

## ELECTRONIC REVIEW

# Psychosocial factors at work in relation to low back pain and consequences of low back pain; a systematic, critical review of prospective cohort studies

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Relevant studies of low back pain (LBP) published between 1990 and 2002 were systematically retrieved via electronic databases and checking of reference lists. Forty papers fulfilled the inclusion criteria; 10 were of high quality. A wide variety of instruments had been used for collection of data on work related psychosocial factors, many of which had not undergone any form of validation. Moderate evidence was found for no association between LBP and perception of work, organisational aspects of work, and social support at work. There was insufficient evidence for a positive association between stress at work and LBP. No conclusions could be drawn regarding perception of work and consequences of LBP. There was strong evidence for no association between organisational aspects of work and moderate evidence for no association between social support at work and stress at work and consequences of LBP.

high psychological demands may leave muscles vulnerable to mechanical loads.<sup>6</sup> The consequences and prognosis of LBP could also be influenced by psychosocial factors. For example, pain that under optimal circumstances would be tolerated by workers, may in a stressful psychosocial environment lead to injury reporting due to decreased pain tolerance.<sup>7</sup> Further, as suggested by Nachemson, workers may be more inclined to take sick leave in poor psychosocial environments.<sup>8</sup>

Bongers *et al* reviewed 46 articles published between 1973 and 1992 dealing with psychosocial factors at work as risk factors for low back and neck pain.<sup>4</sup> The authors concluded that, even though the overall picture was unclear, an association had been shown between LBP and several psychosocial job variables, but that many of the studies suffered from methodological shortcomings.<sup>4</sup> Consequently, they recommended further studies applying improved epidemiological methodology, in particular prospective cohort studies.<sup>4</sup> Newer reviews on this subject have dealt with underlying methodological issues<sup>2</sup> and with assessment of the level of evidence for psychosocial factors as risk factors for the occurrence of LBP.<sup>1</sup> In light of the many recent publications in this area and because none of the previous reviews assessed both the level of evidence and the strength of possible associations, we decided that another systematic, critical review was warranted.

In this paper we critically review prospective cohort studies published between 1990 and 2002 (including both years) to determine: (1) the level of evidence for exposure to poor psychosocial work environments influencing the presence of LBP or its consequences (filing injury claim, sick leave, delayed return to work, disability pension); and (2) to estimate the strength of these associations.

## METHODS

A prospective cohort study is the best observational design for questions of aetiology and consequences. To be included in this review, studies had to be prospective cohort studies with population based samples or samples of working populations dealing with either LBP (that is, any pain in the lower back) or any consequence of LBP (that is, filing injury claim, sick leave, delayed return to work, disability pension). Only full reports written in English were included and not letters or abstracts. Descriptive studies that did not compare exposed

Do psychosocial factors at work cause low back pain (LBP) or affect behaviour of patients with existing LBP? These questions have been the subject of a large number of studies over the past 30 years. And just as primary studies arrive at conflicting results, systematic literature reviews disagree in their conclusions. For instance, in 2000 Hoogendoorn *et al* concluded that there was "strong evidence for low social support in the workplace and low job satisfaction as risk factors for back pain" after reviewing 11 cohort and two case-control studies,<sup>1</sup> whereas Davis and Heaney, after reviewing 66 papers published before 1999, concluded that "even the most optimistic interpreter of this body of results would be cautious in terms of inferring that psychosocial work characteristics are contributing to the occurrence of LBP".<sup>2</sup>

A psychosocial factor may be defined as a measurement that potentially relates psychological phenomena to the social environment and to pathophysiological changes.<sup>3</sup> For LBP, it has been hypothesised that exposure to suboptimal psychosocial factors may lead to altered spinal loading due to increased muscle tension. This then possibly affects the nutrition of intervertebral discs, nerve roots, and other spinal tissues.<sup>4,5</sup> Further, raised plasma cortisol levels following

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## Main messages

- According to recent epidemiological literature, evidence for significant positive associations between psychosocial factors at work and LBP and consequences of LBP is lacking.
- Methodology in recent epidemiological studies dealing with work related psychosocial factors and low back pain is highly variable, and associations reported may be spurious.

workers with a reference population of non-exposed or less exposed workers were discarded. Finally, studies dealing with LBP due to lumbar disc herniations, osteoporosis, cancer, pregnancy, or other specific causes were not included.

