational Safety and Health [21], we coded technicians, agricultural or fishery workers as craft or trades workers; plant or machine operators, elementary workers and armed forces as blue collar occupations; legislators, senior officials, managers, professionals, clerks and service or sales worker were coded as white-collar occupations. Participants were asked to take part in the study when attending a health practitioner for their first episode of acute/subacute LBP or for recurrent LBP. The latter was defined in accordance with Stanton, Latimer and Maher, et al. as LBP with a least 30 LBP-free days between two episodes and exceeding 20 out of 100 points on a visual analogue scale [22].

To be eligible, patients had to be 18–65 years old (the legal retirement age in New Zealand), 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 over 12 weeks at the time of the first visit to a health practitioner) [23, 24], specific LBP (infection, tumour, osteoporosis, ankylosing spondylitis, fracture, deformity, inflammatory process, cauda equina syndrome) [25], 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 with a standardised, structured telephone interview addressing all eligibility criteria. If eligible, patients were sent a baseline questionnaire by mail and asked to return it within one week. Follow-up questionnaires were sent out after 3, 6 and 12 weeks. Baseline and follow-up questionnaires were based on the recommendations of the MMICS Statement addressing potential occupational, personal and psychosocial resources preventing the development of persistent LBP [15]. However, due to restraints in study design to keep patients involved in the study, we could not assess all predictor variables at follow-ups. If not returned, a reminder was sent out after 1 and 2 weeks. As compensation of their time, participants received 10-NZD[1] vouchers for each returned questionnaire.

Selection of the candidate predictors was oriented by own research and theoretical underpinnings [16]. Selection of predictors was also guided by the socioenvironmental model for influencing health care utilisation that includes social support and other psychosocial factors [26].

The *job satisfaction* measure assesses general job satisfaction [27]. It is a combined score of 4–28 points with 28 indicating the highest job satisfaction. The original scale has four items, one of which is a Kunin-item asking "How satisfied are you in general with your work?" (1 = *exceedingly unsatisfied*, 7 = *exceedingly satisfied*). The other items ask how often participants have had the following thoughts about their work: "I hope my job situation will always remain as good as it is now", "After days-off, I'm really happy to return to work" and "Unless some aspects of my work change, I will look for another job" (1 = *never*, 7 = *always*).

Mental health was measured with the Mental Component Scale of the Short Form 12 Health Survey Questionnaire (SF-12) [28]. 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 was derived from Ware and Sherbourne's SF-36 [28, 29]. Literature on the minimal clinically important difference (MCID) of the SF-12 is scarce. Copay, Glassman, Subach, et al. reported an MCID of 4.9 points for the physical well-being scale [30]. Similarly, Samsa, Edelman, Rothman, et al. propose an MCID of 3–5 for physical well-being of the SF-36 [31]. According to Samsa et al., comparable effect sizes can be found for physical and mental well-being when employing either SF-36 or SF-12. Therefore, it seems legitimate to transfer the MCID of 3–5 from the SF-36 to both scales of the SF-12. In this study, 5 was chosen as an MCID for both scales of the SF-12 further supported by Copay et al.'s MCID of 4.9. Fifty SF-12 points were selected as a cut-off point for good health as 50 points is the average value for both components within the general population [32].

Social support was assessed with Caplan, Cobb, French, et al.'s scale [33]. It is a combined score of 6–30 points with higher scores expressing higher social support. 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 in getting one's job done and are willing to listen to personal problems. They are answered with regard to one's supervisor, closest colleague, other colleagues and spouse/partner on a 5-point scale from 1 (*not at all*) to 5 (*absolutely*). The scale has been shown to predict occupational LBP [12].

Statistical Analysis

Patients with nonpersistent LBP at 12-week follow-up were compared to patients with persistent LBP at 12-week follow-up. Nonpersistent LBP was defined by functional limitation with the Oswestry disability index (ODI). The ODI assesses limitations to various activities of daily living in 10 categories: pain intensity, personal care, lifting, walking, sitting, standing, sleeping,

[1] 10 NZD = 8.4 USD = 6.3 EUR

sex life, social life and travelling [34]. The total possible score of the ODI is 100, where 0 is no or minimal disability. As the normal value for the ODI in a general population is 10 points [35], patients with an ODI score under or equal 10 at 12-week follow-up were considered to have nonpersistent LBP [36]. Additionally, a 10-point change is considered to be the ODI's MCID [37]. Therefore, ODI change scores decrease between baseline and 12-week follow-up that exceeded 10 points also defined patients with nonpersistent LBP. All patients with an ODI score over 10 and under a 10-point change score were defined as persistent LBP.

