HHS Public Access

Author manuscript

Am J Ind Med. Author manuscript; available in PMC 2024 January 01.

Published in final edited form as:

Am J Ind Med. 2023 January ; 66(1): 41–53. doi:10.1002/ajim.23444.

Psychosocial Risk Factors for Low Back Pain in US Workers: Data from the 2002–2018 Quality of Work Life Survey

Haiou Yang, PhD. [Specialist],
Center for Occupational and Environmental Health, University of California, Irvine

Ming-Lun Lu, PhD, CPE,
CDC/NIOSH/DFSE

Scott Haldeman, DC, MD, PhD, FRCP(C), FCCS(C), FAAN [Clinical Professor],
Department of Neurology, University of California, Irvine. Adjunct Professor, Ontario Tech University, Toronto, Ontario, Canada, President, World spine Care

Naomi Swanson, PhD
CDC/NIOSH/DSI

Abstract

Background—Examining workplace psychosocial risk factors for back pain becomes increasingly important because of the changing nature of work and rising healthcare costs. Some psychosocial risk factors for back pain, such as work and family imbalance, the exposure to a hostile work environment and job insecurity, have been understudied for the working population in the United States.

Methods—Data used in this study came from the Quality of Work Life Survey (QWL), a supplementary topical module on the General Social Survey conducted in the United States. Data from the 2002, 2006, 2010, 2014 and 2018 QWL surveys were used in these analyses, giving a total sample size of 6,661. Five domains of workplace psychosocial risk factors for back pain were examined, including job strain, low social support, work-family imbalance, exposure to a hostile work environment (harassment and discrimination), and job insecurity. The adjusted odds ratio (aOR) of each psychosocial risk factor for back pain with a 95% confidence interval (CI) was estimated using a multivariable logistic regression model after controlling for job physical factors, occupation, and demographic and socioeconomic characteristics.

Results—Significant associations were found between back pain and several psychosocial factors including job strain (aOR 1.19, CI 1.00,1.41), work-family imbalance (aOR,1.42, CI 1.22,1.64), harassment (aOR 1.40, CI 1.15,1.71), and discrimination (aOR 1.20, CI 1.00,1.44).

Conclusion—This study contributes to the understanding of the relationship between a variety of workplace psychosocial factors and back pain. Our findings suggest directions in future longitudinal research to examine emerging workplace psychosocial factors for back pain.

Corresponding author: Ming-Lun Lu, PhD, CPE, CDC/NIOSH/DFSE.

Keywords

LOW BACK PAIN; PSYCHOSOLCIAL STRESSOR; WORK-FAMILY IMBALANCE; HOSTILE WORK ENVIRONMENT; JOB INSECURITY; JOB STRAIN

1. BACKGROUND

Back pain, or more specifically low back pain, is a common and costly health condition in the working population of the United States and most workers are expected to experience back pain in their working life.[1,2] Back pain may be a precursor for underlying spinal or musculoskeletal disorders (MSDs), which have caused significant burden to individuals and the society as a whole. Katz (2006) estimated the total costs of low back pain in the United States to exceed $100 billion per year, with approximately one third accounted for by direct medical expenses and two thirds resulting from indirect costs, such as productivity loss and sickness absence.[3] The annual direct cost of treating spinal pain was reported as the third highest treatment cost among all the major health conditions in the US, costing $87.6 billion in 2013. In 2016, spinal pain was ranked the highest among all major health conditions in amount of health care spending, costing an estimated $134.5 billion.[4] The Global Burden of Disease 2017 study demonstrated that among 354 diseases and injuries, low back pain was ranked highest in terms of leading cause of disability and years lived with disability.[5] Back pain also leads to suffering and interference with quality of life for individuals.[6–11] Investigating workplace related factors for back pain has been recognized as a critical area of research in the field of occupational health.