Relevant articles from peer reviewed journals were identified by computerised searches in the databases Psychinfo, OSHROM, and Medline for 1990–2002 inclusive. In Psychinfo all articles with the words “back pain” as descriptor were retrieved (n = 798) and abstracts were screened for possible inclusion. In OSHROM abstracts for all articles with index term “low back” in combination with either “disabilities”, “disease”, “disorders”, “injured”, “pain”, “economics”, “epidemiology”, “pathology”, “physio-pathology”, “prevention and control”, “psychology”, and “rehabilitation” were screened for inclusion (n = 1316). In Medline, a three step search procedure was performed. First, a search was performed using “low back pain” or “lumbago” or “sciatica” either as MESH term or in the title or abstract (n = 7616). Second, a similar search was performed using “job satisfaction” or “workplace” or “occupational groups” or “occupational exposure” or “employment” or “occupations” or “workload” or “stress” or “occupational diseases” or “vibration” (n = 218 454). Third, results of the two searches (“hedges”) were combined and titles and abstracts of all remaining articles were screened for possible inclusion (n = 1005). Together, these searches resulted in the inclusion of 38 papers. Finally, relevant references were sought in all included publications and review articles published during the 13 year period, resulting in inclusion of an additional two articles. The computerised searches were assisted by a research librarian.

## Abstraction

Using a checklist, each article was abstracted independently by two of the authors (JH, SL) for a list of core items. Completed checklists were subsequently compared and discordances were resolved by discussion until consensus was reached.

## Psychosocial variables

Thirty different psychosocial variables were measured in the included studies. For clarity, these were grouped into four categories as follows:

- *Perception of work*, including the variables job satisfaction, feelings towards work, feelings towards work conditions, enthusiasm for work, enjoyment of work, and low occupational pride.
- *Organisational aspects of work*, including the variables influence on work conditions, job security, time pressure, conflicting demands, pace, work content, work control, work tempo, quantitative demands, qualitative demands, psychological demands, decision authority/latitude, skill discretion, few possibilities for on the job development, no

## Policy implications

- Standardised, valid, and clinically relevant definitions of both low back pain and work related psychosocial factors need to be developed and implemented internationally.
- Strategies for preventing low back pain by improving the psychosocial work environment will probably be fruitless until the true relation between the two has been disentangled.

education at employer’s expense, excessive job demands, and work monotony.

- *Social support at work*, including the variables recognition and respect, social support, co-worker support, social relations, relationships at work, others listening, external support, and supervisor support.
- *Stress at work*, including the variables stress, overstrain, job strain, level of distress, total mental exertion.

## Quality of studies

No validated, standardised method of assessing the quality of epidemiological studies exists. We therefore constructed our own nine point quality scale based on well recognised requirements for epidemiological studies (table 1). The quality criteria concerned the study sample, the exposure and outcome measurements, and the statistical analysis and reporting. Studies scoring eight or nine points were considered high quality studies.

## Assessment of outcomes

Studies were divided into two groups: those dealing with risk factors for low back *pain* and those dealing with risk factors for any consequence of LBP (filing injury claim, taking time off work, delayed return to work after period of absence due to LBP, etc). In the latter group, we looked for whether the psychosocial variables under investigation affected the outcome in a negative or positive direction.

## Assessment of level of evidence and strength of association

Two steps were used in assessment of the association between the psychosocial variables and LBP. First, level of evidence was determined based on the number, quality, and outcome of the studies as follows:

- Strong evidence: Provided by generally consistent findings in multiple (>1) high quality studies.
- Moderate evidence: Provided by generally consistent findings in one high quality study and one or more low quality studies, or in multiple low quality studies.
- Insufficient evidence: Only one study available or inconsistent findings in multiple studies.

**Table 1** Quality criteria applied to each article

1. Purpose of study clearly stated (aetiology versus prognosis)
2. Main features of study population described
3. Response rate 80% at baseline and reported at follow up
4. Psychosocial data collected using validated instrument
5. Data on physical workload collected
6. Clear, reproducible definition of low back pain
7. Low back pain data collected for at least one year
8. Multivariate analysis including confounder control
9. Outcome measures (OR, RR) reported with 95% confidence intervals

This method has previously been used in the assessment of level of evidence of clinical interventions for LBP as well as psychosocial factors as risk factors for LBP.

Further, the strength of the associations was considered according to a method used by Hemingway and Marmot<sup>3</sup> as follows:

- No statistically significant positive association:  $p > 0.05$  or odds ratio (OR) or relative risk (RR)  $< 1$  or 95% CI below or straddling 1.00, that is OR or RR not significantly different from unity.
- Moderate association:  $OR \text{ or } RR > 1.00 \leq 2.00$ .
- Strong association:  $OR \text{ or } RR > 2.00$ .

Tables 2 and 3 summarise descriptive items for all studies.

## RESULTS

Forty studies fulfilled the inclusion criteria. Eighteen papers reported studies dealing with LBP<sup>10–27</sup> (table 2) and 22 reported studies dealing with consequences of LBP<sup>14 15 23 28–46</sup> (table 3). Three studies dealt with both pain and consequences and are thus displayed in both table 2 and table 3.<sup>14 15 23</sup> The two papers by Bigos and colleagues<sup>28 29</sup> apparently report on the same study and are only counted as one in the analysis. Ten of the 40 studies scored either eight or nine points out of nine in the quality assessment and were thus labelled as studies of higher quality<sup>15 16 18 19 23 26 39 41 43 46</sup> (table 4).

