ORIGINAL ARTICLE

The role of physical workload and pain related fear in the development of low back pain in young workers: evidence from the BelCoBack Study; results after one year of follow up

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Aims: To study the influence of work related physical and psychosocial factors and individual characteristics on the occurrence of low back pain among young and pain free workers.
Methods: The Belgian Cohort Back Study was designed as a prospective cohort study. The study population of this paper consisted of 716 young healthcare or distribution workers without low back pain lasting seven or more consecutive days during the year before inclusion. The median age was 26 years with an interquartile range between 24 and 29 years. At baseline, these workers filled in a questionnaire with physical exposures, work related psychosocial factors and individual characteristics. One year later, the occurrence of low back pain lasting seven or more consecutive days and some of its characteristics were registered by means of a questionnaire. To assess the respective role of predictors at baseline on the occurrence of low back pain in the following year, Cox regression with a constant risk period for all subjects was applied.
Results: After one year of follow up, 12.6% (95% CI 10.1 to 15.0) of the 716 workers had developed low back pain lasting seven or more consecutive days. An increased risk was observed for working with the trunk in a bent and twisted position for more than two hours a day (RR 2.2, 95% CI 1.2 to 4.1), inability to change posture regularly (RR 2.1, 95% CI 1.3 to 3.5), back complaints in the year before inclusion (RR 1.7, 95% CI 1.1 to 2.8), and high scores of pain related fear (RR 1.8, 95% CI 1.0 to 3.1). Work related psychosocial factors and physical factors during leisure time were not predictive.
Conclusion: This study highlighted the importance of physical work factors and revealed the importance of high scores of pain related fear in the development of low back pain among young workers.

Low back pain (LBP) is among the most frequent health problems in the general population, affecting 58–84% of all adults at some point in their life.[1] Fortunately, when LBP problems are graded on pain severity and the lowered ability to accomplish tasks of daily living (disability), most episodes appear to be not disabling.[2 3] However, for those experiencing disabling pain, the quality of life is detrimentally affected. Also, disabling LBP is responsible for substantial costs to both the individual patient and society.

An important challenge in occupational health settings is the identification of aetiological factors that are amenable to change through workplace interventions. In that context, several studies have investigated factors related to the occurrence of LBP. Several reviews have revealed that physical and psychosocial work factors as well as individual characteristics are important.[4–8] There are however some issues that need further consideration. Firstly, most studies have focused on a LBP lasting longer than one day. Because LBP lasting one or two days is very common and resolves quickly, it may be more important to investigate risk factors for LBP of longer duration—for example, one week. Secondly, in most studies, the age range of the workers is large. It is highly plausible that risk factors for LBP at older age are risk factors for recurrent LBP, and not for acute LBP. For that reason, our study focused on workers with a young age. Thirdly, clinical psychological research about chronic LBP has revealed that beliefs about LBP and pain related fear are important factors in explaining suffering and disability.[9] Most studies were however cross sectional, and prospective studies investigating the value of LBP beliefs in predicting LBP and disability are still needed.[10] Therefore, a prospective study (the BelCoBack Study) was designed (1) to investigate the effect of work related factors and individual characteristics on the occurrence of LBP in young and pain free workers, and (2) to assess the relative contribution of each risk factor to the occurrence of LBP among exposed workers and among the entire study population.

MATERIALS AND METHODS

Subjects and methods

In 2000 and 2001 participants were recruited among the employees of four healthcare institutions and two distribution companies throughout Belgium, and baseline measurements were obtained. To minimise dropout, we included only workers with a tenured position or equivalent. Furthermore, to reduce the influence of age and of previous episodes of LBP, participants had to be no older than 30 years at the time of intake and to have been free of episodes of LBP lasting seven or more consecutive days during the 12 months before intake in the study. Of 1672 eligible employees, 1200 (72%) agreed to participate. However, during a first contact, 159 were excluded because they did not meet the last inclusion criterion, leaving a sample of 1041 workers. Of those 1041 workers, 972 (93%) completed the questionnaire at baseline.

