Psychosocial Factors and Low Back Pain Outcomes in a Pooled Analysis of Low Back Pain Studies

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Objective: Assessment of possible relationships between work-related psychosocial measures and self-reported low back pain (LBP) outcomes in a large pooled dataset of 1929 participants from 82 facilities in the United States. **Methods:** Pooled data from three prospective cohort studies were used to calculate odds ratios (OR) and 95% confidence intervals (95% CI) for relationships between psychosocial factors and the LBP outcomes. Personal and occupational confounders were controlled for in adjusted Logistic regression models. **Results:** Supervisor support and job satisfaction were significantly ($P < 0.05$) related to all three LBP outcomes. Other psychosocial factors were significantly ($P < 0.05$) associated with at least one of the LBP outcomes. Adjusted ORs ranged from approximately 1.50 to 3.50 for most associations. **Conclusions:** There is a significant relationship between work-related psychosocial measures and LBP outcomes.

Keywords: job control, job satisfaction, lifting index, low back pain, lost time, musculoskeletal disorders, odds ratio, psychosocial factors, seeking medical care, supervisor support, work organizational factors

Psychosocial factors have been related to musculoskeletal disorders (MSDs), including low back pain (LBP). This growing body of evidence suggests a possible causal relationship between psychosocial factors and reporting of subjective measures of musculoskeletal disorders such as pain.

Personal factors including demographic measures (eg, age, sex, body mass index) and occupational factors (job physical factors, hours worked, company tenure) have also been found to be associated with LBP in other studies.[1–9] The development of chronic disabling LBP in a Japanese population was found to be increased by poor impressions of feeling rewarded to work (not feeling rewarded, odds ratio [OR]: 3.62, 95% confidence interval [CI]: 1.17 to 11.19), anxiety (anxious, OR: 2.89, 95% CI: 0.97 to 8.57), and lower daily life satisfaction (not satisfied, ORs: 4.14, 95% CI: 1.18 to 14.58).[10] In another study, multivariate analyses adjusted for individual factors and an ergonomic factor found increased risk of persistent LBP from increased interpersonal stress at work [adjusted OR: 1.96 and 95% CI: 1.00 to 3.82], lower job satisfaction (OR: 2.34, 95% CI: 1.21 to 4.54), higher feelings of depression (OR: 1.92, 95% CI: 1.00 to 3.69), lower support from supervisors (OR: 2.01, 95% CI: 1.05 to 3.85), previous sick-leave due to LBP (OR: 1.94, 95% CI: 0.98 to 3.86), and family history of LBP with disability (OR: 1.98, 95% CI: 1.04 to 3.78).[11] Lost time due to LBP was statistically significantly associated with less frequent negative beliefs (OR 0.97; 95% CI, 0.94, 1.00), increased pain catastrophizing (OR 1.33; 95% CI, 1.04, 1.71), low job satisfaction (OR 0.71; 95% CI, 0.51, 0.97), and high job support (OR 1.35; 95% CI, 1.04, 1.75).[12] A general population survey in Norway found work-related psychosocial predictors of LBP were high job demands (OR 1.41, 95% CI 1.16 to 1.72) and low job control (OR 1.26, 95% CI 1.01 to 1.57).[13] High levels of perceived interpersonal stress at workplace (OR: 2.42, 95% CI: 1.08 to 5.43), and self-reported high frequency of monotonous tasks (OR: 2.21, 95% CI: 0.99 to 4.94) were reported risks for incident cases of LBP in Japan.[14] Workers followed for 1 year were found to have increased risk of disabling LBP from high demands, low control, job strain, low job satisfaction and low job appreciation.[15] Low decision latitude, low social support at work, high job strain, low wage and job satisfaction, feeling stressed at work, and feeling depressed were associated with LBP in a cross-sectional study. High job insecurity, feeling stressed at work, and feeling depressed increase the relative risks for LBP in women.[2] Another study reported that low job control as compared with high control was associated with a 3.2-fold risk (95% CI, 1.3 to 7.8) of hospitalization for back disorders other than those of the intervertebral disc.[16] The rate ratio corresponding with low back disorders for low versus high supervisor support was 2.9 (95% confidence interval, 1.3 to 6.3). High job demands, low levels of coworker support, and high levels of distress were not independently associated with these disorders. The result did not change when patients with chronic back disorder at baseline were excluded from the analysis. There was no association between psychosocial factors at work and hospitalizations for intervertebral disc disorders.[16]