### Low back pain

- *Perception of work.* Perception of work was examined in relation to LBP in 10 studies,<sup>10–12 14–19 27</sup> four of which were of high quality<sup>15 16 18 19</sup> (table 2). Of the latter, three reported no association<sup>16 18 19</sup> and in one study a positive moderate association between perception of one's work and LBP was reported (OR 1.2).<sup>15</sup> Of the five low quality studies, only one reported a positive but strong association (OR 2.00).<sup>14</sup>
- *Organisational aspects of work.* Organisational aspects of work were examined in relation to LBP in nine studies.<sup>13 17 19–21 23–26</sup> Three studies were of higher quality;<sup>19 23 26</sup> only one of these reported a positive association (OR 2.19).<sup>23</sup> Among the studies of lower quality, only one of six reported a positive association,<sup>15</sup> however, the OR was not provided. In two studies of lower quality positive associations were reported for certain groups but not for others.<sup>20 21</sup>
- *Social support at work.* Of 11 studies reporting on social support at work in relation to low back pain, only three were of higher quality and all reported no significant positive association.<sup>19 23 26</sup> Among the low quality studies, six reported no significant positive association,<sup>14 20 21 24 25 27</sup> and in two studies ORs were not provided for significant positive associations.<sup>13 22</sup>
- *Stress at work.* Five studies dealt with stress at work in relation to low back pain,<sup>11 16 23 24 27</sup> of which two were high quality.<sup>16 23</sup> One of these reported a significant and strong positive association (OR 2.68–2.70)<sup>16</sup> and in the other study no significant positive association was found.<sup>23</sup> In all three low quality studies the authors found no significant positive associations.<sup>11 24 27</sup>

In accordance with our predetermined criteria for assessment of level of evidence and strength of association, we found moderate evidence for no positive association between perception of work, organisational aspects of work, and social support at work and LBP. We found insufficient evidence for a positive association between stress at work and LBP.

### Consequences of LBP

- *Perception of work.* In 19 studies consequences of LBP were examined in relation to perception of work<sup>14 15 23 28–36 38–44 46</sup> (table 3). Six of these were high quality studies,<sup>15 23 39 41 43 46</sup> and three reported significant positive moderate associations (OR 1.20–1.95),<sup>15 41 43</sup> whereas no significant positive association was reported in the other three studies.<sup>23 39 46</sup> Among the 13 studies of lower quality only three reported moderate positive associations (OR 1.53–1.87),<sup>28 29 33 44</sup> while in the remaining 10 studies no association was found between perception of work and consequences of LBP.<sup>14 30–32 34–36 38 40 42</sup>
- *Organisational aspects of work.* Nine studies dealt with organisational aspects of work and consequences of LBP<sup>23 35 37 40 41 43–46</sup> (table 3). Four of these were high quality studies,<sup>23 41 43 46</sup> of which none reported a significant positive association. Of the five low quality studies, two reported significant positive moderate associations (OR 1.40–1.79),<sup>35 44</sup> and in the remaining three studies no significant association was found (table 3).
- *Social support at work.* Five of nine studies dealing with social support at work in relation to consequences of LBP were of higher quality.<sup>23 39 41 43 46</sup> Only two of these showed significant positive strong associations (OR 3.40–5.75).<sup>23 46</sup> In the four studies of lower quality, no significant positive associations were found<sup>14 32 35 42</sup> (table 3).
- *Stress at work.* Only three studies investigated stress at work in relation to consequences of LBP,<sup>23 32 37</sup> of which one was a high quality study.<sup>23</sup> Neither this nor the two low quality studies<sup>32 37</sup> reported significant positive associations between stress at work and any consequences of LBP.

In none of the included studies were work related psychosocial factors found to be protective in relation to LBP or consequences of LBP.

In accordance with our predetermined criteria for assessment of level of evidence and strength of association there was insufficient evidence for an association between perception of work in relation to consequences of LBP. There was strong evidence for no association between organisational aspects of work and moderate evidence for no association between social support at work and stress at work and consequences of LBP.

## DISCUSSION

After reviewing and critically assessing 40 prospective studies published between 1990 and 2002, no clear picture of the relation between work related psychosocial factors and LBP emerges. According to the applied quality criteria and cut off values for significance, perception of one's work—for instance, poor job satisfaction, is not associated with LBP, and associations between perception of work and consequences of LBP could not be determined. Both organisation of work and social support at work from co-workers or superiors showed no association with either low back pain or its consequences in both high and low quality studies. There was insufficient evidence for an association between stress at work and LBP and moderate evidence for no association between stress at work and consequences of LBP.