Abbreviations: $AF_{exposed}$, attributable fraction among exposed workers; AF_{total}, attributable fraction among the entire study population; LBP, low back pain; MMH, manual materials handling

One year later (2001–02), participants were requested again to fill in a questionnaire. Of the 972 workers who responded at baseline, 800 (82%) returned the questionnaire.

For the longitudinal analyses described in this paper, a cohort was identified of 851 employees with a minimal experience of at least two months in their function at intake. An interval of at least two months was considered sufficient to appreciate the work constraints in a function. The questionnaire at one year of follow up was available for 716 (84%) of these 851 workers.

The study protocol was approved by the local commission for medical ethics, and an informed consent was given by all included employees before their participation in the study.

Data collection

Questionnaires at baseline

A battery of questionnaires was developed and aimed to assess variables from three areas: physical, psychosocial, and individual variables.

Physical factors were assessed with a self developed questionnaire.[11] Questions on current physical workload addressed (1) the duration of working in awkward postures, (2) the duration of exposure to whole body vibration, (3) the intensity and, where indicated, the frequency of manual materials handling such as lifting, carrying, pushing, or pulling of loads, (4) static work postures (that is, standing and sitting for long periods) and (5) ability to change posture regularly. Duration, frequency, and intensity were rated on three or four point ordinal scales. Furthermore, we addressed the seniority in the current function and the working schedule (percentage of employment, day or night duty). Additional questions on (at least weekly) sporting activities, engagement in construction and embellishment work at home, and on motor vehicle driving (km/year) served to assess the physical load during leisure time.

Psychosocial work characteristics were evaluated with the 43-item Job Content Questionnaire.[12] The different items were measured on four point Likert scales, ranging from "completely disagree" to "completely agree", yielding a sum score for each dimension. Based on the Demand-Control-Support model of Karasek and Theorell, the following dimensions were taken into account: skill discretion (six items), decision authority (three items), psychological job demands (five items), supervisor and co-worker support (four items each), job insecurity (five items), and job dissatisfaction (five items). For the analyses, the psychosocial work characteristics were categorised into tertiles.

Table 1 Functions in the study sample (n = 716)

Function	n
Healthcare sector	
Nurse/nurse's aide	255
Administrator	56
Logistical aid	30
Cleaning personnel	25
Physiotherapist	20
Workman	18
Medical technician	13
Kitchen personnel	10
Technician	9
Pharmacist	8
Engineer	5
Dietician	3
Ergotherapist	3
Psychologist	2
Educationalist	1
Night watchman	1
Speech therapist	1
Distribution sector	
Manual material handler	206
Packager	22
Recycling of empty bottles/boxes	18
Process control	6
Receptionist	3
Porter	1

Table 2 Incidence risk of low back pain lasting seven or more consecutive days after one year of follow up (LBP at t1)

		LBP at t1		
	n	n	%	95% CI
Total study population	716	90	12.6	(10.1 to 15.0)
Men	283	35	12.4	(8.5 to 16.2)
Women	433	55	12.8	(9.6 to 15.8)
Dutch speaking	504	57	11.4	(8.5 to 14.1)
French speaking	212	33	15.6	(10.7 to 20.4)

Individual variables included (1) age, sex, language, and educational level as demographic factors, (2) smoking behaviour, body mass index, perceived general health and complaints of the neck, back, upper or lower limbs in the year before inclusion as health related factors, and (3) pain related fear, catastrophising about pain, negative affectivity, and somatisation as psychological factors. The questionnaire on individual and health related factors was derived from the standardised Nordic Questionnaires for the analysis of musculoskeletal symptoms.[13] For the assessment of psychological concepts, we used the Modified Tampa Scale of Kinesiophobia,[14] the Pain Catastrophizing Scale,[15 16] the Positive Affectivity Negative Affectivity Scales,[17] and an adapted version (29 items) of the Psychosomatic Symptom Checklist,[18] respectively. All items were scored on four or five point Likert scales and for each concept a total score was calculated. For the analyses, these scores were split up into tertiles. Body mass index (BMI) was categorised as BMI <20, BMI 20–<25 (normal), BMI 25–<30 (overweight), and BMI $\geqslant 30$ (obese).

