

Psychosocial job factors associated with back and neck pain in public transit operators

by Niklas Krause, MD,¹ David R Ragland, PhD,¹ Birgit A Greiner, PhD,¹ S Leonard Syme, PhD,¹ June M Fisher, MD²

Krause N, Ragland DR, Greiner BA, Syme SL, Fisher JM. Psychosocial job factors associated with back and neck pain in public transit operators. *Scand J Work Environ Health* 1997;23(3):179–86.

Objectives This cross-sectional study examined associations between psychosocial job factors and the prevalence of nondisabling back or neck pain in professional drivers after physical work load was taken into account.

Methods A total of 1449 transit vehicle operators completed a medical examination and a questionnaire yielding information on demographic and anthropometric variables, health status, and physical and psychosocial job factors. Company records were used to supplement information on employment history. Physical work load was measured in life-time years and current weekly hours of professional driving. The relation of psychosocial factors with back or neck pain was analyzed by logistic regression models adjusted for past and current physical work load, vehicle type, age, gender, body height, and weight.

Results The main result of this study was that both physical work load and psychosocial factors were simultaneously and independently associated with back or neck pain. Psychosocial factors associated with back or neck pain included extended uninterrupted driving periods, frequency of job problems, high psychological demands, high job dissatisfaction, and low supervisory support. An analysis of specific job problems is provided which may be useful in setting priorities for research and intervention efforts in this high risk occupation.

Conclusion The results provide support for the role of psychosocial job characteristics in the etiology of back or neck pain in occupational settings.

Key terms back pain, job strain, motor vehicle driving, neck pain, physical work load, psychological demands, social support.

The role of psychosocial risk factors in the development of spinal disorders is still under debate. A recent review of the literature by Bongers et al (1) showed that, despite a series of publications finding associations between psychosocial factors and musculoskeletal disorders, including those involving the spine, a conclusion about the role of psychosocial risk factors could not be reached. First, most studies of psychosocial factors and spinal disorders did not control for physical work load (1). Since heavy physical labor is often concurrent with psychosocial risk factors such as job dissatisfaction, poor supervisor support, high levels of stress and strain, and organizational factors such as shift work, overtime, or isolation from co-workers, it has been argued that the associations found with psychosocial factors might at least in part reflect exposure to physical labor. Second, most studies have been unable to account for lifetime physical work load.

Since physical stressors may have a cumulative impact on the spine over the worklife of an employee, studies need to take current and past work load into account. Third, some studies lacked sufficient variation in physical work load or psychosocial characteristics for the detection of effects in 1 domain or the other (2).

This study of urban public transit operators tries to overcome some of the methodological shortcomings of previous studies by examining associations between psychosocial job factors and the prevalence of back or neck pain while taking into account past and current physical work load.

Based on previous reports in the literature, 5 dimensions of work were hypothesized to be related to back or neck pain. The first was work organization in terms of the distribution of driving and recovery periods, indicated by weekly driving hours, breaks, and type of shift.

¹ School of Public Health, Division of Epidemiology, University of California, Berkeley, California, United States.

² School of Medicine, University of California, San Francisco, California, United States.

Reprint requests to: Dr Niklas Krause, School of Public Health, Division of Epidemiology, 140 Warren Hall, University of California, Berkeley, CA 94720–7360, USA.

These factors determine the duration of restricted postures and may be responsible for the finding that a sense of time pressure has been associated with chronic neck pain (3). Both prolonged sitting and standing have been identified as risk factors for low-back pain (4). The second dimension was job strain and its 2 major components, low decision latitude and high psychological job demands. The latter has been found to be related to symptoms of the neck, back, and shoulders (5). Low social support from co-workers or supervisors formed the third dimension. Low social support has been linked to neck pain and to low-back pain (6–8). Job dissatisfaction was the fourth; it has been related to many musculoskeletal disorders, including those of the spine (1, 6, 9). Fifth was the frequency of potentially stressful job problems. A summary score of musculoskeletal symptoms has been found to be associated with the frequency of job problems among San Francisco transit operators (10).