In 1993 Bongers *et al* asked for more prospective cohort studies dealing with work related psychosocial factors and musculoskeletal disease.<sup>4</sup> Since then, 40 prospective studies dealing with LBP alone have been published, and this review is, to our knowledge, the first to address both the level of evidence and the strength of association between the two. Hoogendoorn *et al* assessed the level but not the strength of the evidence and found an effect of low workplace social support and low job satisfaction after reviewing 11 cohort

**Table 2** Studies dealing with low back pain

First author, country, year (reference no.)	Sample size; participation rate at baseline, follow up	Study participants	Work related psychosocial exposures	Instrument used/s	Definition of LBP	Adjustments	Odds ratio
Viihari-Juntura, Finland, 1991 (10)	154; NR*	Historic cohort, population based	Job satisfaction	Not reported	Pain. Standardised Nordic Questionnaire	Age, sex, physical workload, education	NR*
Ready, Canada, 1993 (11)	119; 23%, 5%	Random sample of nurses employed at large health centre	Stress level Job satisfaction	Own instrument	Accident reports filed by employees	Age, fitness level, smoking, weight, alcohol intake	NS** NS**
Niedhammer, France, 1994 (12)	469; NR*	Randomly selected nurses from acute care in six French hospitals	Loss of enthusiasm for job Psychosocial factors at work	Own instrument	Symptoms from entire spine during previous 12 months	Age, sex, physical workload	NS**
Leino, Finland, 1995 (13)	411; NR*	Systematic, non-proportionate >sampling of workers at machine producing factory	Work content Work control Social relations Overstrain	Own instrument	Pain. Standardised Nordic Questionnaire	Age, sex, physical workload, occupational class	S*** S*** S*** S***
Papageorgiou, UK, 1997 (14)	1412; 59%, 18%	General population, employed and free from back pain in past month	Job satisfaction Relationships at work	Own instrument	Any pain below ribs and above gluteal fold past 12 months	Age	2.0 (1.7-3.3)
Tvan Poppel, Holland, 1998 (15)	238; 82%, 63%	All manual handling workers from Shiphol Airport Cargo Department	Job satisfaction	<b>Questionnaire by Dijkstra Health Risk Appraisal Questionnaire</b>	Pain or sick leave due to LBP past three months	Age, history of LBP, time riding forklift truck	0.9 (0.3-3.0) 1.2 (1.01-1.4)
fFeuerstein, USA, 1999 (16)	174; 49%, 49%	Back related disability from army Physical Disability Agency	Stress Job satisfaction	Own instrument	Disability due to LBP	Age, sex, physical workload, rank, group membership	2.71 (1.36-5.38) NS**
Bildt C, Sweden, 2000 (17)	788; 62%, 54%	Previous participants in population based survey	Low occupational pride Job strain On job development Education at employers expense	Own instrument	LBP > seven days during follow-up period but not previously	Age	F M 2.2 S 1.5 NS** 2.3 S 2.2 NS** 2.6 S 1.4 NS** 1.7 S 0.8 NS**
fFeyer, Australia, 2000 (18)	694; 100%, NR*	Two consecutive first year intake of student nurses	Job satisfaction	<b>General Health Questionnaire Karasek job content questionnaire</b>	'History of LBP'	Age, sex, history of LBP, work history, BMI, smoking, exercise	0.98 (0.95-1.00)
fHoogendoorn, Holland, 2001 (19)	861; 87%, 72%	Workers from 34 companies throughout the Netherlands	Quantitative demands Conflicting demands Decision authority Job satisfaction Skill discretion Supervisor support Co-worker support Job influence Decision latitude Social support Job demands Job insecurity Psychological demands Decision authority Social support Management support Low supervisor support High colleague support	<b>General Health Questionnaire Karasek job content questionnaire</b>	Standardised Nordic Questionnaire	Age, sex, physical workload, smoking, BMI, exercise, coping skills	1.41 NS** 1.37 NS** 0.98 NS** 1.75 NS** 0.97 NS** 1.24 NS** 1.65 NS**
Shannon, Canada, 2001 (20)	900; NR*, 48%	Random sample of hospital workers	Job satisfaction	<b>Questionnaire by Greenberger and Greenhalgh and own</b>	Back/buttock pain past week	Backwards stepwise regression with multiple variables	S*** NS** NS** NS** NS** S*** NS** S***
Torp, Norway, 2001 (21)	721; 75%, 26%	Workers from 226 Norwegian garages	Job satisfaction	<b>Karasek job content questionnaire</b>	Pain severity and duration past 30 days	Age, sex	S*** NS** NS** S***
Eflering, Switzerland, 2002 (22)	46; NR, 85% of baseline	Initially asymptomatic subjects with lower extr. injuries	Management support Low supervisor support High colleague support	<b>Questionnaire by Caplan et al</b>	Standardised Nordic Questionnaire	Physical workload, impairment, pain intensity, number of episodes	S*** S*** S***

