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Prognostic factors for chronic disability from acute low-back pain in occupational health care

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Objectives This study attempted to determine the prognostic indicators of low-back pain in an occupational health setting.

Methods The identification of prognostic factors of (i) functional disability after 3 months' follow-up, (ii) functional disability after 12 months' follow-up, and (iii) time to return to work among 120 workers who reported to an occupational health unit and were off work with low-back pain for at least 10 days. Crude and adjusted odds ratios and hazard ratios with 95% confidence intervals were estimated for the 3 outcome measures.

Results Factors related to a longer time to return to work were radiating pain, high functional disability at the beginning of the study, problems in relations with colleagues, and high work tempo and work quantity. High functional disability at the beginning of the study and a high avoidance coping style predicted functional disability at 3 months. Functional disability at 12 months was more accurately predicted by work-related and psychosocial factors.

Conclusions Especially radiating pain and functional disability predict a long duration of low-back pain in occupational health practice. Occupational physicians should also note work-related and psychosocial characteristics.

Key terms functional disability, health care workers, prognosis, return to work.

Musculoskeletal disorders, especially low-back pain, are common reasons for absence from work (1). Especially for patients with chronic low-back pain, sickness absence is a major consequence of their health problems. A recent population-based prevalence study reported work absenteeism in the last 12 months for 32% of chronic patients (2). Approximately 22% of all disability pensions in The Netherlands are due to musculoskeletal disorders. About half of this musculoskeletal category consists of patients who are disabled because of low-back pain (3). Diagnoses for sickness benefits show similar figures for back pain (4).

To intervene more efficiently occupational physicians should be able to identify patients with a high risk of chronic disability. However, in spite of the magnitude of the problem, little is known about the course of and prognostic factors for low-back pain among sick employees. Most studies about this topic concern patients in general practice or patients in a rehabilitation center, and the results will differ from those involving workers on sick leave with low-back pain who visit their occupational physicians (5, 6). Patients with chronic low-back pain in primary care usually have little sickness absence, and patients from a rehabilitation center form a selection of more problematic cases (7).

In 5 prospective studies on the prognosis of acute low-back pain in an occupational health setting, only pain intensity and radicular signs were positively related to duration of sick leave or work status at follow-up in more than 1 study (8—12). Three factors, work load, age and past history, predicted outcome in only 1 of the 5 studies. Therefore, currently, there is a rather unclear and contradictory picture of prognostic indicators for the course of low-back pain in occupational health.

Therefore, we wanted to identify factors that predict long-term functional disability and long-term absence from work among patients who had recently reported sick because of low-back pain.

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Methods

Study population

Eight occupational health services for health care and university workers in The Netherlands participated in this study. Workers were eligible if they were on sick leave with low-back pain for at least 10 days and were working at a department that had approved participation. Additional criteria were pain located below the scapulae and above the gluteal fold, no consultation with the occupational physician for low-back pain in the past 3 months, not pregnant, and an understanding of Dutch. One hundred and forty-two eligible patients were identified. Of these, 120 agreed to participate in the study. The nonrespondents did not differ as to gender, age, occupation, time to return to work, and sick leave during 1 year. The patients were randomly assigned either to an occupational physician group [ie, the intervention group (N=61)] or to a reference group (N=59). Before and during the research project the occupational physicians were given guidelines for the occupational rehabilitation of low-back pain patients (13). In the reference group the patients were not sent to the occupational physician during the first 3 months of sick leave. However, 14 of these employees insisted on a consultation with the occupational physician and were allowed to have their consultations. In the analysis they were treated as belonging to the original reference group.

Data collection

Independent variables. The patients were followed for 12 months. Potential prognostic factors were assessed by a questionnaire which was filled out when the patients had given their informed consents for participation. Demographic factors, perceptions of work conditions (14), low-back pain characteristics, pain intensity (15), functional disability (16, 17), general health perception (18), coping (19), and health locus of control (health LOC) (20) were assessed. The base-line questionnaire was returned by 117 patients (98%).