Pearson correlations identified baseline variables associated with nonpersistent LBP at 12 weeks. Univariate regression analysis performed on these variables determined odds ratios (*OR*) of nonpersistent LBP at 12-week follow-up, controlling for age, gender and body mass index (BMI) as potential confounding variables. The retained variables were entered into multivariate logistic regression to identify a final predictor model, again controlling for age, gender and BMI. Data was analysed with IBM SPSS Statistics 19 (IBM, USA). Statistical significance was set at $p < .05$, two-tailed.

3. RESULTS

In total, 562 patients suffering from acute or subacute LBP were screened consecutively from April 2008 until October 2010. One hundred and twenty-four patients were found ineligible because they were either LBP-free at the time of the screening interview (10), had chronic LBP for over 12 weeks (93), had specific LBP (8), had osteoarthritis of the hip or knee joint (2), were pregnant (3), were not available for follow-ups (2) or were over 65 years of age (6). Twenty-six patients decided not to participate and 97 did not return the baseline questionnaire in spite of two reminders. Three hundred and fifteen patients were enrolled, 120 patients were lost to follow-up and 195 patients participated over the 12-week period. Table 1 shows baseline characteristics of the participants and the individuals lost to follow-up.

The loss-to-follow-up was consistently ~15% at each follow-up time point (Table 2).

Individuals lost to follow-up showed significantly worse mental health measured with the SF-12 mental component scale [29], had significantly higher alcohol consumption and were of significantly younger age. All other baseline characteristics did not demonstrate any significant difference. Drop-out analysis revealed a significant bias for differences in included variables between different follow-up time points (Little's MCAR [missing completely at random] test, sig. = .11).

One hundred and six patients at 12-week follow-up were classified as nonpersistent, 89 (46%) as persistent. ODI baseline scores in the nonpersistent group were 0–62 points ($M = 18.7$), scores in the persistent group were 12–60 points ($M = 26.0$), revealing a lower functional limitation at baseline for the nonpersistent LBP group based on differences in means ($p < .001$).

Table 3 shows patient characteristics at baseline and at different follow-up time points for the nonpersistent LBP group.

Job satisfaction ($r = .26$, $p < .001$); *mental health* ($r = .32$, $p < .001$) and *social support* ($r = .30$, $p < .001$) at baseline correlated with nonpersistent LBP at 12-week follow-up. The odds of having nonpersistent LBP at 12-week follow-up were 1.39 for *job satisfaction* (95% CI [1.10, 1.75]); 1.06 for *mental health* (95% CI [1.03, 1.10] and 2.05 for *social support* (95% CI [1.42, 2.96]).

Multivariate regression analysis revealed a final three-predictor model comprising *mental health* and *social support* with the three covariates of age, gender and BMI ($\chi^2 = 34.7$, $df = 6$, $p < .001$; Table 4).

All predictors and covariates predicted 24% of the variance in nonpersistent LBP (Nagelkerke R^2). The lack of significance of the χ^2 Hosmer-Lemeshow test indicated that this final predictor model had a good fit for the data. The overall accuracy was the percentage of individuals who were correctly predicted either to have persistent pain (true positives) or to have nonpersistent pain (true negatives). Thus, the overall accuracy of the model was 72%, with 81% of nonpersistent LBP patients (true negatives) and 60% of persistent (true positives) correctly identified.

TABLE 1. Health Characteristics of Participants Who Completed 12-Week Follow-Up Versus Participants Lost to Follow-Up