Questionnaires at one year of follow up

The occurrence of LBP and some of its characteristics were queried by means of the questionnaire developed by Von Korff[2] and a modified version of the standardised Nordic Questionnaires for the analysis of musculoskeletal symptoms.[13] Low back complaints were registered as a positive answer to the question "Have you had ache, pain or discomfort in the low back region [indicated on a manikin as the area between the lower ribs and the gluteal folds], irradiating to the legs or not, for seven or more consecutive days during the past twelve months?" This definition is more strict than the one used in the Nordic Questionnaire, in that complaints should have occurred continuously for at least a week rather than eight days or more in total.[19 20] Characteristics included more detailed information on onset, intensity, and frequency of the symptoms, on consequences on work and social and daily life, and on medical care seeking.

Analytic methods

The outcome variable for this study was the development of LBP lasting seven or more consecutive days after one year of follow up. To study the impact of work related factors and individual variables at baseline on this incidence risk, we first carried out univariate analyses. For the categorical data, we used χ^2 tests and calculated relative risks with 95% confidence intervals. For the continuous data, Mann-Whitney U or unpaired *t* tests were applied.

Table 3 Risk factors for low back pain lasting seven or more consecutive days after one year of follow up (LBP at t1) in univariate analyses

Variable at baseline		n	LBP at t1 n	LBP at t1 %	RR	95% CI	p Value*
Physical work factors							
Working with the trunk in bent and twisted position	No	446	49	11.0	1.00		**0.041**
	⩽2 hours/day	181	25	13.8	1.26	(0.80–1.97)	
	>2 hours/day	75	16	21.3	**1.94**	**(1.17–3.23)**	
Ability to change posture regularly	Yes	616	66	10.7	1.00		<**0.001**
	No	90	24	26.7	**2.49**	**(1.65–3.76)**	
Individual variables							
Perceived general health	Very good	339	30	8.8	1.00		**0.014**
	Fairly good	349	54	15.5	**1.75**	**(1.15–2.66)**	
	Moderate	24	5	20.8	**2.35**	**(1.01–5.53)**	
Back complaints in the year before inclusion	No	370	35	9.5	1.00		**0.008**
	Yes	343	55	16.0	**1.70**	**(1.14–2.53)**	
Upper limb complaints in the year before inclusion	No	581	65	11.2	1.00		**0.015**
	Yes	132	25	18.9	**1.69**	**(1.11–2.58)**	
Pain related fear	Low	237	26	11.0	1.00		**0.048**
	Medium	238	24	10.1	0.92	(0.54–1.55)	
	High	235	40	17.0	1.55	(0.98–2.46)	

RR, relative risk; 95% CI, 95% confidence interval.
*Calculated with χ^2 tests.

Secondly, we performed multivariate analyses using Cox regression with a constant risk period for all subjects. This technique estimates the relative risk rather than the odds ratio, which would result from logistic regression.[21] It was decided from inception to include age and sex as epidemiological confounders, irrespective of their relation with LBP. Then, variables that met the 20% level of significance in the univariate analyses were considered for inclusion in the multivariate analyses. We calculated correlation coefficients among the variables to prevent the occurrence of collinearity. In the final multivariate models only variables with a p value less than 0.05 were retained; non-significant variables were removed by means of a backward selection procedure. All analyses were conducted with the SPSS computer package (version 10; SPSS Inc, Chicago, IL, USA).

In a third and last stage, we calculated the attributable fraction among the exposed workers ($AF_{exposed}$) as well as the attributable fraction among the entire study population (AF_{total}) for those variables that were found to constitute risk factors. The $AF_{exposed}$ estimates the fraction of exposed cases that would not have occurred if exposure had not occurred. The AF_{total} estimates the fraction of all cases that would not have occurred if exposure had not occurred.[22]

RESULTS

Descriptive statistics of the study population

Of the 716 workers, 64% were recruited in healthcare institutions and 36% in distribution companies. It is noteworthy that heterogeneity of functions exists in the healthcare sector and, to a lesser extent, in the distribution (table 1). Sixty one per cent of the workers were women. We registered a median age of 26 years (interquartile range of five years) and a median seniority in the current function of three years (interquartile range of four years). Eighty eight per cent had a full time employment. Dutch was the native language of 70% and French that of the remaining 30%.