Pain intensity during the week before the measurement was rated on a visual analogue scale (VAS) of 100 mm, ranging from no pain to very severe pain (15). The Roland Disability Questionnaire (RDQ) was used to assess functional disability. It has been reported to be a reliable, valid, and responsive instrument (21, 22). The RDQ contains 24 yes-no questions. The total score can range from 0 to 24, which we transformed to a 0—100 range. General health perception was measured by the Nottingham Health Profile (NHP), of which the following 4 scales were used for this study: energy (3 items), sleep (5 items), emotional reactions (9 items), social isolation (5 items). We totaled the yes answers per scale and transformed the score to the 0—100 range. The NHP has proved to be a reliable and valid instrument for various study populations (18). Scores on the scales for the perception of work conditions were also expressed on a 0—100 continuum per scale (14). We categorized occupation on the basis of job title in groups of mentally demanding work (eg, secretary), mixed mentally and physically demanding work (eg, nurse) and physically demanding work (eg, cleaner) (23). The base-line characteristics of the study population are summarized in table 1. The 75th percentile for functional disability was 75 (25th percentile 41, median 58).

Dependent variables

The return to work status was determined from computerized record systems. Return to work was defined as working as many hours as before absence. Sick leave was measured over the course of 1 year. Time to return to work was used as the main dependent variable. Sick leave data could be gathered from all the participants from computerized record systems. After 3 and 12 months data were collected on functional disability (RDQ) with patient questionnaires. After 3 months 110 questionnaires were returned (92%), and 108 questionnaires were completed after 12 months (90%). The dependent variables were blindly administered without knowledge of the prognostic factors.

Statistical analysis

A Kaplan-Meier survival curve was estimated to describe the probability of not returning to work in relation to time since inclusion. For functional disability after 3 and 12 months, respectively, the group of patients was divided into 2 subgroups with the 75th percentile as the cut-off point. The group with the highest scores (>75th percentile) was supposed to represent the most serious cases.

Each independent variable was first tested for univariate association with the dependent variables. The chi-square test was used for discrete variables, and the t-test and the Mann-Whitney U test was used for continuous variables with a normal or a nonnormal distribution, respectively. For time to return to work each independent variable was first tested for a univariate association in Cox's proportional hazards regression analyses. To reduce the number of variables, independent variables that were associated with the dependent variable at a significance level of $P<0.15$ were selected for use in the multiple logistic regression analysis or Cox proportional hazards analysis. Apart from this statistical criterion for use in the multivariate model, variables were also selected according to their practical relevancy to the work of an occupational physician. The variable "group" (ie, intervention group or reference group) was always entered in the first step because of the design of the study. Separate multivariate analyses were used for each dependent variable. Independent variables with a nonnormal distribution were recoded in a low and high score, with the 75th percentile

Table 1. Prevalence of potential prognostic factors at the inclusion of the study population (N=120). (LBP = low-back pain)

	Mean	SD	%
Patient characteristics			
Age (years)	39	8.7	.
Gender (male)	.	.	33
Smokers	.	.	33
Sporting activities (≥1 h/week)	.	.	68
Low-back pain characteristics			
Initial diagnosis			
Nonspecific LBP	.	.	76
Suspicion of root compression	.	.	24
Radiating pain			
Until knee	.	.	24
Beyond knee	.	.	38
Work-related cause of LBP	.	.	33
Duration of sick leave (d)	18	6.3	
History of LBP			
On sick leave during last year	.	.	31
On sick leave more than once	.	.	44
Pain intensity (range 0—100)	58	23	.
Functional disability (range 0—100)	58	20	.
Psychosocial characteristics			
Not enjoying work (range 0—100)	9.1	15.8	.
Coping (range 1—4):			
Not active	2.1	0.5	.
No search for social support	2.7	0.6	.
Avoidance	1.9	0.5	.
Palliative reactions	2.0	0.6	.
Health locus of control (range 1—6):			
Not internal	3.6	0.8	.
Physician directed	2.5	1.0	.
Chance	3.1	0.9	.
Perceived health (range 0—100):			
Lack of energy	42	36	.
Sleep problems	21	27	.
Emotional reactions	14	20	.
Social isolation	9	14	.
Work characteristics			
Occupation			
Mentally demanding work	.	.	25
Office workers	.	.	11
Operators	.	.	6
Various (eg, professor, photographer)	.	.	8
Mixed mentally or physically demanding work	.	.	53
Nurses and nursing aides	.	.	42
Various (eg, laboratory, surgical nurse)	.	.	12
Physically demanding work	.	.	22
Bed transport	.	.	5
Cleaning	.	.	7
Kitchen and catering	.	.	8
Various	.	.	2
Workhours	.	8.5	.
Work experience in present function (<10 years)	.	.	66
Problems with work conditions (range 0—100)			
Work tempo and work quantity	44	15	.
Physical effort	40	22	.
Emotional effort	30	14	.
Lack of participation	47	20	.
Lack of variation in work	41	21	.
Lack of independence in work	47	19	.
Problematic relations with immediate supervisor	21	16	.