Despite the growing literature evaluating relationships between work-related psychosocial factors and LBP, few studies attempted to adjust estimates for potential confounding factors, in particular job-related physical risk factors. Furthermore, there are virtually no studies assessing the complex relationships between psychosocial factors and both personal factors and company tenure. The objectives of this study were to combine data from several studies (ie, LBP research consortium) and[1] examine the relationships between psychosocial factors and both personal and company tenure and[2] quantify relationships between work-related psychosocial factors and LBP outcomes while controlling for personal, physical risk factors, and company tenure.

METHODS

Population

The LBP research consortium included five members: National Institute for Occupational Safety and Health (NIOSH),

From the Family and Preventive Medicine (Dr Thiese, Dr Hegmann); Division of Field Studies and Engineering, National Institute for Occupational Safety and Health, Cincinnati (Dr Lu); Mechanical Engineering (Dr Merryweather), University of Utah, Utah; Occupational Science and Technology, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin (Dr Tang, Dr Kapellusch); Spine Research Institute, The Ohio State University (Dr Ferguson, Dr Marras), Ohio; and American University, Washington (Dr Malloy).

Clinical significance: Low back pain (LBP) is a common and costly health outcome. Measuring the relationships between psychosocial factors and severe measures of LBP is important. By knowing more about these relationships clinicians can identify potential risks for developing pain as well as target interventions to reduce or prevent LBP.

Source of support: This research was supported by grants from the Centers for Disease Control and Prevention (NIOSH), 1R01OH009155 and R01OH010916 and NIOSH Education and Research Center training grant T42/CCT810426-10. No Industry support.

Conflict of interest: None declared.

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DOI: 10.1097/JOM.0000000000001941

the Ohio State University (OSU), the University of Wisconsin-Milwaukee (UWM), Texas A&M University (TAMU), and the University of Utah (UU). The consortia analyses and the underlying cohort studies were approved by their respective Institutional Review Boards prior to enrollment of study participants. Prior studies have reported methods for the underlying cohort studies[17–19] and pooled study.[20,21]

Workers were enrolled from 82 worksites in six US states (IL, MI, OH, TX, UT, WI). The workers were employed across a wide variety of manufacturing and service industries, such as automobile part manufacturing, appliance manufacturing, grocery warehousing, clothing distribution centers, and office work. These worksites included low, medium, and high job physical demands for primarily manual lifting tasks.

Workers were enrolled regardless of a history of either current or past LBP. For the cross-sectional analyses of the pooled data in this study, the primary exclusion was for workers who were planning on leaving the job. One site, NIOSH, required eligible workers to have been employed for at least 1 year in an attempt to reduce attrition due to job turnover.

Workers completed questionnaires at enrollment between 2003 and 2006. These questionnaires included demographic, workplace psychosocial, work organizational factors, and LBP outcomes.

Job physical variables were separately collected on-site by trained ergonomists. Job physical factors included the weight of objects lifted, frequencies lifted, horizontal distance of the lift from the L5/S1 disc, and vertical distance at the origin and destination of the lift. The job physical variables allowed for the calculation of a composite measure (ie, cumulative lifting index or CULI) of job physical demands using the revised NIOSH lifting equation (RNLE).[22,23]

Work-Related Psychosocial Factors

Seven workplace psychosocial variables were collected across all sites. All psychosocial factors were self-reported and therefore perceived by each individual study participant. These variables included supervisor support, coworker support, job satisfaction, worker's control over breaks, worker's control over task order, worker's control over job pace, and worker's control over job variety. These variables were collected on a 3–5 Likert scale, and were subsequently categorized by a priori thresholds to group similar responses (eg, combining ''Very Much'' and ''Much'' for control over breaks, task order, and job pace) for comparisons with potentially predictive factors. Psychosocial factors were kept in a Likert scale for assessing potential relationships with LBP outcomes to maintain resolution of data.