**Table 2** Continued

First author, country, year (reference no.)	Sample size; participation rate at baseline, follow up	Study participants	Work related psychosocial exposures	Instrument used <sup>§</sup>	Definition of LBP	Adjustments	Odds ratio
†Elfering, Switzerland, 2002 (23)	186; 76%, 61%	Young nurses participating in other longitudinal study	Time control Social support Social stressors Job satisfaction Time pressure Stress Support Appreciation from clients Total mental exertion Monotonous work	Own questionnaire, questionnaires by Caplan <i>et al</i> and Oegeti <i>et al</i>	Standardised Nordic Questionnaire	Age, sex, physical workload, problems at baseline, BMI, leisure time sport, smoking, general health	2.19 (1.04–4.61) NS** NS** NS** NS** NS** NS** NS** NS** 1.50 (0.86–2.62) 1.70 1.39 (0.92–3.15) 1.39 (0.69–2.83) 1.00 NS** 2.07 (1.10–3.88) 0.80 0.30–2.00 1.00 (0.40–2.70) 1.50 (0.50–4.20) 1.85 (1.00–3.42) NS** NS** NS**
Gonge, Denmark, 2002 (24)	157; 89%, 85%	All employees in three Danish municipalities working in residential home care for elderly or handicapped people		Own questionnaire	LBP today, ten point Likert scale		
Latza, Germany, 2002 (25)	571; NR, 86%	Convenience sample of Hamburg bricklayers		Own 5 point scales	LBP >90 days past year	Age, sex	
†Gonge, Denmark, 2002 (26)	273; 84%/73%	Nurses in elderly care in three Danish municipalities	Time control Job control Social support Satisfaction with achievements Time pressure Emotional demands Social support	Own questionnaire, questionnaires by Kivimöki <i>et al</i> and North <i>et al</i>	LBP today	Age, physical exertion, smoking, neuroticism	
Yip, Hong Kong, 2002 (27)	337; NR/70% of baseline	Enrolled students or registered nurses working in same job for at least one month	Relationship with colleagues Relationship with supervisor Satisfied with work Stress at work Enjoy work	Questionnaires by Bigos and Goldberg	New or recurrent LBP	Age, sex, physical workload, smoking, alcohol, sociodemographic data, exercise	

†Study of higher quality according to quality assessment.

§In bold if validated instrument was used.

\*Not reported.

\*\*Non-significant, outcome measure or 95% CI not reported.

\*\*\*Significant, outcome measure not reported.