as the cut-off point. In the final phase, interaction terms were added to determine whether the model could be improved. For functional disability a multiple logistic regression with a manual forward stepwise selection procedure ($P_{in}<0.05$; $P_{out}>0.10$) was used. Odds ratios (OR) and 95% confidence intervals (95% CI) were estimated for the variables in the model. Cox regression analysis was used with the same procedure for the outcome parameter "time to return to work", and hazard ratios (HR) and 95% confidence intervals (95% CI) were estimated. Odds ratios and hazard ratios for continuous variables are presented for the difference between a specific score and 10 points higher, instead of 1 point higher, to make it easier to understand. The best model was chosen on the basis of the contribution of the variables to the fit, tested with the likelihood ratio test. The rate of correct classification of all the cases has been presented, along with the rate of correct classification for the high functional disability group separately; this rate can be interpereted as the sensitivity of the model. We also examined time-dependent effects of the prognostic factors to check if the proportional hazard assumption was correct. This result was checked by the log-minus-log survival plots with 2 strata (1 stratum up to the 75th percentile score and 1 stratum above this score) of the prognostic factors. If these plots of the 2 strata crossed, the effect of the interaction term of time in months with that specific factor was assessed with time-dependent Cox regression analyses.

With the final model for time to return to work, we estimated survivor functions at 2, 3, and 6 months for 2 hypothetical patient profiles with $S(t,z) = (S_0(t))^{\exp PI}$, where $S_0(t)$ is the base-line survivor function and PI is the prognostic index for each worker, $PI_i = \beta_1(z_{1i}-z_1)+...+\beta_p(z_{pi}-z_p)$. $\beta_1,...\beta_p$ are the regression coefficients estimated by the model and $z_{1i},...z_{pi}$ are the scores on the independent significant variables for patient *i*. The mean level of a covariate for continuous variables or the score for the reference category for dichotomous variables is represented by $z_1,...z_p$ (24).

All the analyses were done with SPSS (statistical package for the social sciences) for windows 6.1.3 (SPSS Inc, IL, USA).

Results

Functional disability after 3 months of follow-up

After 3 months of follow-up the 75th percentile for functional disability dropped to 50 (25th percentile 5, median 21). Therefore, the group of employees with scores from 0 through 50 was classified as the "low functional disability" subgroup, scores 51 through 100 were classified as "high functional disability".

Patients with a high disability score at inclusion [odds ratio (OR) 1.5, 95% confidence interval (95% CI) 1.1—2.0 per 10 scale units) and a high avoidance coping style (OR 4.1, 95% CI 1.2—15) increased the chance of a high functional disability score at the 3-month follow-up. Work factors (occupation, lack of variation in work, emotional effort), pain intensity at inclusion, and lack of energy and physician-directed health locus of control were related to functional disability in the univariate analyses, but none of these factors contributed significantly to the final multivariate model (table 2). Eighty-two percent of the patients were classified correctly with this model (likelihood ratio test 13.5, df 3; P=0.004), but the sensitivity was low with highly disabled patients correctly classified in only 23% of the cases. The interaction terms did not improve the model significantly.

Some independent variables correlated with each other. For functional disability at inclusion the following correlation coefficients were found: 0.43 for pain intensity, 0.06 for avoidance coping style, 0.13 for physician-directed health locus of control, 0.47 for lack of energy, 0.43 for social isolation, -0.05 for emotional effort at work, 0.05 for lack of variation in work, 0.01 for work tempo, -0.02 for problematic relations with colleagues, 0.04 for physical effort.