Variables	Completed (*n* = 195)	Lost (*n* = 120)	*p*
Pain history	1782 (2831)	1926 (2733)	.659
duration LBP			
LBP (days); *M* (*SD*)			
present LBP episode (days); *M* (*SD*)	21 (15)	21 (15)	.940
recurrent[a] LBP; *n* (%)	53 (27)	39 (33)	.313
Radiating pain; *n* (%)			
radiating pain below knee	35 (18)	13 (11)	.086
Lifestyle factors			
IPAQ score (physical activity); *n* (%)			.783
low	24 (13)	15 (13)	
moderate	110 (58)	70 (60)	
high	57 (30)	33 (28)	
smoking status[b]; *n* (%)	81 (42)	51 (43)	.867
pack/years[b,c]; *M* (*SD*)	52 (67)	81 (72)	.058
increased alcohol consumption[d]; *n* (%)	76 (39)	62 (52)	.027
Marital status; *n* (%)			
never married	82 (43)	58 (49)	.543
currently married	79 (41)	48 (41)	
separated	5 (3)	3 (3)	
divorced	16 (8)	7 (6)	
widowed	3 (2)	0 (0)	
cohabiting	7 (4)	2 (2)	
Education status; *n* (%)			
no formal schooling	1 (1)	1 (1)	.594
incomplete primary school	2 (1)	2 (2)	
primary school	10 (5)	7 (6)	
secondary school	31 (16)	15 (13)	
high school	54 (28)	42 (35)	
college/university	77 (40)	41 (34)	
postgraduate degree	20 (10)	12 (10)	
Work characteristics			
employment status; *n* (%)			.174
full-time original work	75 (39)	35 (29)	
full-time lighter work	6 (3)	5 (4)	
part-time	34 (17)	25 (21)	
not working, disability	15 (8)	3 (3)	
homemaker	18 (9)	18 (15)	
retired	4 (2)	1 (1)	
unemployed	9 (5)	5 (4)	
student	34 (17)	28 (23)	
sick leave (days); *M* (*SD*)	10 (46)	8 (29)	.634
occupation; *n* (%)			.829
N/A	33 (17)	25 (21)	
legislator/senior official/manager	15 (8)	8 (7)	
professional	55 (28)	26 (22)	
technician	12 (6)	7 (6)	
clerk	31 (16)	22 (18)	

TABLE 1. (*continued*)

Variables	Completed (*n* = 195)	Lost (*n* = 120)	*p*
service/sales	5 (3)	2 (2)	
agricultural/fishery	7 (4)	4 (3)	
craft/trades	15 (8)	13 (11)	
plant/machine operator	11 (6)	9 (8)	
elementary worker	8 (5)	3 (2)	
armed forces	2 (1)	2 (2)	
Compensation and benefits; *n* (%)			
LBP covered by ACC	74 (38)	48 (40)	.698
other benefits	30 (15)	22 (18)	
health insurance	29 (15)	10 (9)	
salary replacement	35 (18)	19 (16)	
healthcare replacement	34 (17)	17 (14)	
claimed lump sum	29 (15)	22 (19)	
received lump sum	8 (4)	3 (3)	
Psychological factors; *n* (%)			
DRAM classification			.061
no depression[e]	72 (37)	33 (28)	
at risk[f]	60 (31)	37 (31)	
distressed depressive[g]	32 (16)	25 (21)	
distressed somatic[h]	31 (16)	25 (21)	
Occupational factors; *M* (*SD*)			
job satisfaction	3.7 (0.9)	3.8 (1.0)	.280
General health; *M* (*SD*)			
SF-12-PCS	44 (9)	46 (9)	.127
SF-12-MCS	46 (10)	43 (11)	.012
Psychosocial factors; *M* (*SD*)			
social support			
at home	3.6 (1.1)	3.8 (1.3)	.842
at work	3.6 (1.1)	3.7 (1.3)	.948
total	3.6 (1.0)	3.7 (1.0)	.860
Demographics			
age; *M* (*SD*)	36.4 (13.1)	32.2 (11.3)	.003
BMI; *M* (*SD*)	28 (6)	28 (7)	.963
female; *n* (%)	125 (64)	84 (70)	.282
ethnicity; *n* (%)			.911
NZ European	148 (76)	85 (71)	
Maori	6 (3)	5 (4)	
Samoan	2 (1)	1 (1)	
Chinese	2 (1)	2 (2)	
Indian	4 (2)	1 (1)	
other	23 (12)	15 (13)	
Maori/NZ European	9 (5)	9 (8)	
NZ European/Maori	1 (1)	1 (1)	

Notes. LBP = low back pain; IPAQ = international physical activity questionnaire; N/A = not applicable, ACC = Accident Compensation Corporation, DRAM = distress and risk assessment method [40], SF-12 = short form 12 health survey questionnaire [28], PCS = physical component score, MCS = mental component score, BMI = body mass index, NZ = New Zealand, VAS = visual analogue scale, ZUNG = modified self-rating depression scale by Zung [38], MSPQ = modified somatic perceptions questionnaire [39]; a = as defined by Stanton, Latimer and Maher, et al. [22]: VAS > 20; at least 30 days pain-free between episodes; b = regular smokers and ex-smokers; c = (packs smoked per day) × (years as a smoker); d = defined in regards to AUDIT-C; e = ZUNG < 17; f = ZUNG 17–33, MSPQ < 12; g = ZUNG > 33; h = ZUNG 17–33, MSPQ > 12.