Potential Confounders

Age, sex, BMI, smoking status, the cumulative lifting index (CULI), and company tenure were a priori considered potential confounders in this study. The CULI was used as the measure for the overall job related physical demands for manual lifting tasks. Based on the well-validated lifting index (LI), the CULI integrates biomechanical stressors (eg, lifted load, lifting frequency, body postures for lifting) from all tasks performed during a work shift into a single job-level exposure.[24–26] Because of the field data collection opportunities and intensive labor for measuring the task variables required for calculating the CULI, there were 322 participants missing CULI information. Separate models adjusting for all a priori confounders and all except CULI were created and assessed for goodness-of-fit.

LBP Outcomes

Three self-reported questionnaire based LBP outcomes were analyzed; (1) any LBP lasting seven continuous days or more in the past year, (2) seeking care for LBP, and (3) lost time for LBP. These outcomes have been reported elsewhere.[17–19] We selected these three outcomes a priori as they are indicative of more severe LBP.

Statistical Analyses

Frequencies and percentages were calculated for categorical variables. Correlations and Cronbach Alpha statistics were calculated for relationships between psychosocial variables. Logistic regression was used to calculate crude and adjusted odds ratios (ORs) and 95% confidence intervals (CI). Psychosocial factors were dichotomized to assess relationship between individual psychosocial factors and age, sex, BMI, and company tenure. Potential confounders were adjusted using multivariable logistic regression. Data were analyzed in SAS (Cary, NC).

RESULTS

A total of 1929 workers were enrolled from 82 facilities in six US states and completed baseline data collection. Descriptive statistics of the population and their psychosocial responses are in Table 1.

Spearman correlations between the psychosocial variables were generally weak, with most falling below $r = 0.5$. The one exception was the correlation between Control order and Control pace ($r = 0.54$). Cronbach Alpha was calculated for measures with $r > 0.4$ and the highest alpha was 0.65, suggesting some agreement but not to the generally accepted threshold of 0.70.[27] Therefore, none of these psychosocial variables were combined into a larger single metric for calculating their ORs for LBP outcomes.

Table 2 shows the adjusted ORs and 95% CI for relationships between psychosocial variables and both personal factors and company tenure. Poor job satisfaction, supervisor and coworker support were most strongly associated with both demographic factors and company tenure. Increased company tenure was associated with poor supervisor support, poor coworker support, and poor job satisfaction. It is worth mentioning that there was an increasing trend in the adjusted ORs for the above poor psychosocial variables with the increased company tenure. Contrary to company tenure, age was not associated with these psychosocial variables. Additionally, women were significantly more likely to report poor control over job pace but less likely to report poor supervisor support or poor control over breaks.

The ORs with 95% CI for the relationships between perceived psychosocial factors and LBP outcomes are presented in Table 3. Supervisor support and job satisfaction were significantly related to all three LBP outcomes. All other factors were significantly associated with one of the LBP outcomes, most of which were LBP. Coworker support was the only one that was statistically significant for lost time but not the other LBP outcomes. Test-for-trend for the relationship between LBP and increasing odds ratios across ordered categories in each psychosocial factor were statistically significant, with exception of coworker support ($P = 0.068$). Test-for-trend was also statistically significant for most psychosocial factors and both seeking care and lost time.