Subjects and methods

Study population and participation rates

Eligible for the study were 1871 transit vehicle operators employed by the San Francisco Municipal Railway (Muni) who completed physical examinations and extensive medical history forms in 1983–1985 during the mandatory bi-annual medical examination required for renewal of commercial drivers' licenses. Information on occupational and psychosocial factors was available for 1463 operators (78%) who participated in a previously published study of stress and hypertension and who had completed an optional occupational and psychosocial questionnaire immediately after their medical examination (10). Fourteen participants and 3 nonparticipants were excluded from the analyses due to incomplete information on employment history. A total of 1449 participants comprised the sample for this secondary analysis of risk factors for back or neck pain.

Assessment of back and neck pain

At the medical examination, the drivers first completed a self-reported health questionnaire as part of their medical history. The questionnaire had a 60-item symptom list that included questions as to whether drivers "have now" or "had in the past" experienced "back or neck pain". This study compared drivers who reported having such pain "now" with those who did not or who had such symptoms only in the past. All the drivers were active in their job at the time of the examination, since drivers on sick leave or workers' compensation were not scheduled for examination. Drivers on modified duty were excluded from the study population. Therefore the outcome of this

study was self-reported back or neck pain that had not led to work disability at the time of the examination. Adapting a classification of occupational disability due to low-back pain as suggested by Krause & Ragland (11) we used "nondisabling back or neck pain" that had not been officially reported as work-related as our outcome.

Ascertainment of duration of professional driving

The following sources of information were used to obtain a complete driving history: (i) the mandatory medical history form asking for type of industry, job duties, and employment dates for the current and 2 longest-held jobs; (ii) the optional occupational questionnaire inquiring about which vehicle type had been driven during what years and for how many months or years employment with Muni had been interrupted; and (iii) company records on employment and seniority. Information on occupational history and age from all these records was cross-checked on a case-by-case basis and inconsistencies were corrected.

Measurement of physical work load

The mechanical load on the spine among transit drivers is largely determined by the amount of sitting or standing, movements of the trunk while driving, and whole-body vibration. The amount of professional driving measured in years and hours serves as a proxy for exposure to all 3 factors. Current and past exposure to professional driving was measured by the following 3 parameters: (i) lifetime years of professional driving in the transportation industry inside and outside of Muni; (ii) regular weekly driving hours; and (iii) weekly hours of overtime driving during the 12 months preceding the date of examination. All 3 parameters combined are referred to as physical work load. Jobs held in the transport industry, which required regular driving of trains, trucks, delivery vans, taxi cabs or other motor vehicles, were included in the calculation of driving years, as were years as a conductor in public transport systems. Interruptions of employment with Muni were subtracted unless the person indicated professional driving during that time. Weekly hours of regular driving and overtime driving during the last 12 months were separately assessed by an occupational questionnaire.

Work organization

The questionnaire items included regular weekly work hours, weekly hours of overtime, break time actually taken on an average day, type of shift, and specific work-site. Regular weekly work hours were coded as <40 h, 40 h, and >40 h of driving. Breaktime was categorized into none, 15–60 min, and >60 min. Five different shifts were coded as regular (daylight, twilight, or night), split shift, and combination of split and regular shifts.

Job strain, job dissatisfaction and social support

Job strain, job dissatisfaction, and social support were measured using the 27-item job content questionnaire developed by Karasek (12). The following subscales were created and coded using a median split: decision latitude, psychological demands, job dissatisfaction, co-worker support, and supervisor support. A category of high job strain was created for drivers who were in the upper tertile of psychological demands (score >35) and in the lower tertile of decision latitude (score <28).

Job problems

The frequency of potentially stressful problems at work was assessed by a 19-item questionnaire. Based on individual interviews and focus groups among the study population, a list of typical job problems had been developed which was specific to situations encountered by Muni drivers (10). Drivers were asked to rate both the frequency and significance of each job problem. The questions — and answer options — for each item were: (i) "How often does this happen to you? — daily, weekly or monthly, yearly or less often, never." and (ii) "How upsetting is this to you? — extremely, very, slightly, not at all". Answers were coded from 1 to 4, and 2 different average scores were developed, 1 for frequency of job problems and 1 for reaction to job problems. Each average score was based on the items checked by the respondent. The analyses in this paper have been based on the reported frequency of job problems, rather than on the reported emotional reactions to the job problem.