TABLE 2. Health Characteristics at Baseline and Different Follow-Up (FU) Time Points

Variables	Baseline (*n* = 315)	3-Week FU (*n* = 256)	6-Week FU (*n* = 224)	12-Week FU (*n* = 195)
Functional limitation				
ODI; *M* (*SD*)	22 (13)	20 (14)	19 (15)	17 (15)
minimal disability (0–20); *n* (%)	167 (53)	156 (61)	137 (61)	132 (68)
moderate disability (21–40); *n* (%)	120 (38)	72 (28)	67 (30)	43 (22)
severe disability (41–60); *n* (%)	27 (9)	26 (10)	19 (8)	17 (9)
crippled (>61); *n* (%)	1 (0.3)	2 (1)	1 (0.4)	3 (1)
General health; *M* (*SD*)				
SF-12-PCS	45 (9)	46 (9)	47 (9)	48 (9)
SF-12-MCS	45 (11)	46 (11)	47 (10)	47 (11)
Pain				
sensory pain; *M* (*SD*)	28 (18)	22 (19)	21 (20)	18 (19)
affective pain; *M* (*SD*)	9 (13)	15 (20)	15 (21)	13 (18)
total pain; *M* (*SD*)	37 (26)	37 (36)	35 (37)	31 (35)
pain intensity last week (VAS); *M* (*SD*)	37 (24)	37 (36)	28 (25)	25 (25)
present pain intensity; *n* (%)				
no pain	40 (13)	54 (21)	58 (26)	66 (34)
mild	116 (36)	104 (41)	95 (42)	71 (36)
discomforting	129 (41)	75 (29)	57 (26)	36 (18)
distressing	18 (6)	16 (6)	10 (4)	15 (8)
horrible	10 (3)	7 (3)	4 (2)	7 (4)
excruciating	2 (1)	0 (0)	0 (0)	0 (0)
Psychosocial factors; *n* (%)				
DRAM classification				
no depression[a]	105 (33)	96 (37)	116 (52)	105 (54)
at risk[b]	98 (31)	82 (32)	45 (20)	42 (21)
distressed depressive[c]	58 (19)	35 (14)	33 (15)	21 (11)
distressed somatic[d]	54 (17)	43 (17)	30 (13)	27 (14)

Notes. ODI = Oswestry disability index, SF-12 = short form 12 health survey questionnaire [28], PCS = physical component score, MCS = mental component score, VAS = visual analogue scale, DRAM = distress and risk assessment method [40], ZUNG = modified self-rating depression scale by Zung [38], MSPQ = modified somatic perceptions questionnaire [39]; a = ZUNG < 17; b = ZUNG 17–33, MSPQ < 12; c = ZUNG > 33; d = ZUNG 17–33, MSPQ > 12.

4. DISCUSSION

4.1. Main Findings

This study focused on occupational, personal and psychosocial resources for preventing persistent LBP 12 weeks after an acute/subacute episode of LBP. It centred on widely used validated assessment instruments suggested by the MMICS Statement [15]. High job satisfaction, good mental health and good social support reduced the likelihood of persistent LBP at 12 weeks.