Table 2. Prognostic factors for functional disability after 3 months (N=108). Univariate odds ratios (OR) and mean differences in prognostic factor between high and low functional disability; multiple logistic regression with odds ratios, adjusted for the other variables in the model. (95% CI = 95% confidence interval, LOC = locus of control)

	Functional disability after 3 months			
	Univariate OR	95% CI[a]	Adjusted OR	95% CI[b]
Patient characteristics				
Intervention group	0.74	0.29—1.9	0.92	0.32—2.6
Psychosocial characteristics				
Avoidance coping style	4.6	1.4—14	4.1	1.2—15
Physician-directed health LOC	3.4	1.2—9.4	.	.
Lack of energy	4.2	1.4—12	.	.
Work characteristics				
Occupation				
Mental	1	.	.	.
Mixed mental physical	0.74	0.22—2.5	.	.
Physical	4.0	1.1—14	.	.
Continuous prognostic factors	Mean difference	95% CI[c]	Adjusted OR per 10 scale units	95% CI[d]
Low-back pain characteristics				
Pain intensity at inclusion	12	–2.0—23	1.5	1.1—2.0
Functional disability at inclusion	14	5.1—23	.	.
Work characteristics				
Emotional effort	–6.3	–13—0.11	.	.
Lack of variation in work	10	0.72—20	.	.

[a] For univariate OR.
[b] For adjusted OR.

Functional disability after 12 months of follow-up

The 75th percentile for functional disability dropped to 34 (25th percentile 0, median 13) after 12 months. Only the psychosocial factors, lack of variation in work (OR 1.34, 95% CI 1.10—1.97 for 10 scale units higher), low emotional effort (OR 0.60, 95% CI 0.39—0.90, for 10 scale units higher), lack of energy (OR 9.9, 95% CI 2.4—41), and social isolation (OR 4.3, 95% CI 1.3—14) contributed significantly to the model for high functional disability after 12 months' follow-up (likelihood ratio test 35.6, df 5, P<.0001). Most of the factors that were related to functional disability in the univariate analyses were not significant in the final multivariate model (table 3). The model could classify 88% correctly, with a sensitivity of 58%.

Table 3. Prognostic factors for functional disability after 12 months (N=107). Univariate odds ratios (OR) and mean differences in prognostic factor between high and low functional disability; multiple logistic regression with odds ratios, adjusted for the other variables in the model. (95% CI = 95% confidence interval, LOC = locus of control)

	Functional disability after 12 months			
	Univariate OR	95% CI[a]	Adjusted OR	95% CI[b]
Patient characteristics				
Intervention group	1.2	0.51—3.0	2.2	0.70—7.0
Sporting activities	0.37	0.13—1.1	.	.
Low-back pain characteristics				
Radiating pain	3.3	1.1—9.6	.	.
Psychosocial characteristics				
Not enjoying work	3.2	1.2—9.0	.	.
Physician-directed health LOC	4.3	1.6—12	.	.
Lack of energy	7.9	2.5—25	9.9	2.4—41
Social isolation	2.4	0.98—6.0	4.3	1.3—14
Work characteristics				
Occupation				
Mental	1	.	.	.
Mixed mental physical	0.38	0.12—1.2	.	.
Physical	3.4	1.03—11	.	.
Continuous prognostic factors	Mean difference	95% CI[c]	Adjusted OR per 10 scale units	95% CI[d]
Patient characteristics				
Age	4.7	0.81—8.6	.	.
Low-back pain characteristics				
Pain intensity at inclusion	13	3.0—23	.	.
Functional disability at inclusion	11	2.2—20	.	.
Work characteristics				
Emotional effort	–10	–16—–3.9	0.6	0.4—0.9
Lack of variation in work	16	7.2—25	1.3	1.1—2.0
Work tempo and work quantity	7.0	0.54—14	.	.
Physical effort	11	1.7—21	.	.

[a] For univariate OR. [b] For adjusted OR. [c] For mean difference. [d] For adjusted OR per 10 scale units.

Belonging to a specific occupational health service seemed to be a potential confounder because this factor was related to the outcome and to some prognostic factors. However, this covariate did not influence the results of the multivariate analysis, so it was not necessary to treat "occupational health service" as a confounder.