Analyses

Predictor variables and covariates were chosen on theoretical grounds according to the study hypotheses. Frequency distributions and univariate and age-adjusted analyses of the relationship of each variable with back or neck pain were performed to determine the direction and shape of the relationship. If nonlinear relationships were found, the variables were recoded as categorical. In the case of driving years, a nonlinear relationship was modeled with a linear and a quadratic term in the regression model, yielding a good fit of the model with the data (Hosmer-Lemeshow goodness-of-fit test, chi-square with 8 degrees of freedom = 7.79, $P = 0.45$) (13). Logistic regression was used for all the multivariate analyses. Adjusted odds ratios with 95% confidence intervals and P -values were calculated for each variable.

Results

Comparison of respondents and nonrespondents

The participants ($N = 1449$) and nonparticipants ($N = 405$) did not differ with respect to demographic

variables such as age, gender, ethnicity, education, or marital status. No differences were found for type of vehicle driven, number of self-reported work injuries, or sick days during the past year. The study participants were slightly better educated and reported more health-related symptoms than the nonparticipants (13).

Prevalence of nondisabling back and neck pain

The prevalence of back or neck pain was 14.7% among the study participants. Table 1 shows a breakdown by gender, age group, and years of professional driving.

Work organization

Table 2 shows how the time patterns of driving or resting periods were associated with the prevalence of back or neck pain, after adjustment for age, gender, height,

Table 1. Prevalence of nondisabling back or neck pain by gender, age, and years of professional driving — San Francisco transit operator study, 1983–1985.

Subgroup	N	Prevalence of back or neck pain (%)
Gender		
Male	1319	13.9
Female	130	23.1
Age (years)		
25–35	241	13.7
> 35–45	722	16.2
> 45–55	367	12.8
> 55–65	119	13.5
Years of professional driving		
0–5	487	13.4
> 5–10	387	16.2
> 10–15	246	19.1
> 15	329	11.9
All study participants	1449	14.7

Table 2. Occurrence of back or neck pain in relation to work organization characteristics — San Francisco transit operator study, 1983–1985. (OR = adjusted odds ratio, 95% CI = 95% confidence interval)

Variable	OR ^a	95%CI	P-value
Regular driving hours per week (reference 40 hours)			
< 40 hours	0.68	0.28–1.64	0.358
> 40 hours	1.32	0.96–1.81	0.084
Shift (reference regular)			
Split shift	0.73	0.49–1.08	0.113
Both	1.05	0.73–1.51	0.798
Break time taken (reference 15–60 minute)			
> 60 minutes	0.83	0.57–1.19	0.359
None	1.29	0.75–2.21	0.148

^a All odds ratios were adjusted for age, gender, height, weight, vehicle type, and physical work load (assessed by driving years, driving years squared, regular weekly driving hours, and hours of overtime driving).

weight, vehicle type, years of professional driving, current hours of driving, and overtime hours of driving. There was a stepwise increase of risk of back or neck pain from working less than 40 h, to 40 h, to over 40 h. Regularly driving more than 40 h showed an increased risk for back or neck pain (OR 1.32, 95% CI 0.96—1.81). Working split shifts (ie, driving in the morning, having several hours off, and resuming driving in the afternoon) was inversely associated with back or neck pain when compared with regular shifts characterized as 1 continuous driving period per day. Those unable to take breaks during their workday had a higher risk of back or neck pain than those taking some breaks. A total break time of more than 60 min was associated with a lower risk than break times of between 15 and 60 min. The duration of professional driving showed a strong association with back or neck pain (eg, for 10 years of driving OR 3.20, 95% CI 1.40—7.32) (13).

Frequency of job problems

The first 4 columns in table 3 show the prevalence of back or neck pain by frequency of self-reported job problems. The P-values reported in column 5 are based on chi-square test statistics. The problems involving the following aspects of the job were significantly more frequent among the drivers with back or neck pain than among those without back or neck pain: equipment, fares, passengers, co-workers, supervisors, run schedule, long or odd workhours, being written up for violations, traffic or road conditions, other vehicles, crimes against driver or passengers, communication with central control, and access to restrooms. No differences were seen for problems related to accidents.