Mental health was found to be a protective factor for the development of persistent LBP at 12-week follow-up, meaning that development of persistent LBP was less likely for patients with good mental health at baseline compared to those with poor mental health. Waddell and Burton's rehabilitation principles for LBP that mental health issues are the main obstacles to recovery, beside lack of social support, mirror these findings [37]. This was also found in this study to be a resource preventing the development of persistent LBP. On the other side, good LBP recovery might have also caused good mental health. Both relationships are possible and not mutually exclusive, and could be expected to change their relative

TABLE 3. Health Characteristics of Patients With Nonpersistent LBP at Baseline and Different Follow-Up (FU) Time Points

Variables	Baseline (*n* = 106)	3-Week FU (*n* = 106)	6-Week FU (*n* = 106)	12-Week FU (*n* = 106)
Medication				
medication taken last week; *n* (%)	N/A	63 (61)	56 (53)	57 (54)
N/A	N/A	41 (39)	29 (28)	27 (26)
analgesics	N/A	28 (27)	10 (10)	8 (8)
NSAIDS	N/A	12 (12)	1 (1)	0 (0)
strong analgesics	N/A	2 (2)	6 (6)	12 (11)
analgesics/NSAIDS	N/A	20 (19)	3 (3)	1 (1)
analgesics/NSAIDS/strong analgesics	N/A	0 (0)	0 (0)	1 (1)
analgesics/strong analgesics	N/A	0 (0)	0 (0)	0 (0)
NSAIDS/strong analgesics	N/A	1 (1)	0 (0)	0 (0)
General health				
SF-12-PCS; *M* (*SD*)	46 (10)	49 (8)	51 (8)	52 (7)
SF-12-MCS; *M* (*SD*)	49 (9)	49 (10)	50 (10)	49 (10)

Notes. Participants in the 3-week follow-up and 6-week follow-up subgroups with variable type of medication do not add up to the total number of participants due to missing data; N/A = not applicable, NSAIDS = nonsteroidal anti-inflammatory drugs, SF-12 = short form 12 health survey questionnaire [28], PCS = physical component score, MCS = mental component score.

TABLE 4. Final Logistic Regression Model Controlled for Age, Gender and Body Mass Index

Predictor at Baseline	*B*	*SE*	Wald	*p*	*OR*	CI (*OR*)
Mental health	0.06	0.02	9.45	.002	1.06	[1.02, 1.10]
Social support	0.58	0.20	8.02	.005	1.78	[1.20, 2.66]
Job satisfaction	0.11	0.15	0.55	.458	1.12	[0.84, 1.49]

Notes. R^2 = .24 (Nagelkerke), χ^2 = 34.7**, *df* = 6, **p < .001; two-tailed; *B* = logistic regression coefficient; Wald = logistic regression coefficient divided by *SE*, squared; *p* = significance level of Wald; *OR* = odds ratio; CI (*OR*) = 95% confidence interval of *OR*.

impact during the course of LBP. We assessed mental health at baseline when patients went to their general practitioner because of acute and subacute LBP. Thus, at the beginning of the study, good mental health was likely to function as a resource. However, with increasing time, good LBP recovery could have also caused good mental health.

Social support was found to be protective for the development of persistent LBP at 12-week follow-up. The variable *social support* includes the subvariables *social support at work* and *social support at home*. Furthermore, social support at work comprises emotional support and assistance by both colleagues and supervisors [41]. This study does not distinguish between different types of social support or between different sources of social support at work, i.e., between the social support at work provided by colleagues or supervisors. A future study should differentiate between support providers, as Elfering, Semmer, Schade, et al.'s [12] findings suggest that provider-specific constellations of social support at work may be either protective or risk factors for the development of persistent LBP.

In the present study, *job satisfaction* was significant in bivariate correlations but was not significant in the final predictor model, in contrast to Elfering's [16], Elfering and Mannion's [42] and Linton's [43] results. Findings from this study need to be considered in the context of its sample size. Although they should not be underestimated, protective effects in the workplace are often moderate. Large workplace protective

effects would need to be observed in a study of this size.

4.2. Limitations

A limitation of this study is attrition bias as a threat to the representativeness. However, a recent study found that attrition had only marginal influence on the point estimates of LBP-related outcomes [44]. In the present study, the loss-to-follow-up was consistently ~15% at each follow-up time point. Missing analysis showed a systematic bias in drop out across waves, which is a limitation. The total loss-to-follow-up was 46% over the whole study period. This apparently high rate should be considered in the context of a postal survey, where direct contact with the participants was limited to the initial screening interview. A recent study on 342 LBP patients presenting to a health practitioner with acute/subacute LBP were followed up six times over a 6-month period and showed a comparable loss-to-follow-up of 45% [45].

Another limitation to the generalisability of our findings is that the protective effect of mental health for the development of persistent LBP has been a conservative estimate as individuals lost to follow-up showed a significantly lower mental health status. Also the fact that those lost to follow-up had a significantly higher alcohol consumption and were significantly younger narrows the variance of the drop-out qualities alcohol consumption and age leading to a systematic bias.