Failure to return the questionnaire after two reminders accounted for 71 of the 135 workers lost to follow up. The remaining 64 (35 from the healthcare sector, 29 from the distribution sector) had left their company. A comparison of the baseline information of the group lost to follow up to that of the retained study population yielded (1) a higher percentage of workers with back complaints in the year before inclusion (59% *v* 48%, χ^2 test, p = 0.018), (2) a lower seniority in the current function (a median of two years *v* a median of three years, Mann-Whitney U test, p = 0.014), and (3) a higher exposure to motor vehicle driving during leisure time (a median of 20 000 km *v* a median of 15 000 km, Mann-Whitney U test, p = 0.014). In addition, the loss to follow up for the French speaking workers was higher than for the Dutch speaking workers (21% *v* 14%, χ^2 test, p = 0.006).

Descriptive statistics of the outcome

After one year of follow up, 12.6% (95% CI 10.1 to 15.0) of the 716 workers had developed LBP lasting seven or more consecutive days. This incidence risk did not differ

Table 4 Relations between manual materials handling and low back pain lasting seven or more consecutive days after one year of follow up (LBP at t1) in univariate analyses

Variable at baseline		n	LBP at t1 n	LBP at t1 %	RR	95% CI	p Value*
Pushing or pulling heavy loads	No	322	31	9.6	1.00		0.077
	<1 time/hour	201	27	13.4	1.40	(0.86–2.27)	
	⩾1 time/hour	183	30	16.4	**1.70**	**(1.07–2.72)**	
Lifting or carrying loads	No	122	12	9.8	1.00		0.430
	⩽10 kg	83	11	13.3	1.35	(0.62–2.91)	
	>10 kg, ⩽25 kg, ⩽12 times/hour	122	15	12.3	1.25	(0.61–2.56)	
	>10 kg, ⩽25 kg, >12 times/hour	50	7	14.0	1.42	(0.60–3.40)	
	>25 kg, ⩽12 times/hour	310	39	12.6	1.28	(0.69–2.36)	
	>25 kg, >12 times/hour	13	4	30.8	**3.13**	**(1.18–8.33)**	

RR, relative risk; 95% CI, 95% confidence interval.
*Calculated with χ^2 tests.

Table 5 Risk factors for low back pain lasting seven or more consecutive days after one year of follow up (LBP at t1)

Variable at baseline		n	LBP at t1		Univariate analyses*			Multivariate analyses†			AF exposed		AF total	
			n	%	RR	95% CI	p Value	RR	95% CI	p Value	AF	95%CI	AF	95% CI
Physical work factors														
Working with the trunk in bent and twisted position	No	382	40	10.5	1.00		0.020	1.00		0.038				
	≤2 hours/day	146	22	15.1	1.44	(0.86–2.42)		1.30	(0.77–2.20)					
	>2 hours/day	57	14	24.6	2.35	(1.28–4.31)		2.21	(1.20–4.07)		0.55	(0.17–0.75)	0.11	(0.02–0.23)
Ability to change posture regularly	Yes	512	56	10.9	1.00		<0.001	1.00		0.005				
	No	73	20	27.4	2.51	(1.50–4.17)		2.11	(1.26–3.54)		0.53	(0.21–0.72)	0.12	(0.03–0.24)
Individual variables														
Back complaints in the year before inclusion	No	295	28	9.5	1.00		0.019	1.00		0.027				
	Yes	290	48	16.6	1.74	(1.09–2.78)		1.71	(1.07–2.75)					
Pain related fear	Low	194	20	10.3	1.00		0.006	1.00		0.013				
	Medium	201	18	9.0	0.87	(0.46–1.64)		0.85	(0.45–1.60)					
	High	190	38	20.0	1.94	(1.13–3.33)		1.81	(1.04–3.14)		0.45	(0.04–0.68)	0.21	(0.01–0.41)

RR, relative risk; 95% CI, 95% confidence interval; $AF_{exposed}$, attributable fraction among the exposed workers; AF_{total}, total attributable fraction for the entire study population.
*Cox regression.
†Cox regression, backward selection, $P_{in} = 0.20$, $P_{out} = 0.05$.
Results from the model with no missing values (n = 585) for standing work for long periods, regular recreational sports, possibilities to develop skills, psychological job demands, perceived general health, family situation, body mass index, complaints of the lower limbs in the year before inclusion, age, sex, and the factors mentioned in the table.

significantly between men and women, or between Dutch and French speaking employees (table 2).