The last 3 columns of table 3 show the relative risk of back or neck pain as estimated by the odds ratios for 4 frequency levels of each job problem using the "never group" as reference, 95% confidence intervals, and the

Table 3. Prevalence of back or neck pain by frequency of job problems and their association as assessed by chi-square test statistics and multivariable logistic regression analyses — San Francisco transit operator study, 1983—1985. (OR = adjusted odds ratio, 95% CI = 95% confidence interval)

Frequency of job problems	N	%	Prevalence (%)	P-value ^a	OR ^b	95% CI	P-value ^c
Equipment							
Never	62	4.3	6.5		—	—	—
Yearly or less often	134	9.3	9.0		1.23	0.38—4.05	.728
Weekly or monthly	935	64.8	14.2		2.07	0.73—5.87	.172
Daily	312	21.6	20.2	.002	3.30	1.14—9.62	.028
Fares and transfers							
Never	158	11.0	10.1		—	—	—
Yearly or less often	167	11.6	11.4		1.00	0.49—2.04	.997
Weekly or monthly	401	27.8	11.7		1.04	0.56—1.92	.907
Daily	717	49.7	18.1	.003	1.68	0.95—2.98	.074
Too many passengers							
Never	203	14.9	7.9		—	—	—
Yearly or less often	108	7.5	11.1		1.56	0.70—3.46	.274
Weekly or monthly	407	28.2	12.5		1.66	0.91—3.04	.098
Daily	723	50.2	18.3	.001	2.58	1.46—4.54	.001
Caused by Passengers							
Never	125	8.7	11.2		—	—	—
Yearly or less often	341	23.7	10.0		0.82	0.42—1.60	.557
Weekly or monthly	629	43.7	13.5		1.11	0.60—2.05	.747
Daily	345	24.0	22.6	.000	1.99	1.06—3.74	.031
Caused by coworkers							
Never	593	41.2	10.8		—	—	—
Yearly or less often	442	30.7	14.9		1.44	0.98—2.10	.060
Weekly or monthly	304	21.1	21.7		2.20	1.48—3.27	.000
Daily	103	7.1	15.5	.000	1.43	0.78—2.64	.250
With supervisors							
Never	636	44.1	11.5		—	—	—
Yearly or less often	492	34.1	16.3		1.51	1.06—2.15	.023
Weekly or monthly	240	16.7	19.2		1.80	1.18—2.75	.006
Daily	73	5.1	17.8	.014	1.97	0.99—3.92	.053
Not maintaining schedule							
Never	275	19.1	11.3		—	—	—
Yearly or less often	272	18.9	13.2		1.16	0.69—1.95	.574
Weekly or monthly	500	34.7	14.2		1.20	0.76—1.89	.442
Daily	393	27.3	18.6	.049	1.69	1.06—2.69	.028

