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Risk factors for back pain incidence in industry: a prospective study

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Abstract

The objective of this study was to examine the relationship between physical and psychological risk factors on the one hand, and the occurrence of new episodes of back pain on the other hand. A prospective study was conducted with 12 months follow-up by means of self-administered questionnaires. The study took place in the Cargo Department of a major Dutch airline company. The subjects for this study were 270 workers involved in heavy physical work. Only workers without back pain at baseline were included. Self-reported back pain and sick leave due to back pain during the follow-up period were measured. Of the 238 workers included in the analysis, 73 (31%) developed a new episode of back pain during the follow-up period, and 27 (11%) subjects reported sick leave due to back pain. Multiple logistic regression analysis showed that the history of back pain was the best predictor for the occurrence of a new episode of back pain during follow-up (OR 9.8; 95% CI 2.8–34.4 for subjects who had back pain more than twice in the past year). Low job satisfaction was also associated with an increased risk for the occurrence of back pain during follow-up (OR 1.2; 95% CI 1.01–1.4). Riding a forklift truck appeared to be a protective factor for the occurrence of back pain (OR 0.7; 95% CI 0.5–0.99). In this study the best predictors for the occurrence of back pain were the history of back complaints and low job satisfaction. Although it needs to be confirmed by future intervention studies, the results indicate that increasing job satisfaction may be a successful (co-)intervention for the prevention of back pain at the workplace.

Keywords: Back pain; Risk factors; Job satisfaction; Prospective study

1. Introduction

Back pain in industry is a major problem. Prevalences of back pain in the working population vary from 12 to 41%, depending on the profession, with a mean prevalence of 27% in the Netherlands (Hildebrandt, 1995). Furthermore, musculoskeletal disorders, of which more than 50% are back disorders, are one of the major reasons for work disability (Van der Putten, 1985; Zuidema, 1985) and sick leave (Hettinger, 1985; Zuidema, 1985). A lot of effort has been put into research concerning the association between physical working conditions and the occurrence of back pain (Venning et al., 1987; Svensson and Andersson, 1989; Johanning, 1991; Burdorf et al., 1993; Holmström et al., 1993). The majority of preventive measures in industry are aimed at reducing the impact of physical working conditions on the back, either by reducing the physical load (ergonomic adjustments, instructions on lifting techniques, lumbar supports), or by increasing the strength of the back and general fitness (exercises). Although there are indications that a relationship between physical work load and back pain exists, there is little evidence that preventive measures in this area are very effective (Lahad et al., 1994; Van Poppel et al., 1997).

A number of studies have shown that psychosocial factors can be important in the aetiology of back pain as well (Biering-Sørensen and Thomsen, 1986; Svensson and Andersson, 1989; Bigos et al., 1991; Bongers et al., 1993; Holmström et al., 1993). Furthermore, the consequences of an episode of back pain are also influenced by psychosocial factors (Linton and Bradley, 1992; Coste et al., 1994).

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These findings suggest that preventive measures dealing with physical factors only may be less effective than measures addressing multiple facets in the aetiology of back pain. However, before an optimal preventive strategy can be designed, more knowledge on the causal relationship between (psychosocial) risk factors and the occurrence of back pain is needed.

The majority of previous longitudinal studies included both subjects with and without a history of back pain. This makes it difficult to speculate on the temporal relationship between the various risk factors and the occurrence of back pain. In this study an attempt is made to evaluate the association of potential risk factors with the incidence of back pain in industry, using separate analyses for subjects without a history of back pain.

2. Subjects and methods

Originally, our study was designed as a randomised controlled trial with three intervention groups (lumbar support and education, education only, and lumbar support only) and a control group. The interventions, however, had no effect on the incidence of back pain or sick leave due to back pain. Therefore, data were re-analysed focusing on risk factors for the occurrence of a new episode of back pain, with adjustments for the intervention.

2.1. Subjects

Workers from the cargo department of a major Dutch airline company at Schiphol Airport were recruited. All workers involved with manual material handling were invited to participate. Typical tasks of the workers included the loading and unloading of cargo pallets, as well as transportation and sorting of cargo, both manually and with a forklift truck. Workers who had a permanent (partial) work disability were excluded from the study. Of 380 eligible subjects, 20 (5%) refused to participate and 312 (82%) completed the baseline measurements. Because of holidays and a high workload, workers were not always available for the study. Consequently, baseline measurements were missing for 48 (13%) workers. Subjects with self-reported back pain at baseline ($n = 42$) were excluded from the analysis presented in this paper. The study was approved by the Medical Ethical Committee of the Vrije Universiteit Amsterdam. Workers personally received information about the procedures of the study and were enrolled after giving their consent.