Risk factors for the occurrence of low back pain

Univariate analyses

Two physical factors were related to the occurrence of LBP in the following year: (1) working with the trunk in bent and twisted position for more than two hours a day and (2) inability to change posture regularly. The variables on manual materials handling were not related to LBP, although increased risks were observed for the categories with highest exposure—that is, pushing or pulling heavy loads at least once every hour (RR 1.70, 95% CI 1.07 to 2.72) or lifting or carrying more than 25 kg more than 12 times per hour (RR 3.13, 95% CI 1.18 to 8.33). This last group however was very small (n = 13). Furthermore, we found evidence for a dose-response relation for pushing or pulling heavy loads, but not for lifting or carrying weights. None of the psychosocial work characteristics was predictive for LBP. For the individual variables, moderately increased risks were observed for (1) general health perceived as moderate to fair, (2) back complaints in the year before inclusion, (3) complaints of the upper limbs in the year before inclusion, and (4) pain related fear. Table 3 summarises the results significant in univariate analyses. Table 4 describes the results for manual materials handling.

Multivariate analyses

The following variables, associated with a p value $\leqslant 0.20$ in univariate analyses, were considered for inclusion in multivariate analyses: the physical factors (a1) inability to change posture regularly (χ^2 test, p<0.001), (a2) working with the trunk in bent and twisted position (χ^2 test, p = 0.041), (a3) regular recreational sports (χ^2 test, p = 0.075), (a4) pushing or pulling of heavy loads (χ^2 test, p = 0.077) and (a5) standing for long periods (χ^2 test, p = 0.183); the psychosocial work characteristics (b1) possibilities to develop skills (χ^2 test, p = 0.096), (b2) job dissatisfaction (χ^2 test, p = 0.107), and (b3) psychological job demands (χ^2 test, p = 0.157); and the individual variables (c1) back complaints in the year before inclusion (χ^2 test, p = 0.008), (c2) perceived general health (χ^2 test, p = 0.014), (c3) complaints of the upper limbs in the year before inclusion (χ^2 test, p = 0.015), (c4) pain related fear (χ^2 test, p = 0.048), (c5) family situation (χ^2 test, p = 0.070), (c6) age (Mann-Whitney U test, p = 0.075), (c7) language (χ^2 test, p = 0.124), (c8) body mass index (χ^2 test, p = 0.154), (c9) pain catastrophising (χ^2 test, p = 0.164), and (c10) complaints of the lower limbs in the year before inclusion (χ^2 test, p = 0.171). Sex was included as epidemiological confounder, although it was not significantly related to LBP (χ^2 test, p = 0.891).

Multivariate analyses were based on backward selection. We constructed a model for each comprehensive combination of unrelated variables significant at $p \leqslant 0.20$ in univariate analyses. In table 5, we show the results of a model with unrelated variables. In case of interrelations, the most significant variable was included in this model. This model showed significant results for: (a1) inability to change posture regularly, (a2) working with the trunk in bent and twisted position for more than two hours a day, (c1) back complaints in the year before inclusion, and (c4) pain related fear. All the other models yielded essentially identical results.

The analyses in table 5 were based on a smaller population than those in table 3. This is due to the fact that, in table 5, people with missing values have been excluded in the multivariate analyses. To check if there was a bias due to missing values, we compared the group without missing values (n = 585) with the group with missing values (n = 131) with respect to the variables that were included in the multivariate model. The two groups did not differ significantly in any of these. Therefore, we may conclude that there is no bias due to the missing values.

Attributable fractions

In contrast to a history of back complaints, physical work factors and pain related fear are amenable to preventive measures in an occupational context. Therefore, we calculated the proportion of LBP that can be attributed to these exposures (table 5). Among exposed workers ($AF_{exposed}$), each of the three identified risk factors (a1, a2, c4) accounted for a comparable proportion of low back complaints after this one year period. Furthermore, the relative contribution of each of these risk factors to the occurrence of LBP in the entire study population (AF_{total}) was comparable.