continued

Table 3. Continued

Frequency of job problems	N	%	Prevalence (%)	P-value ^a	OR ^b	95% CI	P-value ^c
Long or odd hours							
Never	449	31.8	10.2		—	—	—
Yearly or less often	323	22.4	13.4		1.38	0.88—2.17	.156
Weekly or monthly	339	23.5	18.0		2.01	1.30—3.10	.002
Daily	329	22.8	17.9	.005	1.87	1.21—2.89	.005
Written-up for rule violations							
Never	435	30.2	10.1		—	—	—
Yearly or less often	865	60.1	16.1		1.71	1.18—2.48	.005
Weekly or monthly	128	8.9	20.3		2.26	1.30—3.91	.004
Daily	12	0.8	16.7	.008	1.88	0.38—9.38	.440
Unfairly written-up for rule violation							
Never	628	43.6	11.8		—	—	—
Yearly or less often	698	48.5	16.3		1.40	1.01—1.93	.043
Weekly or monthly	88	6.1	18.2		1.74	0.95—3.20	.073
Daily	26	1.8	26.9	.021	2.33	0.90—6.03	.082
Minor accident with no injuries							
Never	342	23.7	13.7		—	—	—
Yearly or less often	1047	72.7	15.1		1.06	0.74—1.53	.740
Weekly or monthly	40	2.8	15.0		1.26	0.49—3.22	.637
Daily	12	0.8	8.3	.857	0.57	0.07—4.58	.596
Serious accident with injuries							
Never	1150	79.8	14.1		—	—	—
Yearly or less often	276	19.2	17.4		1.37	0.95—1.96	.091
Weekly or monthly	11	0.8	18.2		1.56	0.23—7.50	.580
Daily	4	0.3	0.0	.435	—	—	—
Accident that is your fault							
Never	659	45.7	14.0		—	—	—
Yearly or less often	766	53.2	15.4		1.06	0.78—1.43	.727
Weekly or monthly	14	1.0	7.1		0.44	0.06—3.47	.438
Daily	2	0.1	50.0	.360	10.68	0.59—204.1	.116
Serious traffic or road problems							
Never	187	13.0	8.6		—	—	—
Yearly or less often	284	19.7	12.0		1.47	0.78—2.77	.236
Weekly or monthly	449	31.2	14.3		1.71	0.07—1.30	.074
Daily	521	36.2	18.8	.002	2.29	1.30—4.06	.004
With other vehicles							
Never	195	13.5	9.7		—	—	—
Yearly or less often	229	15.9	10.0		0.97	0.51—1.86	.927
Weekly or monthly	366	25.4	14.2		1.32	0.75—2.34	.332
Daily	651	45.2	18.1	.003	1.85	1.09—3.12	.023
Crimes against you while driving							
Never	909	63.1	12.0		—	—	—
Yearly or less often	414	28.8	17.6		1.57	1.23—2.18	.008
Weekly or monthly	80	5.6	25.0		2.38	1.36—4.15	.002
Daily	37	2.6	24.3	.001	2.42	1.07—5.45	.033
Crimes against your passengers							
Never	473	32.9	9.7		—	—	—
Yearly or less often	751	52.2	16.1		1.69	1.16—2.45	.006
Weekly or monthly	175	12.2	20.0		2.17	1.33—3.55	.002
Daily	40	2.8	20.0	.001	2.14	0.91—5.07	.083
Communicating with central control							
Never	460	31.9	8.5		—	—	—
Yearly or less often	414	28.7	14.1		1.64	1.06—2.55	.027
Weekly or monthly	421	29.2	18.3		2.29	1.51—3.48	.000
Daily	146	10.1	26.0	.000	3.44	2.05—5.76	.000
Poor access to restrooms on the line							
Never	214	14.9	8.9		—	—	—
Yearly or less often	229	15.9	10.0		1.02	0.53—1.95	.953
Weekly or monthly	330	22.9	15.2		1.68	0.95—2.97	.076
Daily	668	46.4	18.0	.001	1.94	1.14—3.30	.014

^a Based on chi-square test statistics.^b All the odds ratios were adjusted for age, gender, height, weight, vehicle type, and physical work load (as assessed by driving years, driving years squared, regular weekly driving hours, hours of overtime driving).^c From adjusted logistic regression models.

P-value from logistic regression analyses. For every type of job problem except accidents, at least 1 frequency level differed significantly from the reference group, and for many problems a graded relationship with back or neck pain was found. Daily problems in communicating with central control were experienced by 10% of the drivers and were associated with the highest odds ratio for back or neck pain (OR 3.44, 95% CI 2.05–5.76). The second highest risk was found for daily problems with equipment, which were reported by 22% of the operators (OR 3.30, 95% CI 1.14–9.62). Other daily hassles that were experienced by many drivers and that were significantly related to the risk of back or neck pain were too many passengers (50%, OR 2.58, 95% CI 1.46–4.54), not maintaining the schedule (27%, OR 1.69, 95% CI 1.06–2.69), long or odd hours (23%, OR 1.87, 95% CI 1.21–2.89), serious traffic or road problems (36%, OR 2.29, 95% CI 1.30–4.06), problems with other vehicles (45%, OR 1.85, 95% CI 1.09–3.12), and poor access to restrooms (46%, OR 1.94, 95% CI 1.14–3.30). Some infrequent job problems were also significantly related to back or neck pain, including those caused by co-workers, those with supervisors, being written up for violations, crimes against the driver, and crimes against passengers. All the odds ratios were adjusted for age, gender, body height, weight, vehicle type, and past and current physical work load as measured by lifetime years of professional driving and current regular and overtime hours of driving.