DISCUSSION

The findings from this study suggest that the investigated psychosocial factors were not significantly correlated nor had a high Cronbach alpha, suggesting that participants' perceptions of supervisory support, coworker support, job satisfaction, control over breaks, task order, and job pace were independent factors that might have different underlying effects on the development of LBP. Further examinations showed that the relationships between multiple psychosocial factors and each of the three LBP outcomes remained significant after adjustment for potential confounders. This finding suggests that perceived psychosocial factors are independently associated with LBP outcomes and the associations are

TABLE 1. Personal, Work-Related Psychosocial Factors and LBP Outcomes of Pooled Study Population

Variable	*N* (%)
Gender	
Male	1446 (75.0)
Female	483 (25.0)
Age	
Less than 25	356 (18.5)
25–29	340 (17.7)
30–34	299 (15.5)
35–39	232 (12.1)
40–44	204 (10.6)
45–49	178 (9.3)
50–54	181 (9.4)
55–59	83 (4.3)
60 or more	52 (2.7)
Smoking	
Less than 100 cigarettes in their life	957 (49.6)
Smoked in the past but quit	404 (20.9)
Current smoker	568 (29.5)
Body mass index	
Normal weight (BMI $< 25.0\,kg/m^2$)	624 (32.6)
Overweight (BMI 25.0–29.99 kg/m^2)	675 (35.3)
Stage I obesity (BMI 30.0–34.99 kg/m^2)	382 (20.0)
Stage II obesity (BMI 35.0–39.99 kg/m^2)	144 (7.5)
Stage III obesity (BMI $\geq 40.0\,kg/m^2$)	89 (4.7)
Cumulative lifting index	
<1.00	347 (18.0)
1.00–1.99	390 (20.2)
2.00–2.99	401 (20.8)
3.00 or more	470 (24.4)
Missing	321 (16.6)
Company tenure	
<3 months	115 (6.0)
3–11 months	331 (17.3)
12–35 months	458 (23.9)
3.0–4.9 years	284 (14.8)
5.0–9.9 years	386 (20.1)
10 or more years	343 (17.9)
Supervisor support	
Almost always*	935 (49.0)
Some of the time	758 (39.8)
Hardly ever	214 (11.2)
Coworker support	
Almost always*	817 (42.8)
Some of the time	915 (47.9)
Hardly ever	178 (9.3)
Job satisfaction	
Very satisfied*	592 (31.0)
Somewhat satisfied	975 (51.0)
A little satisfied	272 (14.2)
Not at all satisfied	72 (3.8)
Control over breaks	
Very much*	169 (9.5)
Much*	260 (14.6)
Moderate amounts	434 (24.4)
A little	361 (20.3)
Very little	558 (31.3)
Control over task order	
Very much*	274 (15.4)
Much*	392 (22.0)
Moderate amounts	483 (27.2)
A little	253 (14.2)
Very little	377 (21.2)
Control of job pace	
Very much*	363 (20.2)
Much*	443 (24.6)
Moderate amounts	444 (24.7)
A little	228 (12.7)
Very little	322 (17.9)
Low back pain lasting 7 days or more in the past year	483 (25.0)
Seeing a health care provider for low back pain	272 (14.1)
Lost work time for low back pain	192 (10.0)

*Indicates combined groups used as the reference group for logistic regression.

TABLE 2. Adjusted Odds Ratios and 95% Confidence Intervals for Relationships Between Psychosocial Variables and Both Personal Factors and Company Tenure