Further limitations are that dynamic relations between psychological variables and health status including nonlinear correlations and recursive associations cannot be detected in correlation-based analysis and advanced statistics, and that job satisfaction, mental health and social support contain an uneven number of items. Future studies should measure resource constructs with a comparable number of items to control for biases that may arise from unequal numbers of items.

Another limitation is that resource factors were measured as perceived resources, which might have had a deceptive impact when LBP occurs and develops. Future studies should, therefore, also rely on observer data and reports from significant supervisors at work, partners and family members when assessing resources.

The final three-predictor model comprising job satisfaction, mental health and social support as predictive resources preventing the development of persistent LBP at 12-week follow-up should be interpreted cautiously. This predictor model explained 24% of variance of nonpersistent LBP at 12-week follow-up, suggesting there may be other protective factors this study did not identify. The final three-predictor model has a good ability to rule in patients likely to have nonpersistent LBP at 12-week follow-up (sensitivity .81) but is less able to rule out patients with a high risk of developing persistent LBP (specificity .60) [46].

This study's strength is that it used validated and widely used instruments only. Consistent use of outcome measures recommended by the MMCIS Statement will facilitate comparisons of results with other studies. A further strength is that baseline characteristics of participants and individuals lost to follow-up did not show significant differences, except for lower mental health, higher alcohol consumption and younger age for individuals lost to follow-up. This is typical for study populations in which the healthier individuals stay in the study.

This study confirms the importance of occupational, personal and psychosocial resources for preventing the development of persistent LBP. Resources, easily identified with widely available screening tools, will facilitate the provision of necessary strategies to reduce the societal and financial burden of persistent LBP.

4.3. Conclusions

In this study of patients with acute/subacute LBP, good *social support* reduced the likelihood of persistent LBP at 12 weeks. Further research is required to confirm the role of different types of *social support* regarding their prognostic influence on the development of persistent LBP. Furthermore, future studies should assess recovery more frequently, e.g., weekly or even daily [47] and might use texts (short message service, SMS) to collect outcomes [48].

REFERENCES

1. Katz JN. Lumbar disc disorders and low-back pain: socioeconomic factors and consequences. J Bone Joint Surg Am. 2006;88 Suppl 2:21–4.
2. Melloh M, Röder C, Elfering A, Theis JC, Müller U, Staub LP, et al. Differences across health care systems in outcome and cost-utility of surgical and conservative treatment of chronic low back pain: a study protocol. BMC Musculoskelet Disord. 2008;9:81. Retrieved January 14, 2013, from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2438357/.
3. 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(11):1755–75. Retrieved January 14, 2013, from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2223341/.
4. Melloh M, Elfering A, Egli Presland C, Roeder C, Barz T, Rolli Salathé C, et al. Identification of prognostic factors for chronicity in patients with low back pain: a review of screening instruments. Int Orthop. 2009;33(2):301–13. Retrieved January 14, 2013, from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2899092/.
5. Melloh M, Aebli N, Elfering A, Röder C, Zweig T, Barz T, 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. Retrieved January 14, 2013, from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2630319/.
6. Heneweer H, Aufdemkampe G, van Tulder MW, Kiers H, Stappaerts KH, Vanhees L. Psychosocial variables in patients with (sub)acute low back pain: an inception cohort in primary care physical therapy in The Netherlands. Spine (Phila Pa 1976). 2007;32(5):586–92.
7. Steenstra IA, Verbeek JH, Heymans MW, Bongers PM. Prognostic factors for duration of sick leave in patients sick listed with acute low back pain: a systematic review of the literature. Occup Environ Med. 2005;62(12):851–60. Retrieved January 14, 2013, from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1740930/.
8. Melloh M, Elfering A, Egli Presland C, Röder C, Hendrick P, Darlow B, et al. Predicting the transition from acute to persistent low back pain. Occup Med (Lond). 2011;61(2):127–31.
9. Michie S, Williams S. Reducing work related psychological ill health and sickness absence: a systematic literature review. Occup Environ Med. 2003;60(1):3–9. Retrieved January 14, 2013, from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1740370/.
10. Hartvigsen J, Lings S, Leboeuf-Yde C, Bakketeig L. Psychosocial factors at work in relation to low back pain and consequences of low back pain; a systematic, critical review of prospective cohort studies. Occup Environ Med. 2004; 61(1):e2. Retrieved January 14, 2013, from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1757801/.
11. Hoogendoorn WE, van Poppel MN, Bongers PM, Koes BW, Bouter LM. Systematic review of psychosocial factors at work and private life as risk factors for back pain. Spine (Phila Pa 1976). 2000; 25(16):2114–25.
12. Elfering A, Semmer NK, Schade V, Grund S, Boos N. 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. 2002;7(2):130–40.
13. Elfering A, Grebner S, Gerber H, Semmer NK. Workplace observation of work stressors, catecholamines and musculoskeletal pain among male employees. Scand J Work Environ Health. 2008; 34(5):337–44.
14. Williams RA, Pruitt SD, Doctor JN, Epping-Jordan JE, Wahlgren DR, Grant I, et al. The contribution of job satisfaction to the transition from acute to chronic low back pain. Arch Phys Med Rehabil. 1998;79(4):366–74.
15. 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(1):14–24. Retrieved January 14, 2013, from: http://onlinelibrary.wiley.com/doi/10.1002/art.23251/pdf.