2.2. Risk factors and measurements

Lumbar supports were used during the first 6 months of the follow-up. Workers were instructed to wear the lumbar support at all times during working hours and to tighten the side-pulls for stronger support when performing strenuous tasks. Education was given in the form of lifting instructions, which were given by two experienced paramedical therapists and were aimed at making workers aware of their movements and postures during work. Lifting instructions were given in three group sessions (10–15 workers): the first session of 2 h took place at the start of the intervention, the other two sessions of 1.5 h each were given after 6 and 12 weeks.

At baseline a questionnaire was filled in containing questions on demographic data, history of back pain (never back pain/more than 1 year ago/once or twice in past year/more than twice in past year), and also containing the COOP/WONCA questionnaire on general health status (Scholten and Van Weel, 1992). The overall opinion of workers on their job was asked with a single question: 'Do you feel that the job you are employed for is good, reasonable, moderate, or bad?' (Dijkstra et al., 1981). Job satisfaction was determined using 25 items on the work situation from the short version of a Dutch questionnaire on work and health (Dijkstra et al., 1981). This questionnaire consists of items covering supervision and colleagues, tasks and organisation, material working conditions (e.g. smells, draft), and appreciation of the work. Each item scored yes or no. The sum-score is the number of questions answered negative divided by the total number of questions answered (range from 0 to 1). Negative in this context means that the employee had problems with the work situation covered by that particular item. A high sum-score indicates low job satisfaction. Other questions in the baseline questionnaire focused on smoking, exercise habits, the workers' attitude towards their own potential to influence their health, and time spent on various working tasks. In addition, height and weight of the workers were measured as well as trunk muscle strength: the abdominal strength was determined by the number of sit-ups a subject could perform (Oja and Tuxworth, 1995). The abdominal endurance was determined by the time a subject could maintain a partial sit-up position (Hyytiäinen et al., 1991) and the back muscle endurance by the time a subject could keep the unsupported trunk in a horizontal position (Biering-Sørensen, 1984).

During the first 6 months of the follow-up period workers received a monthly questionnaire on the occurrence of a new episode of back pain and sick leave due to back pain, as well as the number of days with back pain and/or sick leave due to back pain. The same questionnaire, covering 3 months, was filled in 9 and 12 months after the baseline measurements.

Based on the literature the following variables were considered to be potential risk factors (Table 1): the continuous variables age, trunk muscle strength (three variables), body mass index (weight/height^2), hours performing manual lifting tasks per week, hours riding a forklift truck per week, and the categorical variables history of back pain, smoking status, exercise, workers' attitude towards their own potential to influence their health, and the six dimensions of the COOP/WONCA questionnaire. The risk factor 'job satisfaction' was assessed using both the sum-score (continuous

Table 1

Variables included in the study

Individual factors
Age (years)
Employment at cargo department (years)
History of back pain
Never back pain; >1 year ago;
1 or 2 times in past year; >2 times in past year
Smoking
Yes; no
Abdominal muscle strength (no. of sit-ups, range 0–15)
Abdominal muscle endurance (range 0 to 240 s)
Back muscle endurance (range 0 to 240 s)
BMI (kg/m^2)
Exercise
<1 time per month; 1–3 times per month; >1 time per week
Attitude towards own potential to influence health
No influence; hardly any; reasonable; much influence

Psychosocial factors
Opinion on work
Good; reasonable; moderate; bad
Job satisfaction (sum score, range 0–1)

Physical factors
Riding forklift truck (h/week)
Manual lifting tasks (h/week)

COOP/WONGA questionnaire
Maximal physical exertion
Very heavy; heavy; moderate; light; very light
Emotional problems
No problems, slight, some, much, very much
Social activities
No problems, slight, some, much, very much
Daily activities
No problems, slight, some, much, very much
Change in condition
Much worse, worse, no change, better, much better
Overall health
Excellent; very good, good, moderate, bad

Intervention
Control; lumbar support and education; education; lumbar support

variable) and the single question on the overall opinion on work (good/reasonable/moderate or bad).

2.3. Statistical analysis

Potential risk factors were first evaluated in univariate analyses. In total the association of 20 variables with incident back pain was studied. Variables were preselected for the multivariate analysis, using a criteria of $P < 0.2$ in the univariate analysis (Altman, 1991). In a step-up logistic regression model the relationship between the variables and back pain incidence and sick leave due to back pain was studied. Age and intervention groups were always controlled for in the multivariate logistic regression models.