Psychosocial Variable	Adjusted Odds Ratio and 95% CI
Poor supervisor support	
Gender	
Male	1.00 (Reference)
Female	0.67 (0.54, 0.84)*
Age (per year)	0.97 (0.96, 0.98)*
Body mass index (per kg/m^2)	1.00 (0.98, 1.01)
Company tenure	
<3 months	1.00 (Reference)
3–11 months	2.23 (1.40, 3.53)*
12–35 months	2.60 (1.66, 4.06)*
3.0–4.9 years	3.58 (2.22, 5.77)*
5.0–9.9 years	4.28 (2.68, 6.84)*
10 or more years	5.02 (3.05, 8.25)*
Poor coworker support	
Gender	
Male	1.00 (Reference)
Female	1.04 (0.84, 1.29)
Age (per year)	1.00 (0.99, 1.01)
Body mass index (per kg/m^2)	1.00 (0.98, 1.01)
Company tenure	
<3 months	1.00 (Reference)
3–11 months	1.18 (0.77, 1.82)
12–35 months	1.34 (0.88, 2.02)
3.0–4.9 years	1.79 (1.14, 2.80)*
5.0–9.9 years	1.87 (1.21, 2.90)*
10 or more years	1.75 (1.10, 2.78)*
Poor control over job breaks	
Gender	
Male	1.00 (Reference)
Female	0.77 (0.59, 0.99)*
Age (per year)	1.015 (1.004, 1.027)*
Body mass index (per kg/m^2)	0.978 (0.968, 0.99)*
Company tenure	
<3 months	1.00 (Reference)
3–11 months	0.92 (0.55, 1.55)
12–35 months	0.88 (0.53, 1.44)
3.0–4.9 years	0.92 (0.54, 1.58)
5.0–9.9 years	0.85 (0.51, 1.44)
10 or more years	0.89 (0.51, 1.57)
Poor control over job pace	
Gender	
Male	1.00 (Reference)
Female	1.261 (1.003, 1.582)*
Age (per year)	1.00 (0.99, 1.01)
Body mass index (per kg/m^2)	1.00 (0.99, 1.02)
Company tenure	
<3 months	1.00 (Reference)
3–11 months	0.94 (0.61, 1.46)
12–35 months	1.10 (0.72, 1.68)
3.0–4.9 years	1.14 (0.73, 1.80)
5.0–9.9 years	1.16 (0.75, 1.80)
10 or more years	1.31 (0.81, 2.10)
Poor control over job task order	
Gender	
Male	1.00 (Reference)
Female	1.21 (0.96, 1.54)
Age (per year)	1.014 (1.002, 1.023)*
Body mass index (per kg/m^2)	0.99 (0.98, 1.01)
Company tenure	
<3 months	1.00 (Reference)
3–11 months	0.92 (0.58, 1.44)
12–35 months	0.78 (0.51, 1.21)
3.0–4.9 years	0.87 (0.54, 1.40)
5.0–9.9 years	1.01 (0.64, 1.60)
10 or more years	0.97 (0.60, 1.59)
Poor job satisfaction	
Gender	
Male	1.00 (Reference)
Female	0.83 (0.66, 1.04)
Age (per year)	0.97 (0.96, 0.98)*
Body mass index (per kg/m^2)	0.987 (0.971, 0.997)*
Company tenure	
<3 months	1.00 (Reference)
3–11 months	1.25 (0.80, 1.96)
12–35 months	1.75 (1.13, 2.71)*
3.0–4.9 years	2.04 (1.27, 3.27)*
5.0–9.9 years	2.20 (1.39, 3.48)*
10 or more years	2.94 (1.80, 4.80)*

*$P < 0.05$.

TABLE 3. Adjusted Odds Ratios for Relationships Between Psychosocial Factors and Low Back Pain Outcomes[†]