16. Elfering A. Work-related outcome assessment instruments. Eur Spine J. 2006;15 Suppl 1:S32–43. Retrieved January 14, 2013, from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3454554/.
17. Melloh M, Elfering A, Chapple CM, Käser A, Rolli Salathé C, Barz T, et al. Prognostic occupational factors for persistent low back pain in primary care. Int Arch Occup Environ Health. Epub 2012 Mar 21.
18. Melloh M, Elfering A, Salathé CR, Käser A, Barz T, Röder C, et al. Predictors of sickness absence in patients with a new episode of low back pain in primary care. Ind Health. 2012;50:288–98. Retrieved January 14, 2013, from: http://www.jniosh.go.jp/en/indu_hel/pdf/IH_50_4_288.pdf.
19. Rolli Salathé C, Melloh M, Mannion AF, Tamcan Ö, Müller U, Boos N, et al. Resources for preventing sickness absence due to low back pain. Occup Med (Lond). 2012;62(4):273–80.
20. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. Adopted by the 18th general assembly, Helsinki, Finland, June 1964. Retrieved January 14, 2013, from: http://www.wma.net/en/30publications/10policies/b3/17c.pdf.
21. Work, smoking, and health. A NIOSH scientific workshop. National Institute for Occupational Safety and Health (NIOSH); 2000. Retrieved January 14, 2013, from: http://www.cdc.gov/niosh/docs/2002-148/pdfs/2002-148.pdf.
22. Stanton TR, Latimer J, Maher CG, Hancock MJ. A modified Delphi approach to standardize low back pain recurrence terminology. Eur Spine J. 2011;20(5):744–52. Retrieved January 14, 2013, from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3082681/.
23. Airaksinen O, Brox JI, Cedraschi C, Hildebrandt J, Klaber-Moffett J, Kovacs F, et al. Chapter 4. European guidelines for the management of chronic nonspecific low back pain. Eur Spine J. 2006;15 Suppl 2:S192–300. Retrieved January 14, 2013, from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3454542/pdf/586_2006_Article_1072.pdf.
24. Balagué F, Mannion AF, Pellisé F, Cedraschi C. Clinical update: low back pain. Lancet. 2007;369(9563):726–8.
25. van Tulder M, Becker A, Bekkering T, Breen A, del Real MT, Hutchinson A, 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:S169–91. Retrieved January 14, 2013, from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3454540/pdf/586_2006_Article_1071.pdf.
26. Tamers SL, Beresford SA, Thompson B, Zheng Y, Cheadle AD. Exploring the role of co-worker social support on health care utilization and sickness absence. J Occup Environ Med. 2011;53(7):751–7.
27. Baillod J, Semmer N. Fluktuation und Berufsverläufe bei Computerfachleuten [Turnover and career paths of computer specialists]. Zeitschrift für Arbeits- und Organisationspsychologie. 1994(38):152–63.
28. Ware JE Jr, Kosinski M, Keller SD. A 12-item short-form health survey: construction of scales and preliminary tests of reliability and validity. Med Care. 1996;34(3):220–33.
29. Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care. 1992;30(6):473–83.
30. Copay AG, Glassman SD, Subach BR, Berven S, Schuler TC, Carreon LY. Minimum clinically important difference in lumbar spine surgery patients: a choice of methods using the Oswestry Disability Index, Medical Outcomes Study questionnaire Short Form 36, and pain scales. Spine J. 2008;8(6):968–74.
31. Samsa G, Edelman D, Rothman ML, Williams GR, Lipscomb J, Matchar D. Determining clinically important differences in health status measures: a general approach with illustration to the

Health Utilities Index Mark II. Pharmacoeconomics. 1999;15(2):141–55.