**Table 3** Studies dealing with consequences of low back pain

First author, country, year (reference no.)	Sample size; participation rate at baseline, follow up	Study participants	Work related psychosocial variables	Instrument used <sup>s</sup>	Definition of LBP	Adjustments	Odds ratio
Bigos, USA, 1991 (28)	1223; 75%, 54%	Volunteer hourly employees of Boeing aircraft factory	Job satisfaction	MMPI, Work APGAR	LBP claims past four years	Sex, previous LBP, treatment, education, physical workload	Without previous LBP 1.53 (1.09–2.29) With previous LBP 1.85 (1.30–2.62) S*** NS**
Bigos, USA, 1992 (29)	3020; 75%, 53%	Volunteer hourly employees of Boeing aircraft factory	Job satisfaction	MMPI, Work APGAR	LBP claims past four years	Age, sex, physical workload, covariates with highest predictive power	NS**
Härköpää, Finland, 1992 (30)	473; 61%, NR*	Chronic or recurrent LBP patients recruited through mailed questionnaires	Job satisfaction	Own instrument	Disability pension due to LBP	Age, sex	NS**
Lancourt, USA, 1992 (31)	134; 81%, 67%	Consecutive LBP patients receiving workers compensation	Job satisfaction	Not reported	Return to work after sick leave for LBP	Predictive indices based on discriminant analysis	NS**
Lehmann, USA, 1993 (32)	83; 84%/66%	Patients presenting with LBP and sick leave at 2–6 weeks	Job mental requirement Job stress Job appreciation Job responsibility Job affect Job supervisor affect External support Others listening Co-worker helpfulness Job satisfaction	Own, questionnaire by Price <i>et al</i>	Return to work	Not reported	NS** NS** NS** NS** NS** NS** NS** NS** NS** NS**
Coste, France, 1994 (33)	103; NR, 89% of baseline	Consecutive patients > 18 y presenting to GP office	Feelings towards work	Not reported	Return to work	Age, sex, physical workload, pain at entry, disability at entry, delay of care seeking, compensation status	0.57 (0.21–1.13) (Hazard ratio for return to work)
Infante-Rivard, Canada, 1996 (34)	270; 76%, 67%	Workers presenting with first time compensated LBP	Feelings towards work conditions	Faces scale	Return to work after sick leave for LBP	Sex, age physical workload, diagnosis, time from debut of pain to beginning of treatment, spinal flexion, neurological symptoms, duration of employment, private v public employer, possibilities for breaks	1.00** 1.00**
Hemingway, UK, 1997 (35)	10308; 73%, 53%	All non-industrial civil servants aged 35–55 and working in the London office of 20 depts	Control over work Conflicting demands Pace Social support at work Job satisfaction	Own instrument or Questionnaire by Karasek	Absence from work due to LBP	Age, sex, physical workload, education, car access, tenure, BMI, exercise, smoking	1.44 (1.11–1.85) 0.73 (0.55–0.95) 1.79 (1.39–2.31) 1.12 (0.84–1.41) 1.17 (0.92–1.48) 1.09 (0.78–1.52)
Nordin, USA, 1997 (36)	557; 40%, 29%	All employees with lost work episode due to LBP in two large public New York companies	Negative feelings about work Job satisfaction	Questionnaires by Israel, Quinn and Shephard	Delayed return to work	Not reported	0.96 (0.65–1.42)
Papageorgiou, UK, 1997 (14)	1412; 59%, 18%	General population, employed and free from back pain in past month	Relationships at work Influence on work conditions Recognition and respect Job security	Own instrument	Consulting doctor for any pain below ribs and above gluted fold past 12 months	Age	0.8 (0.2–2.7)
Wicksström, Finland, 1998 (37)	306 NR*	White and blue collar employees from two companies	Stress past five years Job satisfaction	Own instrument	Sick leave due to LBP	Age, physical workload	1.3 (0.9–1.9) 1.05 (0.59–1.88)
Williams, USA, 1998 (38)	87; 94%, 60%	Consecutive first time male LBP patients at medical center	Job satisfaction	Job description index, Work APGAR	Waddell physical impairment index—severity of pain	Physical limitation, ethnicity	1.99 (1.14–3.46) 1.35 (0.75–2.45) 1.10 (0.62–1.96) NR*

**Table 3** Continued

First author, country, year (reference no.)	Sample size; participation rate at baseline, follow up	Study participants	Work related psychosocial variables	Instrument used <sup>s</sup>	Definition of LBP	Adjustments	Odds ratio
Tvan Poppel, Holland, 1998 (15)	238; 82%, 63%	All manual handling workers from Shiphof Airport Cargo Department	Job satisfaction	<b>Questionnaire by Dijkstra</b>	Sick leave due to LBP past three months	Age, history of LBP, time riding forklift truck	1.2 (1.05-1.7)
Tvan der Weide, Holland, 1999 (39)	142; 85%, 76%	Health service workers sick listed for LBP	Problematic relations with colleagues Not enjoying work Work tempo	Not reported	Return to work	Unknown	0.82 (0.73-1.00) NS** NS**
Tousignant, Canada, 2000 (40)	601; 23-69%; NR	Employees from three companies in Quebec	Work monotony Job satisfaction	Not reported	New occurrence of compensation related to LBP	Unknown	1.2 (0.4-3.4)
Tvan der Giezen, Holland, 2000 (41)	298; 58%, 53%	Private sector employees sick-listed for 90 consecutive days	Decision latitude Psychological demands Social support	<b>Questionnaires by Karasek, Theorell, Johansson, Symonds</b>	Return to work after sick leave for LBP	Sex, age, physical workload, significant predictors for return to work	1.1 (0.9-1.3) NS** NS** NS**
Fransen, New Zealand, 2002 (42)	854; 59%, 59%	New cases of work related LBP reported at insurance corporation	Job satisfaction Co-worker support	<b>Work APGAR</b>	LBP claim and compensation	Age, sex, physical workload, individual and workplace variables significant in univariate analysis	1.26 (1.11-1.44) NS**
Tellerling, Switzerland, 2002 (23)	186; 76%, 61%	Young nurses participating in other longitudinal study	Time control Social support Social stressors Job satisfaction	<b>Own, questionnaires by Caplan et al and Oegerli et al</b>	Care seeking for LBP	Age, sex, physical workload, problems at baseline, BMI, leisure time sport, smoking, general health	5.75 (1.27-25.9) NS** NS**
THoogendoorn, Holland, 2002 (43)	988; 87%, 43%	Workers from 34 Dutch companies	Qualitative job demands Conflicting demands Decision authority Skill discretion Supervisor support Co-worker support	<b>Questionnaire by Karasek, Dutch questionnaire on job satisfaction</b>	Absence more than three days from work due to LBP	Age, sex, physical workload, physical function at leisure	0.68 (0.30-1.40) 1.20 (0.61-2.19) 0.69 (0.34-1.40) 1.10 (0.58-2.10) 1.43 (0.77-2.74) 1.46 (0.82-2.61)
Hagen, Norway, 2002 (44)	2527; 1 73%, 73%	All employed men and women aged 25-59 in Norwegian county	Job satisfaction Excessive job demands Authority to plan own work	Own questionnaire	Retirement due to LBP, register based	Age, sex, physical workload, other psychosocial variables	1.95 (1.08-3.39) 0.60 (0.40-1.00) 1.40 (1.00-2.00) 1.50 (1.00-2.30) NS**
Schultz, Canada, 2002 (45)	579; 63%/27%	Workers with subacute and chronic low back injuries	Job satisfaction Job content	<b>Questionnaire by Karasek</b>	Return to work	Age, sex, physical workload, duration of pain, union membership, physical functioning, total time in current job, Waddell non-organic signs	NR*
TTubach, France, 2002 (46)	2,236; 78%, 56%	Workers from high physical stress groups from electrical corporation	Decision latitude Psychological demands Social support at work Job satisfaction	<b>Questionnaire by Karasek, own questionnaire</b>	<8 days of sick leave due to LBP >8 days of sick leave due to LBP	Age, sex, physical workload, personal factors, self perceived health	1.20 (0.90-1.60) 1.40 (0.90-2.30) NR* NR* 1.10 (0.60-2.00) 3.40 (1.60-7.30) NR*