DISCUSSION

Incidence of low back pain

Out of the 716 workers who were free of LBP at baseline, 12.6% (95% CI 10.1 to 15.0) had developed LBP after one year of follow up. This incidence is remarkably similar to the yearly incidences reported in the SMASH study (12.3%, 13.7%, and 14.3%) for regular or prolonged LBP.[23] In a Swiss prospective study on LBP in nurses,[20] the incidence of LBP is somewhat higher: 78 (19.7%, 95% CI 15.8 to 23.7) of the 395 nurses, with pain for 0–7 days within the preceding 12 months at baseline, developed LBP for at least eight days during the following year. This small difference may be related to several factors. Firstly, in the Swiss study the outcome was defined as cumulative days of LBP, whereas an LBP episode was defined in our study as seven or more consecutive days of LBP. Secondly, in the Swiss study the sample consisted of older participants (mean age of 36 years in comparison with 26 years in our study). Thirdly, a "healthy worker effect" may have decreased the incidence in our study. One of the reasons of loss to follow up was related to the experience of back pain in our study. In the Swiss study, there was "no healthy worker effect".

We cannot rule out that our incidence is underestimated because of a selective loss to follow up. In our study a higher percentage of the workers lost to follow up reported back complaints in the 12 months before inclusion in the study. Because a history of back complaints has consistently been shown an important predictor for future episodes, the population at follow up may be healthier than the loss to follow up. However, the overall response rate (84%) in our study was high; the "healthy worker effect" in the entire group is probably minimal.

Because Belgium consists of two different linguistic cultures with equivalent healthcare and educational settings, it offers a natural laboratory for investigating cultural differences in the experience of LBP. The Flemish community is in the north of the country (nearly three fifths of the Belgians) and Dutch is the official language. The Walloons live in the south (about two fifths of the Belgians) and speak French. The capital Brussels constitutes a predominantly French speaking enclave in Flanders, close to the language divide. Two population based surveys in Belgium[3 24] have revealed a significant association between LBP and language. In this context it is noteworthy that in a recent national health survey[25] participants from the French speaking community (Walloon) reported a lower physical and mental health, more disability, and a less healthy lifestyle than participants from the Dutch speaking community (Flanders). We could not, however, confirm the effect of sociocultural factors on LBP. As expected, the incidence of LBP was larger for French speaking employees (15.6%, 95% CI 10.7 to 20.4) than for Dutch speaking employees (11.4%, 95% CI 8.5 to 14.1). However, neither in univariate nor in multivariate analyses, was this difference found to be significant. Possible explanations are (1) the lack of statistical power to reveal a small, but robust effect, and (2) a more pronounced "healthy worker effect" in the French speaking workers than in the Dutch speaking workers. For the French speaking workers, the loss to follow up (21%) was larger than for the Dutch speaking workers (14%, χ^2 test, $p = 0.006$). Furthermore, a history of back complaints was reported more frequently by the French speaking (63%) than by the Dutch speaking loss to follow up (57%).

Risk factors for the occurrence of low back pain

Physical factors

In recent reviews,[4–6] the following physical work factors have been identified as risk factors for LBP: (1) bending and twisting/awkward working postures, (2) whole body vibration, and (3) manual materials handling, forceful movements, lifting, and patient handling. For static postures as standing and sitting, no epidemiological evidence has been found. In line with these findings, we observed about twofold increased risks for working with the trunk in a bent and twisted position and the inability to change posture regularly. Standing and sitting for long periods were not associated with LBP.

In the present study, no association was observed between LBP and earlier whole body vibration exposure. However, it should be taken into account that in our study population exposure to whole body vibration was largely limited to standing drivers of pallet forklifts and a limited number of sitting forklift drivers. Studies reporting a link between whole body vibration and LBP mainly concerned truck, tractor, or bus drivers. In addition, there is still no consensus in the literature on the existence of a dose-response relation.[26]

The lack of an effect of manual materials handling (MMH) in our population needs further clarification. For pushing or pulling of loads, our results are in line with those of Hoozemans and coworkers.[27] For lifting or carrying, however, the lack of an effect was unexpected in the light of the high exposures that were reported: 25% indicated lifting or carrying weights between 10 and 25 kg and for 46% the weights even exceeded 25 kg.