The major work-related risk factors for back pain have been seen as physical in nature, including heavy lifting, awkward postures, whole-body vibration, and prolonged sitting.[2,12] There has been substantial evidence in occupation specific studies linking back pain with these work-related physical risk factors.[13–15] The occupational groups with excess risk for back pain include manufacturing,[15] construction,[16,17] transportation,[18] healthcare,[19] and office workers.[14] However, many of these occupation specific studies also found back pain related to psychosocial stressors, such as high psychosocial demands, and low social support.[19]

In addition, population-based studies have demonstrated consistent evidence of associations between work-related physical risk factors and back pain. A longitudinal study of the general working population in Norway indicated that prolonged standing, awkward lifting and squatting/kneeling were significantly related to back pain.[20] A longitudinal study of young adult workers conducted between 1986 and 2007 reported that physically heavy work during young adulthood may have a long-lasting impact on back pain risk.[21] The 2012–2018 Work Environment and Health study of Denmark reported that combined ergonomic exposures (standing/walking combined with lifting/carrying or twisted/bent back) increased risk for back pain and back pain intensity from baseline to a two-year follow-up.[22]

A series of studies based on data from the 2002 to 2014 Quality of Work Life (QWL) modules of the General Social Survey (GSS) reported that lifting (repeated lifting, pulling, or pushing) and hand movement (repetitive or stressful hand movements or awkward

postures) were work-related physical risk factors significantly associated with back pain in the US working population.[23–26] Although the authors reported some associations between workplace psychosocial factors and back pain, these psychosocial factors were reported in individual questionnaire items, instead of using developed scales with multiple questionnaire items.[23–26] Workplace psychosocial stress domains have been increasingly recognized to be important factors for both the initial development of back pain and subsequent disabilities in the past two decades.[27,28] Job strain, defined as a combination of high job demands and low job control,[29,30] has been frequently studied as a psychosocial risk factor for cardiovascular conditions.[31,32] Job strain has also been seen as a psychosocial risk factor for back pain in some recent studies.[33,34] Substantial research evidence from northern European countries has demonstrated significant associations between job strain and back pain. A study based on the Swedish Longitudinal Occupational Survey of Health (SLOSH) indicated that job strain was associated with increased back pain severity.[35] A study of the Swiss working population based on the Fourth European Working Conditions Survey (EWCS) reported that physically or psychologically demanding jobs were associated with higher prevalences of back pain.[36] A population-based study conducted in the largest province of China showed that high perceived job demands were associated with sickness absence due to low back symptoms.[37] Recent research on workplace back pain has identified new psychosocial risk factors associated with back pain, such as work-family imbalance,[38,39] exposure to hostile work environments,[40,41] and job insecurity.[42–44] These new psychosocial risk factors have gained attention in the field of occupational health research on back pain in the past few years.[45]

Haemmig and his colleagues pointed out work-family conflict or imbalance as a “blind spot” in the field of occupational medicine research on back pain, based on survey data covering workers from four large companies in Switzerland.[46] With data from the 2011 Korean Work Condition Survey, Kim and her colleagues demonstrated significant associations between work-family imbalance and increased risk of occupational injury and musculoskeletal pain.[47] Yang and her colleagues reported significant associations between back pain and work-family imbalance (aOR 1.27, CI 1.15,1.4) among workers in the US, based on the 2010 National Health Interview Survey (NHIS).[45]

A population-based study with a prospective design conducted in Norway reported a linkage between exposure to bullying and back pain in male workers.[48] Sabbath and her colleagues identified workplace abuse as a risk factor for musculoskeletal injuries among health care workers.[49] Vignoli and her colleagues conducted a study of retail sales workers in Italy and found associations between bullying and musculoskeletal disorders, including back pain.[50] In analyses of the 2010 NHIS, Yang and her colleagues also found significant associations between back pain and exposure to a hostile work environment (aOR 1.39, CI 1.25,1.55) in the working population of the United States.[51]

Job insecurity has also been seen as an important psychosocial risk factor for back pain in the workplace. With data from the 2006 Korean Work Conditions Survey, Lee and his colleagues showed that job insecurity was linked to a number of health problems including back pain among workers with permanent jobs, while the association was not significant

among workers with temporary jobs.[52] Two studies based on data from the 2010 NHIS demonstrated that American workers with job insecurity were likely to have back pain.[53]

Psychosocial risk factors for back pain have not been well studied in the working population of the United States. The goal of this study is to explore the relationship between back pain and a wide range of workplace psychological factors, including job strain, low social support, work-family imbalance, harassment, discrimination and job insecurity, while controlling for the confounding effects of physical risk factors, occupation, and demographic characteristics.