†Study of higher quality according to quality assessment. \$in bold if validated instrument was used.

\*Not reported.

\*\*Non-significant, outcome measure or 95% CI not reported.

\*\*\*Significant, outcome measure not reported.

**Table 4** Quality of reviewed studies

Quality criteria	1	2	3	4	5	6	7	8	9	Total score
<b>Studies dealing with low back pain</b>										
Viikari-Juntura	y	y			y	y	y			5
Ready	y					y	y	y		4
Niedhammer	y				y	y	y	y		5
Leino	y	y		y	y	y	y	y		7
Papageorgiou	y	y			y	y	y	y		6
van Poppel	y	y	y	y	y		y	y	y	8
Feuerstein	y	y		y	y	y	y	y	y	8
Bildt	y	y			y	y	y	y	y	7
Feyer	y	y	y	y		y	y	y	y	8
Hoogendoorn	y	y	y	y	y	y	y	y	y	9
Shannon	y	y		y		y	y	y		6
Torp	y	y		y		y	y	y		6
Elfering	y	y			y	y	y	y		6
Elfering	y	y		y	y	y	y	y	y	8
Gonge	y		y		y	y		y	y	6
Latza	y				y	y	y	y	y	6
Gonge	y	y	y	y	y	y		y	y	8
Yip	y			y	y	y	y	y	y	7
<b>Studies dealing with consequences of low back pain</b>										
Bigos	y	y			y		y	y	y	6
Bigos	y			y		y	y	y		5
Härkäpää	y					y	y	y		4
Lancourt	y		y		y	y				4
Lehann	y		y	y	y	y				5
Coste	y	y			y	y		y	y	6
Infante-Rivard	y	y			y	y	y	y	y	7
Hemmingway		y		y	y	y	y	y	y	7
Nordin	y	y		y	y	y	y	y	y	7
Papageorgiou	y	y			y	y	y	y		6
Wicksström	y				y	y	y	y	y	6
Williams	y	y	y	y		y		y		6
van Poppel	y	y	y	y	y		y	y	y	8
van der Weide	y		y	y	y	y	y	y	y	8
Toussignant	y				y	y	y	y	y	5
van der Giezen	y	y		y	y	y	y	y	y	8
Fransen	y	y		y	y	y	y		y	7
Elfering	y	y		y	y	y	y	y	y	8
Hoogendoorn	y	y	y	y	y	y	y	y	y	9
Hagen	y	y			y	y	y	y	y	7
Schultz	y	y		y		y		y		5
Tubach	y	y		y	y	y	y	y	y	8

and case-control studies.<sup>19</sup> However, they also noted that slight changes in their rating system would result in a different conclusion.<sup>19</sup> Davis and Heaney, after reviewing 66 articles published before 1999, concluded that studies of better quality appeared to more consistently associate low job satisfaction and job stress with the development of LBP. However, they found it premature to draw causal inferences due to many unresolved methodological issues.<sup>2</sup> We included and critically reviewed only prospective cohort studies of recent date, and after assessing both the level of evidence and the strength of association found a striking lack of association between work related psychosocial factors on one side and LBP and consequences of LBP on the other. This is in contrast to the a review published by Linton in 2001 in which he concluded that there was strong associations between a number of psychosocial work factors and back pain and that the majority of the studies were of acceptable quality.<sup>47</sup> In our opinion these conclusions are not justified on the basis of the published paper. First, Linton included only 21 prospective cohort studies indicating unsystematic and incomplete literature retrieval; second, studies not employing prospective designs were mistakenly labelled as prospective; third, he included studies with outcomes different from back pain (sciatica, disc prolapse); fourth, some results cited in the review are not supported by data published in the original papers; and finally, no critical appraisal of the original papers was performed.