Job strain, job dissatisfaction, and social support

Table 4 shows the associations between measures from the Job Content Questionnaire and the prevalence of back or neck pain. High psychological demands, high job dissatisfaction, and low supervisory support were all significantly associated with back or neck pain (OR 1.87,

95% CI 1.35–2.58; OR 1.62, 95% CI 1.11–2.67; and OR 1.67, 95% CI 1.22–3.63, respectively). High job strain, defined as being in the upper tertile of psychological demands and in the lower tertile of decision latitude, was associated with a marginally significant 50% increased odds ratio (OR 1.50, 95% CI 0.98–2.30). A high frequency of job problems, based on a median split of a sum score of the job problems listed in table 3, was significantly associated with back or neck pain (OR 2.30, 95% CI 1.67–3.18). The frequency of job problems was also analyzed by quartiles; it showed a graded relationship with back or neck pain. Compared with the low quartile, the odds ratio for back or neck pain of the upper quartile was 3.07 (95% CI 1.97–4.8). Each psychosocial factor was assessed in a separate logistic model adjusted for age, gender, body height, weight, vehicle type, and past and current physical work load, measured by lifetime years of professional driving and current regular and overtime hours of driving.

Physical work load

In all the analyses of the presented organizational and psychosocial factors, physical work load remained independently and statistically significantly associated with back or neck pain. The odds ratio for 10 years of driving ranged from 2.35 (95% CI 1.03–5.38), in the model including frequency of job problems, to 3.14 (95% CI 1.37–7.23), in the model including work breaks. The odds ratio for 20 h of regular weekly driving ranged from 1.58 (95% CI 0.83–3.03), in the model including frequency of job problems, to 2.10 (95% CI 1.11–3.96), in the model including decision latitude.

Discussion

This is one of the first studies on the association of organizational and psychosocial job characteristics with the prevalence of back or neck pain that controls for both current and past physical work load. The analyses showed associations between several such organizational and psychosocial job characteristics and back or neck pain. First, there was a trend for higher risks for back or neck pain in association with longer uninterrupted periods of driving, as experienced by drivers working regular shifts, driving ≥ 40 h a week, or unable to take rest breaks within shifts. Second, of the 19 typical and occupation-specific job problems, 16 were related to back or neck pain. Third, high psychological demands, high job strain, high job dissatisfaction, and low supervisory support, as measured by a standard instrument, the Job Content Questionnaire (12), were all related to the prevalence of back or neck pain.

Table 4. Occurrence of back or neck pain in relation to psychosocial job characteristics. — San Francisco transit operator study, 1983–1985. (OR = odds ratio, 95% CI = 95% confidence interval)

Variable ^a	Adjusted OR ^b	95% CI	P-value
Decision latitude low	1.26	0.93–1.72	0.137
Psychological demands high	1.87	1.35–2.58	0.000
Job strain ^c high	1.50	0.98–2.30	0.060
Job dissatisfaction high	1.62	1.11–2.67	0.012
Co-worker support low	1.10	0.80–1.51	0.550
Supervisor support low	1.67	1.22–3.63	0.001
Frequency of job problems high	2.30	1.67–3.18	0.000

^a All the scales were coded using a median split of their distribution (except for job strain, see^c).

^b All the odds ratios were adjusted for age, gender, height, weight, vehicle type, and physical work load (ie, driving years, driving years squared, regular weekly driving hours, hours of overtime driving).

^c High job strain was defined as the combination of high psychological demands (upper tertile) and low decision latitude (lower tertile).

The most significant finding of this study was that nearly all the associations between job factors and back or neck pain remained strongly and statistically significant even after control for past and current physical work load, age, gender, body height, weight, and vehicle type. The only exceptions were shift type and workbreaks, although they showed a similar trend.

The risk estimates have been affected by selection effects both into and out of the job. First, since bus drivers are medically screened for health problems prior to employment and every 2 years thereafter and since their license is dependent on health status, the work force was comparatively healthy. Second, voluntary separation from the job is especially high for health reasons related to back problems (14). Third, the study excluded subjects on sick leave or on light duty with severe disabling low-back pain. All of these selection effects are likely to result in an underestimation of the effect of job conditions on the prevalence of back or neck pain. To get a more complete picture of the impact of psychosocial work conditions on spinal disorders among professional drivers, a prospective cohort study is needed that includes data on sick leave, disability retirement, and other forms of separation.