3. Results

During the 12-month follow-up period 30 of the 312 workers were lost (10%): 21 workers lost their interest in the study after the baseline measurement and nine workers were transferred to other workplaces. Of two workers data were not complete, resulting in 238 workers included in the analysis. Characteristics of the predominantly male population (236 male, 2 female) included in the analysis are listed in Table 2.

3.1. Analysis

Of the 238 workers included in the analysis, 73 (31%) reported back pain during the 12-month follow-up period, with a median of 2.0 days with back pain per month. Sick leave due to back pain was reported by 27 (11%) subjects (median of 1.5 days per month).

In the univariate analyses of the association with the incidence of back pain (Table 3), the following variables had a statistically significant association with the occurrence of a new episode of back pain: history of back pain ($P = 0.0003$), job satisfaction (sum score; $P = 0.002$), and time riding a forklift truck ($P = 0.02$). The variables age and problems with daily activities had P-values < 0.2 in the univariate analysis and were therefore retained for the multivariate analysis. Subjects with back pain in the year before the study developed back pain more often than subjects without a history of back pain. The risk of back pain also increased with decreasing job satisfaction. The overall opinion of workers on their work was not associated with incident back pain ($P = 0.30$). Also no association (univariate $P > 0.20$) with incident back pain was found for factors such as

Table 2

Characteristics of the study population

Variable	All workers $n = 238$
Age, mean (SD), years	34.3 (7.1)
Employment at Cargo Department, mean (SD), years	5.7 (5.4)
History of back pain at baseline, no. of workers (%):	
Never back pain	130 (55)
Back pain more than one year ago	40 (17)
Back pain once or twice in past year	52 (22)
Back pain more than twice in past year	16 (7)
Job satisfaction sum-score[a], mean (SD)	0.29 (0.19)

[a]The sum-score for job satisfaction has a range from 0 to 1, a high score indicates low job satisfaction.

Table 3
Risk of the occurrence of a new episode of back pain and sick leave due to back pain during follow-up

	Incidence of back pain						Sick leave due to back pain		
	Univariate analysis			Multivariate analysis			Univariate analysis[a]		
Variable	OR	95% CI	*P*	OR	95% CI	*P*	OR	95% CI	*P*
Age[b](for an increase of 10 years)	1.3	0.9–1.9	0.17	1.2	0.8–1.8	0.50	1.1	0.6–2.0	0.62
Intervention group[b]			0.77			0.49			0.38
Control	1.0			1.0			1.0		
Lumbar support and education	0.9	0.4–2.0		0.8	0.3–1.9		0.6	0.2–2.2	
Education	0.7	0.3–1.5		0.8	0.4–1.9		0.7	0.2–2.3	
Lumbar support	1.1	0.5–2.3		1.5	0.6–3.4		1.5	0.5–4.4	
History of back pain:			0.0003			0.003			0.01
Never back pain	1.0			1.0			1.0		
Back pain>1 year ago	1.4	0.6–3.2		1.1	0.5–2.5		0.6	0.1–3.0	
Back pain once or twice in past year	2.4	1.2–4.7		1.8	0.9–3.7		2.9	1.1–7.3	
Back pain more than twice in past year	11.3	3.4–37.4		9.8	2.8–34.4		5.5	1.6–18.8	
Job satisfaction[c] (for an increase in score of 0.1)	1.2	1.08–1.4	0.002	1.2	1.01–1.4	0.03	1.2	1.05–1.7	0.01
Riding forklift truck (for an increase of 10 h/week)	0.7	0.6–0.98	0.02	0.7	0.5–0.99	0.04	0.9	0.7–1.3	0.42
Problems with daily activities:			0.12						0.71
No problems	1.0			–	–		1.0		
Problems	1.6	0.9–2.8		–	–		1.2	0.5–2.7	

[a]No multivariate model was found that sufficiently explained the variance in sick leave due to back pain.
[b]Variable is forced into the multivariate analysis.
[c]The sum-score for job satisfaction has a range from 0 to 1, a high score indicates low job satisfaction.

exercise, smoking, intervention group, the workers' attitude towards their own potential to promote their health, trunk muscle strength, manual lifting tasks and body mass index. Of the COOP/WONCA questionnaire only the dimension on problems with daily activities had a P-value < 0.2.

The results of the multivariate model are shown in Table 3. After adjusting for age and intervention, the history of back pain, low job satisfaction and less time riding a forklift truck were associated with incident back pain. Adding subsequently the variable 'problems with daily activities' did not significantly improve the model. The final model predicted 19 of the 72 cases (26%), and 72% was predicted correctly overall. For sick leave due to back pain no multivariate model was found that sufficiently explained the variation of sick leave.