2. METHODS

2.1 Data

Data used in this study came from the QWL survey that was part of the General Social Survey (GSS) which is designed to monitor social changes in the US population. The GSS is a nationally representative survey of non-institutionalized adults in the United States, conducted every 2 years through face-to-face interviews.[54] The QWL is a supplementary topical module on the GSS, sponsored by the National Institute of Occupational Safety and Health (NIOSH), and included on the GSS every 4 years since 2002. The QWL includes a set of variables on workplace risk factors and a limited number of health outcome variables.[55]

The study used data from 5 QWL survey waves conducted in 2002, 2006, 2010, 2014 and 2018. The response rates ranged from 60.2% -71.2% from 2002 to 2014, and dropped to 59.5 % in 2018.[56,57] Two inclusion criteria for this study were participants in the GSS who (a) took part in the QWL and (b) worked 20 hours or more per week. The five survey waves resulted in sample sizes of 1,614, 1,549, 1,075, 1,144 and 1,279 respondents respectively. The combined sample size for the present study was 6,661. Table 1 summarizes the number of respondents from each survey using the inclusion criteria.

There were minor variations in the prevalence of back pain during the study period with similar levels from 2002 (27.6%), 2006 (27.0%), 2010 (25.2%), 2014 (22%) to 2018 (26.0%). These minor prevalence variations in back pian were assumed to be steady and independent of the effect of time for statistical modeling. Myers and her colleagues who monitored the changes in nature of work with the QWL data over 12 years (2004–2014) found that job strain and work-family conflict significantly increased over the 12 year period, but no significant changes were found in other psychosocial factors focused on in this study.[58] Moreover, because the study population for each NHIS survey was different, the effect of time and the variations in the back pain and psychosocial variables from different study populations were difficult to distinguished. On the basis of the limited variations in back pain outcome and most psychosocial factors, as well as different study populations over the study period, the effect of time was ignored in our statistical model.

2.2 Measurements

The QWL surveys included a broad range of workplace psychosocial risk factors, which allowed us to assess different domains of workplace psychosocial factors, in particular those

used in the job strain model.[30] However, the measurements (yes/no questions) of exposure to physical risk factors and the health outcomes are relatively limited by comparison.[55] These variables are described in detail below:

2.2.1 BACK PAIN—In the QWL, back pain is defined as self-reported non-specific back pain every day for a week or more within the past year using a single questionnaire item, "In the past 12 months, have you had back pain every day for a week or more?" This item was developed based on the Nordic Questionnaire for Musculoskeletal Disorders.[59]

2.2.2 Workplace characteristics—The workplace characteristics examined in this study were: psychosocial factors, physical factors and occupation. In this study, these factors were treated as the risk exposure variables for back pain. The psychosocial risk factors included job strain, low social support, work-family imbalance, harassment, discrimination, and job insecurity. The workplace physical factors included lifting (repeated lifting, pulling, or pushing) and hand movements (repetitive/forceful hand movements/awkward arm positions). Table 2 displays information on the constructions of these psychosocial and physical variables by domain, sub-domain, questionnaire item, response options, and coding. Reversed coding was done for items to match the direction of the negative effects (high demands, low control and poor social support) of the psychosocial variables. The higher the score, the more negative direction (high, low or poor) of the variables.