Table 4. Prognostic factors for time to return to work (N=116) — proportional hazard ratios and 95% confidence intervals in univariate and multiple Cox's regression analyses. (95% CI = 95% confidence interval, LOC = locus of control)

	Univariate analysis		Multivariate analysis	
	Hazard ratio	95% CI	Hazard ratio	95% CI
Dichotomous prognostic factors				
Patient characteristics				
Intervention group	1.3	0.90—1.9	1.3	0.88—1.9
Low-back pain characteristics				
Radiating pain	0.52	0.35—0.77	0.45	0.30—0.70
Psychosocial characteristics				
Physician-directed health LOC	0.60	0.36—0.98	.	.
Lack of energy	0.51	0.30—0.87	.	.
Social isolation	0.63	0.42—0.95	.	.
Continuous prognostic factors per 10 scale units				
Patient characteristics				
Age	0.73	0.60—0.90	.	.
Low-back pain characteristics				
Pain intensity at inclusion	0.90	0.82—1.00	.	.
Functional disability at inclusion	0.82	0.73—0.90	0.82	0.73—0.90
Work characteristics				
Work tempo and work quantity	0.90	0.73—1.00	0.82	0.73—1.00
Problematic relations with colleagues	0.90	0.73—1.00	0.82	0.73—1.00
Time dependent covariates				
Lack of variation in work	1.02	0.98—1.17	.	.
Interaction with time in months	0.95	0.91—0.99	.	.

Time to return to work

The median time to return to work was 56 days (interquartile ranges 22—126). Three psychosocial characteristics, age, and pain intensity were only univariately related with the outcome (table 4).

Lack of variation seemed to be time-dependent because it was related to a longer time of sick leave for patients with a long period of sick leave only. However, this time-dependent factor was not significantly related to time to return to work in the final model.

In the final model (likelihood ratio test 43.4, df 5, P<0.0001) radiating pain [HR 0.45, 95% CI 0.30—0.70], high functional disability at inclusion (HR 0.82, 95% CI 0.73—0.90 for 10 scale units higher), problems in relations with colleagues (HR 0.82, 95% CI 0.73—1.00 for 10 scale units higher) and high work tempo and work quantity (HR 0.82, 95% CI 0.73—1.00 for 10 scale units higher) were related to a longer time to return to work. A hazard ratio of less than 1 indicates that the variable was associated with a longer time to return to work. For instance, a hazard ratio of 0.45 for radiating pain means that the chance of return to work was 2.2 (1/0.45) times higher for patients without radiating pain. Figure 1 shows the probability of not returning to work according to time since inclusion for the patients with a score of 70 versus 40 for functional disability. The hazard ratio for no return to work for a score of 70 compared with 40 was 0.47 (95% CI 0.34—0.64).

The probabilities of not returning to work were estimated for 2 hypothetical workers. Patient A had no radiating pain, a functional disability score of 40, and a work tempo score of 30. Patient B, at risk for long-term disability and sick leave, had a more serious profile with radiating pain, a functional disability score of 70, and a work tempo score of 60. Both patients belonged to the reference group. At 6 months, patient A had a

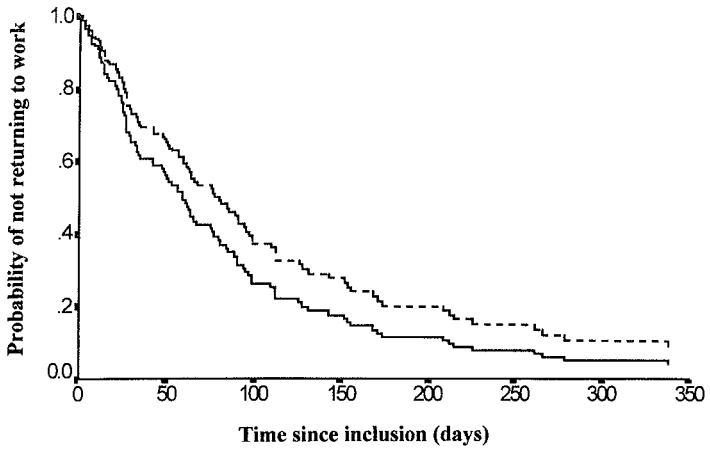

Figure 1. Cumulative probability of not returning to work in relation to functional disability.

probability of not returning to work of only 1% compared with a probability of almost 60% for patient B (table 5).