It is possible that job satisfaction of workers at baseline was influenced by previous episodes of back pain. To be more certain of the temporal relationship between low job satisfaction and back pain, a separate multivariate analysis for incident back pain was conducted in which only subjects without a history of back pain ($n = 130$) were included. In this analysis the variable job satisfaction was still associated with incident back pain (odds ratio 1.4; 95% CI 1.1–2.0), after adjusting for age and intervention. The amount of time riding a forklift truck was not associated with the occurrence of back pain when only subjects without a history of back pain were included in the analysis.

4. Discussion

The major limitation of the study is that it was not primarily designed as a cohort study, but as a randomised controlled trial. Nevertheless, the interventions appeared to have no effect on the incidence of back pain or sick leave due to back pain and were controlled for in the analysis. Furthermore, not all important risk factors for back pain were measured in this study. For instance, coping strategies and other psychological factors were not included, nor were all possible physical work factors measured. It is also possible that measurements of some of the risk factors were not optimal. Especially the amount of time performing various work tasks was reported by the workers themselves. Recording work tasks of all workers by video or scored by an observer would have been better, but is not feasible in a study primarily conducted as a randomised trial. Another limitation may be the homogeneous work group. The study was clearly not designed to determine the influence of various physical work tasks in relation to back pain. Therefore, the results of this study concerning physical work tasks may not be applicable for other working populations. The findings concerning history of back pain and job satisfaction, however, are probably valid for workers in other occupations as well.

The history of back pain was the strongest predictive factor for incident back pain and associated episodes of sick leave during the follow-up period. This finding has been described earlier for various occupations (Venning et al., 1987; Bigos et al., 1991, 1992; Ready et al., 1993; Smedley et al., 1997). It once more illustrates the recurrent nature of back pain.

The amount of time performing lifting tasks was not associated with the occurrence of back pain. It is, however, possible that the group of workers was too homogeneous

regarding this variable, and therefore the contrast between workers at high or low risk was too small. Another explanation could be that not only lifting tasks are putting workers at risk for back pain, but other tasks as well which were not measured explicitly. The amount of time riding in a forklift truck appeared to be a protective factor for the occurrence of back pain. Although driving vehicles by itself is considered to be a risk factor for the occurrence of back pain because of body vibration (Johanning, 1991; Burdorf et al., 1993), it could be that in this cohort of workers the time riding a forklift truck is a surrogate for the amount of time not performing heavy physical tasks and is therefore a protective factor for the incidence of back pain.

The relationship between low job satisfaction and back pain has been reported earlier in both cross-sectional studies (Holmström et al., 1993; Linton and Warg, 1993; Symonds et al., 1996) and longitudinal studies (Bigos et al., 1991, 1992) in industrial settings. In general populations results have been less consistent: a cross-sectional study reported an association between low job satisfaction and back pain among women (Svensson and Andersson, 1989), whereas a longitudinal study found no association in a general population of men and women (Biering-Sørensen and Thomsen, 1986). All previous longitudinal studies included subjects with a history of back pain in their analysis. However, previous back pain is a strong risk factor for future back pain and low job satisfaction could be caused by previous back pain. Therefore, it is difficult to study the temporal relationship between job satisfaction and back pain when subjects with previous back pain are included in the analysis, even when controlling for the history of back pain. In our analysis including only subjects without a history of back pain, job satisfaction was still associated with back pain during the follow-up period. These results suggest that low job satisfaction by itself may be causally related to back pain, or at least the reporting of back pain.

In a review of the association between psychosocial factors at work and several musculoskeletal disorders it was concluded that factors such as low control at work, social support of colleagues, time pressure and work stress seem to be related to musculoskeletal disorders (Bongers et al., 1993). The importance of psychosocial factors was also shown by the positive results of a psychosocial intervention consisting of an educational pamphlet designed to alter avoidance behaviours by encouraging a positive, active approach towards back pain (Symonds et al., 1995). These findings implicate that interventions aimed at increasing job satisfaction, changing beliefs on (causes of) back pain, and encouraging a positive attitude towards back pain may be effective in the prevention of back pain. Previous studies on beliefs of workers concerning back pain showed that both the attribution of back pain to work-related causes and opinions on preventive measures were dependent on the history of back pain and were different between clerical and manual workers (Linton and Warg, 1993; Hyytiäinen, 1994). Since an intervention should correspond with the beliefs and needs of the workers, it may be wise to assess the workers' beliefs regarding causes and prevention of back pain, and general measures for improving the work situation before designing and implementing an intervention.

In summary, in this study the history of back complaints and low job satisfaction were the most predictive for the occurrence of back pain. Although it needs to be confirmed by future intervention studies, the results indicate that increasing job satisfaction may be a successful (co-)intervention for the prevention of back pain at the workplace.

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