32. Oesch P, Hilfiker R, Keller S, Kool J, Schädler S, Tal-Akabi A. Assessments in der muskuloskeletalen Rehabilitation [Assessments in musculoskeletal rehabilitation]. Bern, Switzerland: Huber; 2007.
33. Caplan RD, Cobb S, French JRP Jr, Van Harrison R, Pinneau SR Jr. Job demands and worker health (NIOSH Publication No. 75-160). Cincinnati, OH, USA: National Institute of Occupational Safety and Health (NIOSH); 1975.
34. Fairbank JC, Couper J, Davies JB, O'Brien JP. The Oswestry low back pain disability questionnaire. Physiotherapy. 1980;66(8): 271–3.
35. Fairbank JC, Pynsent PB. The Oswestry Disability Index. Spine (Phila Pa 1976). 2000;25(22):2940–52; discussion 2952.
36. Ostelo RW, Deyo RA, Stratford P, Waddell G, Croft P, Von Korff M, et al. Interpreting change scores for pain and functional status in low back pain: towards international consensus regarding minimal important change. Spine (Phila Pa 1976). 2008;33(1):90–4.
37. Waddell G, Burton AK. Concepts of rehabilitation for the management of low back pain. Best Pract Res Clin Rheumatol. 2005;19(4):655–70.
38. Main CJ, Waddell JP. The detection of psychological abnormality in chronic low back pain using four simple scales. Current Concepts in Pain. 1984;2:10–5.
39. Main CJ. The Modified Somatic Perception Questionnaire (MSPQ). J Psychosom Res. 1983;27(6):503–14.
40. Main CJ, Wood PL, Hollis S, Spanswick CC, Waddell G. The Distress and Risk Assessment Method. A simple patient classification to identify distress and evaluate the risk of poor outcome. Spine (Phila Pa 1976). 1992;17(1):42–52.
41. Semmer NK, Udris I. Bedeutung und Wirkung von Arbeit [Importance and impact of work]. In: Schuler H, editor. Lehrbuch Organsationspsychologie [Textbook of organisational psychology]. 4th ed. Bern, Switzerland: Huber; 2007. p. 157–95.
42. Elfering A, Mannion AF. Epidemiology and risk factors of spinal disorders. In: Boos N, Aebi M, editors. Spinal disorders—fundamentals of diagnosis and treatment. Berlin, Germany: Springer; 2008. p. 153–73.
43. Linton SJ. Occupational psychological factors increase the risk for back pain: a systematic review. J Occup Rehabil. 2001;11(1):53–66.
44. Schmidt CO, Raspe H, Pfingsten M, Hasenbring M, Basler HD, Eich W, et al. Does attrition bias longitudinal population-based studies on back pain? Eur J Pain. 2010;15(1):84–91.
45. Dunn KM, Jordan K, Croft PR. Characterizing the course of low back pain: a latent class analysis. Am J Epidemiol. 2006; 163(8):754–61. Retrieved January 14, 2013, from: http://aje.oxfordjournals.org/content/163/8/754.long.
46. Bossuyt PM, Reitsma JB, Bruns DE, Gatsonis CA, Glasziou PP, Irwig LM, et al. Towards complete and accurate reporting of studies of diagnostic accuracy: the STARD initiative. Fam Pract. 2004;21(1): 4–10. Retrieved January 14, 2013, from: http://fampra.oxfordjournals.org/content/21/1/4.long.
47. Tamcan O, Mannion AF, Eisenring C, Horisberger B, Elfering A, Müller U. The course of chronic and recurrent low back pain in the general population. Pain. 2010;150(3):451–7.
48. Macedo LG, Maher CG, Latimer J, McAuley JH. Feasibility of using short message service to collect pain outcomes in a low back pain clinical trial. Spine (Phila Pa 1976). 2012;37(13):1151–5.