Other researchers have found evidence for the effect of psychosocial workplace characteristics being associated with spinal disorders, although exact outcome definitions vary across studies and might not always be comparable. For example, 1 study among Boeing employees (15) using first reports of work-related low back injuries as an outcome reported that psychosocial job factors, but not physical work load, were related to risk of back injury. Critics of this study have pointed out that the Boeing study lacked an appropriate measure for physical work load, did not take past work load into account, and probably had too small a variance in current physical work load to find any effect (2). In contrast, in the present study of transit drivers, measurement of physical work load was straightforward. It included current and past exposure, and the physical work load varied considerably among the employees. In additional analyses of the same data, not only was physical work load related to back or neck pain, but there was a clear dose-response relationship between physical work load and the prevalence of back or neck pain, even after adjustment for age, gender, body height, weight, vehicle type, and ergonomic factors (13). In the present investigation of psychosocial workplace factors, the same adjustments for demographic and anthropometric variables and vehicle type were made, plus adjustment for physical work load (measured by duration of driving years and hours). It should be pointed out that the effects of physical work load, though attenuated in some cases by the inclusion of psychosocial factors in the multivariate models, remained significant and strongly associated with back or neck

pain (odds ratios for physical work load between 2.3 and 3.1). In fact, one of the main results of this study was that both physical work load and psychosocial factors were found to be simultaneously and independently associated with the prevalence of back or neck pain.

The work of bus drivers has been recognized as mentally and psychologically very demanding (16). In this study, psychological demands and job strain were measured using the Job Content Questionnaire. This questionnaire was originally developed and validated for comparisons between occupations (17). In this study it was used for comparisons within 1 occupation and within 1 company. It is likely that especially job decision latitude is homogeneous across employees, and variations on this scale may reflect variations in perceptions rather than differences in the work environment. Therefore results have to be interpreted with caution.

An alternative explanation for our findings could be that the drivers reporting more pain may also report more job problems. However, a detailed look at the findings shows that the frequency of job problems reported varied greatly between items. For example, the category of "daily occurrence" varied between 50% for "too many passengers" and 0% for "serious accidents". In fact, it is this distinctive patterning of job problems that lessens the likelihood that the results are merely a reflection of a tendency to complain. One would predict that such a tendency would be apt to produce rather uniform frequency distributions in the extreme categories, but this was not observed. A prospective study is needed to confirm this interpretation.

The frequency of job problems and the associated risks for back or neck pain are a significant result for 2 reasons. First, they provide important information about which areas have the greatest potential for the prevention of back or neck pain. For example, to prevent minor accidents with no injuries would have much lower priority than to improve equipment maintenance or to enhance supervisor support. Second, the strong association between the sum score for the frequency of job problems and back or neck pain supports the validity of the finding of a strong association between high psychological demands and back or neck pain. In fact the correlation between both scores was high ($r = 0.42$).

All our findings were related to current nondisabling back or neck pain. The self-reported point-prevalence of 10–15% for back or neck pain, among nonparticipants and participants, respectively, is relatively low when compared with that of other reports in the literature (18, 19). If we add the people who reported having back or neck pain only in the past, the proportion would be 20–28%. The main reason for the relatively low rate of back or neck pain is probably that our survey method systematically excluded people on sick leave or modified duty. The significance of the outcome measure used in this

study lies in the fact that nondisabling back or neck pain can be conceptualized as a precursor of formally reported compensable work-related spinal injuries. In fact, drivers with nondisabling back or neck pain had an 80% increased risk for filing a first workers' compensation claim involving a back or neck injury during up to 5 years of follow-up after the base line when compared with the drivers without back or neck pain at the base line (relative hazard 1.8, 95% confidence interval 1.4–2.4, $P < 0.001$, unpublished observation). This relationship between nonformally reported back or neck pain and formally reported work-related spinal injuries indicates a potential for the primary prevention of workers' compensation claims due to spinal injury.