	Low Back Pain	Seeking Care	Lost Time
High supervisor support	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Moderate supervisor support	1.74 (1.37, 2.20)**	1.91 (1.42, 2.58)**	1.90 (1.33, 2.71)**
Low supervisor support	2.17 (1.54, 3.05)**	1.72 (1.11, 2.66)**	2.57 (1.61, 4.11)**
High job satisfaction	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Moderately high job satisfaction	1.56 (1.21, 2.02)**	1.31 (0.95, 1.81)*	1.80 (1.20, 2.69)**
Moderate low job satisfaction	1.48 (1.04, 2.10)**	1.12 (0.71, 1.75)	1.66 (0.97, 2.83)*
Low job satisfaction	3.44 (2.03, 5.81)**	1.95 (1.02, 3.70)**	3.67 (1.84, 7.32)**
High control over breaks	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Moderately high control over breaks	0.73 (0.44, 1.23)	0.78 (0.39, 1.56)	0.74 (0.33, 1.66)
Moderate control over breaks	1.48 (0.95, 2.31)*	1.93 (1.07, 3.49)**	2.06 (1.06, 4.01)**
Moderately low control over breaks	1.47 (0.93, 2.33)*	1.71 (0.94, 3.13)*	1.37 (0.68, 2.75)
Low control over breaks	1.55 (1.00, 2.39)**	1.60 (0.89, 2.85)	1.82 (0.95, 3.51)*
High control of task order	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Moderately high control over task order	1.42 (0.96, 2.09)*	1.27 (0.79, 2.05)	1.20 (0.69, 2.09)
Moderate control over task order	1.37 (0.95, 1.99)*	1.30 (0.82, 2.05)	1.42 (0.84, 2.38)
Moderately low control over task order	1.71 (1.13, 2.59)**	1.47 (0.88, 2.44)	1.69 (0.95, 2.99)*
Low control over task order	1.75 (1.20, 2.56)**	1.45 (0.91, 2.32)	1.19 (0.69, 2.06)
High control over job pace	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Moderately high control over job pace	1.08 (0.77, 1.52)	0.98 (0.65, 1.47)	0.96 (0.59, 1.56)
Moderate control over job pace	1.21 (0.86, 1.69)	1.11 (0.75, 1.67)	1.29 (0.81, 2.05)
Moderately low control over job pace	1.23 (0.83, 1.84)	0.98 (0.60, 1.61)	0.97 (0.54, 1.72)
Low control over job pace	1.64 (1.15, 2.33)**	1.02 (0.65, 1.58)	1.30 (0.79, 2.13)
High coworker support	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Moderate coworker support	1.11 (0.88, 1.39)	1.24 (0.93, 1.66)	1.44 (1.03, 2.01)**
Low coworker support	1.45 (1.00, 2.11)**	1.42 (0.89, 2.28)	1.47 (0.85, 2.54)

[†]Adjusted for age, BMI, company tenure, cumulative lifting index, and smoking.
*$P < 0.10$.
**$P < 0.05$.

not affected by the adjustments of physical job demands. This finding agrees with a previous cross-sectional and longitudinal studies.[2,13]

LBP has been defined in many different ways in prior studies, including using any LBP, pain duration, pain rating.[1–9] The three outcome measures of LBP for 7 continuous days or more, seeking care for LBP, and lost time for LBP used in these analyses were selected to indicate increasingly severe cases of LBP with a higher likelihood of impacting individual's behavior as compared with those who had LBP for less than 24 hours. Two of these outcomes, seeking care and lost time, also have a direct financial cost and may be of more interest from both an individual participant as well as an organizational, health care provider, and employer perspective.

Many psychosocial factors had statistically significant test-of-trend relationships, even though many individual categories of psychosocial factors were not significantly associated with LBP outcomes at a 0.05 level (Table 3). Three psychosocial variables (job satisfaction, supervisory, and coworker support) were skewed to positive responses (very much/always and somewhat/some of the time) with most of the study population (82% to 90%) reporting in these categories. The higher proportion of participants in these categories of the psychosocial variables is not consistent with data from the Quality of Work Life (QWL) national surveys conducted during the study period. Data from the QWL surveys conducted in 2002, 2006, and 2010 showed a consistent percentage of the same psychosocial variables ranging from 45% to 53%.[28] One possible explanation for this inconsistency is that this study focused on manual lifting jobs, whereas the QWL surveys consisted of jobs in all industry sectors, including non-manual lifting jobs, which may have lower levels of job satisfaction or workplace psychosocial support. Other possible explanations include self-selection or healthy worker effect; individuals with low job satisfaction and/or workplace support are more likely to leave the workplace.