New studies show that associations between psychosocial measures and disease outcomes may be spurious. For instance, Macleod and colleagues<sup>48</sup> found that even though higher self reported psychological stress was associated with symptoms of chest pain, and thus in many cases with a diagnosis of coronary heart disease, most highly stressed patients lacked objective indices of organic heart disease. In fact, self reported stress showed a weak inverse relation to all objective indices of organic heart disease in spite of reported symptoms. Thus persons reporting high stress levels might report more pain even in the absence of organic disease, whereas persons with different personality traits tend to report low stress and no symptoms in spite of objective signs of disease. This same effect may explain the strong association sometimes found between stress at work and LBP, but unfortunately, it is not at present possible to differentiate “organic LBP” from “non-organic LBP”. Also Papageorgiou *et al* found that dissatisfaction with status and income was not related to employment per se, but rather represented dissatisfaction with life in general.<sup>49</sup>

Accuracy, reliability and reproducibility of measurements are essential features of good research data and uniform, standardised definitions of exposure and disease outcome are necessary if results are to be compared across studies. Unfortunately, due to the subjective nature of LBP, no gold standard definition currently exists. Consequently, the definition of outcomes varied among studies from self



reported pain today<sup>24</sup> to disability pension due to long-standing LBP,<sup>30</sup> which in our opinion, are hardly comparable outcomes. Also the definition of the psychosocial factors varied considerably, and some may even be regarded as intermediate variables between exposure and effect (that is, job satisfaction and stress level). We reported results from the primary studies' "face value" since the purpose of this review was not to try to disentangle intermediate effects. Finally, data on psychosocial exposures were collected in a wide variety of ways. For instance, in 12 studies the researchers' own, presumably different questionnaires were used without any reporting of a validation procedure. Further, 20 different validated questionnaires were used in other studies mostly only once, and in five papers the authors did not report how psychosocial data were collected<sup>10 31 33 39 40</sup> (tables 2 and 3). This lack of agreement and standardisation of both exposure and outcome is methodologically unsound and may give rise to random associations in single studies and account for much of the variation between studies. This tendency towards random associations might be further reinforced by the many statistical tests performed in almost every study reviewed.

According to Karasek, people with jobs characterised by low control over their work and high and conflicting work demands might be at higher risk for disease and less satisfied with their work.<sup>50</sup> Presumably, a high level of social support may buffer this effect and low social support may amplify it.<sup>3</sup> The results of this review lead us to question this model in relation to LBP. First, in all of the studies investigating the variables relating to control and demand, no significant positive relation to LBP was found, and in the higher quality studies a negative or neutral association was found. Second, we found moderate evidence for no association between low social support and both LBP and consequences of LBP.

Alternative models of psychosocial work characteristics and their effect on health are based on a concept of imbalance between the effort at work and the rewards received;<sup>51</sup> that is, prestige or high salaries may cause workers to better tolerate and accept unhealthy environments. This model has to our knowledge not been tested in relation to LBP. Maybe both physical and psychosocial work characteristics affect workers differently depending on factors such as job type, income, ethnicity, country, etc; and perhaps the measurement of, for instance, job satisfaction requires different approaches in different environments.

In our opinion, the completion of many prospective cohort studies such as recommended by Bongers *et al* in 1993<sup>4</sup> has not disentangled the relation between work related psychosocial factors and the aetiology and consequences of LBP. The future challenge for researchers will be to develop standardised and valid definitions and operational instruments for reproducible measurements of psychosocial factors internationally and employ these in future studies. Also attention needs to be paid to the biological plausibility of the theories in this field. Until then biological relations remain speculative and strategies for preventing musculoskeletal disease by improving psychosocial work environments will probably be fruitless.

## Conclusions

According to recent epidemiological literature we found moderate evidence for no positive association between perception of work, organisational aspects of work, and social support at work and LBP. We found insufficient evidence for an association between stress at work and LBP. Regarding consequences of LBP, there was insufficient evidence for an association between perception of work in relation to consequences of LBP. There was strong evidence for no association between organisational aspects of work

and moderate evidence for no association between social support at work and stress at work and consequences of LBP. There were major methodological problems in the majority of studies included in this review and the diversity in methods was considerable. Therefore associations reported may be spurious and should be interpreted with caution.

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