Concluding remarks

The most significant finding of this study is the fact that nearly all the associations between psychosocial job factors and back or neck pain remained strongly and statistically significant even after control for past and current physical work load, age, gender, body height, weight, and vehicle type. In addition, the study provides evidence that both physical work load and psychosocial factors are simultaneously and independently associated with the prevalence of back or neck pain. The strength of this study lies in its ability to measure and control for past and current physical work load, the use of several instruments to measure psychosocial work conditions, and an outcome measure that was relevant for the early detection and primary prevention of occupational back or neck pain. The main limitations were the cross-sectional design and comparisons within 1 occupational group only. The study suggests the presence of strong associations with the prevalence of nondisabling back or neck pain among urban transit vehicle operators for several psychosocial workplace factors, including extended uninterrupted driving periods, frequency of job problems, high psychological demands, high job dissatisfaction, and low supervisory support. Detailed analyses of reported job problems may be useful in setting priorities for specific research and intervention efforts.

Acknowledgments

This work was funded in part by the National Institute on Alcoholism and Alcohol Abuse under grant AA8949 and in part by the Doctoral Student Support Award of the School of Public Health, University of California, Berkeley.

References

1. Bongers PM, de Winter CR, Kompier MAJ, Hildebrandt VH. Psychosocial factors at work and musculoskeletal disease [review]. *Scand J Work Environ Health* 1993;19:297–312.
2. Frank JW, Pulcins IR, Kerr MS, Shannon HS, Stansfeld SA. Occupational back pain — an unhelpful polemic [review]. *Scand J Work Environ Health* 1995;21:3–14.
3. Mäkelä M, Heliövaara M, Sievers K, Impivaara O, Knekt P, Aromaa A. Prevalence, determinants, and consequences of chronic neck pain in Finland. *Am J Epidemiol* 1991;134(11):1356–67.
4. Magora A. Investigation of the relation between low back pain and occupation: 3. physical requirements: sitting, standing and weight lifting. *Ind Med Surg* 1972;41(12):5–9.
5. Theorell T, Harms-Ringdahl K, Ahlberg-Hulten G, Westin B. Psychosocial job factors and symptoms from the locomotor system — a multicausal analysis. *Scand J Rehabil Med* 1991;23(3):165–73.
6. Bigos S, Battié M, Spengler D, Fisher L, Fordyce W, Hansson T, et al. A longitudinal, prospective study of industrial back injury reporting. *Clin Orthop Rel Res* 1992;279:21–34.
7. Dehlin O, Berg S. Back symptoms and psychological perception of work: a study among nursing aides in a geriatric hospital. *Scand J Rehabil Med* 1977;9(2):61–5.
8. Linton SJ, Kamwendo K. Risk factors in the psychosocial work environment for neck and shoulder pain in secretaries. *J Occup Med* 1989;31(7):609–13.
9. Bergenudd H, Nilsson B. The prevalence of locomotor complaints in middle age and their relationship to health and socioeconomic factors. *Clin Orthop* 1994;(308):264–70.
10. Winkelby M, Ragland DR, Syme SL. Self-reported stressors and hypertension: evidence of an inverse association. *Am J Epidemiol* 1988;128:1075–83.
11. Krause N, Ragland DR. Occupational disability due to low back pain: a new interdisciplinary classification based on a phase model of disability. *Spine* 1994;19(9):1011–20.
12. Karasek R. Job content questionnaire. Los Angeles (CA): Department of Industrial and Systems Engineering, University of Southern California, 1985.
13. Krause N, Ragland DR, Greiner BA, Holman BL, Fisher JM, Selvin S. Physical workload and ergonomic factors associated with back and neck pain in public transit operators. *Spine*. In press.
14. Backman A-L, Järvinen E. Turnover of professional drivers. *Scand J Work Environ Health* 1983;9(1):36–41.
15. Bigos S, Battié M, Spengler D, Fischer L, Fordyce W, Hansson T, et al. A prospective study of work perceptions and psychosocial factors affecting the report of back injury. *Spine* 1991;16(1):1–6.
16. Evans G. Working on the hot seat: Urban bus operators. *Accid Anal Prev* 1994;26(2):181–93.
17. Karasek R, Theorell T. Healthy work: stress, productivity, and the reconstruction of working life. New York (NY): Basic Books, Harper Collins Publishers, 1990.
18. Anderson R. The back pain of bus drivers: prevalence in an urban area of California. *Spine* 1992;17(12):1481–8.
19. Kompier M. Arbeid en gezondheid van stadsbuschauffeurs [Work and health of city bus drivers]. Delft, (The Netherlands): Eburon, 1988, pp 237.

Received for publication: 1 August 1996