Discussion

In this study we tried to include all the workers who visited the occupational physician and were on sick leave with new episodes of low-back pain of at least 1-week duration. Therefore, we excluded patients if they had seen their occupational physician for their low-back pain in the past 3 months. We excluded patients who recovered within a week of sick leave because their rate of recovery without any intervention is very high (25). The nonrespondents in this study were similar to the respondents. Follow-up data about sick leave could be obtained for all the participants. Loss to follow-up for functional disability was only 10%. Therefore, it is plausible that our study population represents workers with new episodes of low-back pain in these occupational health services. Due to this restriction of duration of sick leave at inclusion we could not study this factor, which was found to be an important prognostic factor in other studies (6).

We hypothesized that our population in an occupational health setting differed from general practice patients and patients from a rehabilitation center. For time to return to work this hypothesis seemed to be corroborated. In our study 50% of the patients returned to work within 8 weeks and 75% within 18 weeks. In studies in a primary care setting the rate of return to work was much higher and functional disability at inclusion was lower (16, 26—28). Patients in studies in a specialized clinic or a rehabilitation center represented more chronic cases when compared with patients in this study (29—31). However, compared with other studies in an occupational health setting, our study had more serious cases (8—10). These differences in outcome probably reflect differences in the study populations at the beginning of the study, for instance, in the severity of low-back pain.

We found that radiating pain, high functional disability at inclusion, problems in relations with colleagues, and a high work tempo and work quantity were the strongest prognostic indicators for time to return to work. In other comparable studies in an occupational health care setting severity of pain or disability at the beginning of the study were consistently prognostic for duration of sick leave (8—10). Other factors that we found in our population were prognostic in some studies, but not in others. Radiating pain was also a prognostic factor for time off work in 2 studies but not in another (8—10). Relations with colleagues or co-workers was predictive in 1 study (10), but not in another (8). Work tempo and work quantity were not included in any of these 5 studies, unlike other vocational factors. Job difficulty was a significant factor in the study by Goertz (9). For physical work demands such as bending and fixed postures contradictory results were also found (8, 11). These contradictory results are probably due to the heterogeneity in the severity of low-back pain, lack of statistical power, invalid assessment of exposure or outcome, or too small a range of exposure in the study population.

Table 5. Estimated probabilities of not returning to work [$S(t,z)$] based on the final Cox's proportional hazard model.

Time since inclusion	Base-line survivor function	Patient A[a]	Patient B[b]
2 months	0.49	0.23	0.83
3 months	0.32	0.095	0.75
6 months	0.12	0.012	0.58

[a] Prognostic index = 0.71.
[b] Prognostic index = −1.38.

We found 2 models for the prognosis of functional disability which were different for the 2 follow-up periods. Functional disability at inclusion was important after 3 months, but work-related and psychosocial factors were more important prognostic factors for the 12 months of follow-up. This finding seems to support the hypothesis that psychosocial or behavioral factors become more relevant after several months of suffering from low-back pain (32, 33). However, functional disability at inclusion was correlated with psychosocial characteristics, the correlation coefficients being about 0.40. Therefore, it is possible that the difference between the 2 models can be explained by the statistical procedure of stepwise regression. In addition, we could not identify any time-dependent factors for time to return to work. However, this lack of identification could be due to the relatively small size of our study population. Others did find time-varying effects in a large study with 10 000 cases, but unfortunately they had no data on psychosocial variables (12). For a better understanding of the long-term prognosis of low-back pain, time-dependent analyses with psychosocial variables should be encouraged.

In conclusion, radiating pain and the severity of functional disability are strong predictors for time to return to work. Work and psychosocial characteristics are probably predictors of long-term functional disability.

We advise practitioners in occupational health who are involved in vocational rehabilitation in a similar setting to assess whether the pain is radiating and to assess functional disability with the Roland Disability Questionnaire. If more than 19 of the items are answered positively, the risk of not returning to work is about 2 times higher than if 5 items or less are scored. Radiating pain also raises the risk of no return to work about 2-fold, independently from the level of disability. The riskis

further increased if there are problems with co-workers and pressure from work. For workers at risk, more intensive rehabilitation procedures should be considered.

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