Compared with the high job satisfaction group, study participants with low job satisfaction were 2.0 to 3.8 times more likely to report the LBP outcomes. Among the risk magnitudes of all the psychosocial variables investigated in this study, job dissatisfaction had the greatest risk association. However, cautions should be exercised about this finding. The single item for measuring the psychometric property of job satisfaction used in this study may not be reliable.[29] Inconsistent results of job satisfaction in relation to LBP have been reported in several studies using single and multiple items.[30–32] Additionally, this factor may be more variable than other psychosocial factors based on workers' immediate perceptions of the workplace, feeling valued and overall mood.

Most of the study participants were men. This is at least partially due to the physically demanding aspects of the job, and is indicative of most manual materials handling and manufacturing industries. Female workers were less likely to report poor supervisory support, poor control over job breaks, and poor job satisfaction. However, they were more likely to report poor control over job pace, which was a physical job-based psychosocial strain. These findings suggest that female workers might be more susceptible or reactive to the pace of the job. Additionally, inconsistent findings suggest that psychosocial strain might be experienced differently between sexes. Possible explanations of these differences include a differential treatment of women compared with men, uncontrolled confounding, or effect modification by sex on the relationships observed.

Results indicate that age may be a protective factor against some psychosocial strain measures including poor supervisory support and job satisfaction. The protective effect may be explained by a potential selective survival or healthy worker effect.[33] In addition, prolonged company tenure tended to increase risk or psychosocial strain, perhaps suggesting that age alone is not protective in companies with troubled safety cultures. It is possible that companies with a stronger emphasis on safety behaviors are more

likely to have more frequent safety retraining. Safety leadership of the company has been linked to the development of LBP in a previous study.[34] Inclusion of safety culture measures in future research may help elucidate the potential interaction effect between age, company tenure, and safety culture. Other possible explanations for these relationships include self-selection of workers who are not safety conscious into specific workplace environments. Whereas workers who are more safety conscious are more likely to change jobs or positions within the company to increasingly safer work environments or safety climates.

Strengths of the present study include a large sample size from different study sites in many industry sectors; a statistical control for confounding factors, in particular physical job demands measured on individual level; and different types and scales of work-related psychosocial measures. However, although workers were enrolled from a variety of worksites, where high physical demand jobs and low physical demand jobs were included, workers in high physical demand jobs (eg, warehouse workers who pick and select orders to compile pallets for shipping to grocery stores) were disproportionately included in this study, suggesting an uneven distribution of job demands for controlling their potential effects on the psychosocial measures. In addition, due to the limited sample size for assessing interaction effects, each individual physical job stress may have interacted with the psychosocial variables differently, resulting in different development of the LBP measures. Another limitation is the unknown effect of the missing portion (16.6%) of the CULI information. Finally, findings of this study were based on a cross-sectional analysis and cannot demonstrate temporality. Further longitudinal research is needed to explore these relationships, in particular the effects of interactions of demographic and occupational factors on the development of psychosocial strain.

CONCLUSIONS

Among all psychosocial factors assessed in this study, supervisor support and job satisfaction were significantly ($P < 0.05$) related to all three LBP outcomes, even after adjusting for personal, job demands, and company tenure. Between the two significant psychosocial variables, poor job satisfaction had the greatest risk (adjusted ORs = 1.95 to 3.67) for all three LBP outcomes. All other psychosocial factors were significantly ($P < 0.05$) associated with one of the LBP outcomes, most of which were LBP. A decreased level of coworker support was significantly associated with lost time due to LBP. There were statistically significant trends with increasingly poor psychosocial factors related to LBP with the exception of coworker support ($P = 0.068$). Respectively, prolonged company tenure and age were positively and negatively associated with psychosocial strain, suggesting some interplay between age and company tenure. Longitudinal analyses of these relationships may help clarify these complex relationships further.

ACKNOWLEDGMENTS

The findings and conclusions in this study are those of the authors and do not necessarily represent the official views of the National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention. They would like to acknowledge our friend and colleague Dr Arun Garg, who recently passed away, for his leadership, guidance, and support on this project. He was also one of the pioneers in the field of occupational ergonomics and worked tirelessly to improve workplace safety for several decades.

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