1. A first explanation may be exposure misclassification. In general, external exposure can be assessed by subjective judgements, systematic observations, or direct measurements. Subjective judgements, including self reported questionnaires, offer the possibility to investigate many subjects at a reasonable cost, but the validity of self reported exposure is often limited. Systematic observations or direct measurements give more accurate estimates, but they are much more expensive in terms of time, labour, and expenditure.[28–30] In view of our resources, external exposure assessment in the BelCoBack study was limited to questionnaires on the whole study population and observations on a representative sample. The results of these observations will be reported later.

Particularly for the questions on lifting or carrying, non-differential misclassification seems likely to be due to a detailed phrasing resulting in a rather complex lay out. For lifting or carrying weights, the workers were asked to rate both the level and the frequency per hour on a typical workday. Other authors also found that the estimation of both weight and frequency of MMH is rather difficult.[31] More specifically, it seems that the questions on frequency cannot be filled in accurately.[32–34] Even authors who do report an acceptable estimation of the frequency of MMH point out that one has to be careful to draw definitive conclusions from their findings. The accuracy noted in these studies may follow from a combination of less intense exposure and shorter recall periods[35] and less detailed phrasing.[36]

Main messages

- We studied the occurrence of low back pain (LBP) in young workers with minimal antecedents of LBP during the year before inclusion. After one year of follow up, one out of eight had developed LBP lasting seven or more consecutive days.
- In line with previous research, physical work factors were found to be predictive for the occurrence of LBP.
- Our study also revealed that high scores of pain related fear increased the risk of LBP one year later.

Furthermore, the choice of the categories may have been less appropriate. Workers who had to lift or carry more than 25 kg more than 12 times per hour (n = 13) showed a significantly increased risk in univariate analyses. For lifting or carrying more than 25 kg less than once an hour and 1–12 times per hour, moderate and non-significant risks of 1.3 were found (results not shown). Extrapolation of this last frequency to a whole workday of eight hours results in 8–96 times per workday. If the risk only rises above a certain threshold, we may have missed it. As non-differential misclassification of exposure in general will be in the direction of the zero value, relations between lifting or carrying and low back complaints will systematically be underestimated.

2. A second explanation may be selection due to the inclusion criteria and the loss to follow up. Both the healthcare and distribution sectors are known for a high exposure to MMH. By including only workers with a tenured position or equivalent and with no episode of LBP lasting seven or more consecutive days in the year before inclusion, more susceptible workers were excluded ("healthy worker selection"). As mentioned above, an additional "healthy worker effect" may be suspected due to the loss to follow up.

In agreement with recent reviews,[6 37] neither sports nor other activities during leisure time were significantly related to LBP.

Psychosocial work characteristics

In literature, three mechanisms have been suggested for an association between psychosocial work characteristics and LBP: (1) an influence on the biomechanical load through changes in posture, movement, and exerted forces; (2) an influence on the development or intensification of symptoms or the pain perception through physiological mechanisms, such as increased muscle tension or increased hormonal excretion; and (3) an influence on the reporting of symptoms through changes in coping ability. However, it may also be that the association found is the result of lack of adjustment for physical factors.[7]

In our sample, none of the psychosocial work characteristics was found to be predictive for the occurrence of LBP one year later. In these analyses, psychosocial work characteristic scores were categorised into tertiles, which may have reduced the power for the psychosocial work characteristics. When using the sum scores, lower possibilities to develop skills proved significant in univariate analyses (Mann-Whitney U test, p = 0.016). However, this effect disappeared in multivariate analyses.

In general, the epidemiological evidence for a relation between psychosocial work characteristics and back disorders is far less consistent than for physical work factors. Various reviews report some evidence, but the results are rather heterogeneous and unstable.[4 5 7] A recent systematic review of prospective cohort studies[38] shows moderate evidence for

Policy implications

- Our results suggest that a more effective primary prevention of LBP may be achieved when prevention strategies address both the ergonomic work environment and attitudes towards pain. In terms of potential effect of preventive measures, pain related fear seems as promising as physical work factors.

no association between LBP and perception of work, organisational aspects of work, social support at work, and insufficient evidence for a positive association with stress at work.

Individual variables

History of back complaints

In literature, a history of back disorders has been described as the most important predictor for future reports.[39] By including only young workers with limited antecedents of LBP in the year preceding intake, we have tried to minimise the influence of earlier episodes. Nevertheless, a history of back complaints still predicted the occurrence of future episodes. Back disorders are a recurrent phenomenon.[20 40 41] The meaning of a previous history of back complaints however is less clear as it may itself reflect previous exposure to risk factors, a higher susceptibility, or a higher tendency to report pain.

Pain related fear

Clinical models of chronic LBP have proposed that beliefs about LBP and pain related fear are important variables in the instantiation and maintenance of LBP, suffering, and disability.[3 42 43] However, most studies were cross sectional in nature, leaving the issue of causality unresolved. In the meta-analysis of Pincus and coworkers[44] only three prospective studies investigating the role of pain related fear in explaining chronicity were identified, and two of these studies were evaluated as having a low methodological quality. We know of only one study[45] that has investigated the role of pain related fear in predicting a new episode of LBP during the following year. This study was performed in a population sample of 415 people (37–47 years) who reported not having experienced LBP during the previous year. In that study, pain related fear almost doubled the risk for a new LBP episode. Our results are intriguingly similar. Although our sample was restricted to individuals that were young and working, pain related fear still almost doubled the risk for a new LBP episode. Moreover, in terms of its potential effect for prevention, pain related fear may be as promising as physical work factors.

There may be several, not necessary mutually exclusive, reasons why pain related fear emerged as an important predictor of LBP lasting seven or more consecutive days. Firstly, it has been repeatedly demonstrated in experiments, in which healthy volunteers experience experimental pain, that threatening interpretations of pain install a heightened attention for (signals of) pain and a diminished ability to disengage attention from pain.[46 47] A heightened attentional focus on pain may result in the reporting of pain of longer duration. Secondly, it is possible that pain related fear has instigated a maladaptive pattern of coping with pain causing pain or a longer duration of pain. It is known that pain related fear may lead to avoidance and guarding.[9 42] Geisser and coworkers[48] have demonstrated that pain related fear among people experiencing chronic pain is associated with abnormal patterns of electromyography during flexion and extension.

It is clear from our study that interventions should be targeted at correcting misconceptions about LBP and its diagnosis and treatment in laymen.[3] The correction of misconceptions and reassurance is an important task for healthcare providers.[49]

CONCLUSION

This study highlights the importance of physical work factors and pain related fear in the development of LBP in young workers. Our results suggest that a more effective primary prevention of LBP may be achieved when prevention strategies address both the ergonomic work environment and attitudes towards pain.

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ECHO

Australia exceeds US and New Zealand in deaths from driving for work

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Comparing fatal work related road traffic accidents from different sides of the world has disclosed similarities, though better data are needed before preventive strategies can be drawn up.

Occupations in the transport industry topped the bill in the United States (US), Australia, and New Zealand, with truck drivers coming off worst, accounting for 37–49% of these deaths. The types of incidents were similar. Over 90% of deaths were in men, who had crude death rates 9–10 times those of women; workers aged ⩾65 had high rates, particularly in Australia, but drivers in Australia in the 20–34 age range had even higher rates than those aged⩾65 in New Zealand and the US. Overall, percentage and crude death rates were significantly higher in Australia than the US and New Zealand (1.69 *v* 0.92 and 0.99/100 000 person years, respectively)—so much so that some bias is suspected, probably underreporting in the US and New Zealand. Nevertheless, these deaths are a substantial fraction of all work related deaths and warrant further studies with improved data systems, recent data, and better range of variables.

Data for Australia and New Zealand came from relevant studies using coroners' data and for the US from a national surveillance system. American and Australian data were compared for 1989–92 and New Zealand data for 1985–98 because of the small data set. More recent data existed only for the US, but the study was only possible at all with data on work related road deaths just becoming available for New Zealand.

▲ Driscoll T, *et al*. *Injury Prevention* 2005;**11**:294–299.