Job strain was assessed with the theoretical integrity of the job strain model and with items that were the same for all 5 data collection waves included in the study. Job strain included 2 domains: job control (5 items) and psychological demands (5 items). The Job Control scale had a Cronbach alpha of 0.663 and the Job Demand scale had a Cronbach alpha of 0.6435. Low social support was measured with 4 items with a Cronbach alpha of 0.7425. The assessment of both job strain and low social support was consistent with that used by Myers and her colleagues in describing changes in work characteristics in the US with the 2002–2014 QWL data series.[58] Job strain was constructed with the quadrant method (high demand and low control) with the mean as the cut-point. Work-family imbalance was assessed with 3 items (Cronbach alpha of 0.5724). Harassment was assessed with 2 items (Cronbach alpha of 0.3433). Discrimination was assessed with 3 items (Cronbach alpha of 0.4750). Job insecurity was assessed with one item.

Occupation was coded into 8 groups: (a) Professional (Computer and mathematical; Architecture and engineering; Life, physical, and social science; Community and social services; Legal occupations; Education, training and library; Arts, design, entertainment, sports and media; Healthcare practitioners and technical), (b) Management (business and financial operations), (c) Sales and related (d) Production related (Farming, fishing, and forestry, manufacturing), (e) Office and administrative support, (f) Services and related (Healthcare support; Protective service; Food preparation and serving related; Building and grounds cleaning and maintenance; and Personal care and service), (g) Construction related (Construction and extraction; Installation, maintenance and repair) and (h) Transportation related. This classification was derived from the 2000 Occupation Subgroups and Major Occupation Groups, respectively, as determined by the U.S. Census Bureau and the Bureau

of Labor Statistics. The occupation group, Professional, was used as the reference group in the logistic regression analyses described in the statistical analysis section.

2.2.3 Demographic characteristics—Demographic variables used in the analysis included gender, age, and race/ethnicity. Age was coded into five age groups: (a) 18 – 25, (b) 26 – 40, (c) 41 – 55, (d) 56 – 65 years, and (e) 66 and over. The 18–25 age group was used as the reference group in the logistic regression analyses.

Race/ethnicity was coded into four groups: (a) Non-Hispanic White, (b) Non-Hispanic Black, (c) Hispanic, and (d) Non-Hispanic Others. The Non-Hispanic White group was used as the reference group in the logistic regression analyses.

Socioeconomic status (SES) variables were education and personal earnings. Education was coded into five categories: a) less than high school, b) high school, c) some college, d) college and e) master's degree and above. The master's degree and above was used as the reference group in the univariate logistic regression analyses, so an inverse association between education level and back pain could be seen. The high school group was used as the reference group in the multivariate logistic regression analyses.

Personal earnings were defined as personal yearly earnings coded into 6 categories, a) under $15,000, b) $15,000 - $24,999, c) $25,000 – 34,999, d) $35,000 - $49,999, e) $50,000 - $74,999, and f) $75,000 and above. The $75,000 and above group was used as the reference group in the univariate logistic regression analyses to demonstrate an inverse association between earning level and back pain. The lowest earning group was used as the reference group in the multivariate logistic regression.

2.3 Statistical analysis

We developed our research model based on two bodies of literature on workplace related psychosocial risk factors: the traditional risk factors of job strain and the emerging psychosocial risk factors of work-family imbalance, exposure to a hostile working environment, and job insecurity.[45] The measurements of job strain in this study were based on questions common to both the Job Content Questionnaire (JCQ) and the QWL that were theoretically consistent with the job strain scale.[60] The job strain model has been a frequently used framework for understanding how job structures impact many health problems of workers, including back pain.[33,61,62] The emerging psychosocial risk factors included in this study were based on the recent research conducted in this area by this research team.[45]

We did not use all the QWL data collected regarding other working conditions that may be related to back pain. For example, work dissatisfaction has been cited as a work related psychosocial variable linked to back pain. [24,63] This study did not include this variable in the analysis model for back pain after examining its multicollinearity with another psychosocial risk factor, job strain.

First, we conducted descriptive analyses of the demographic and socioeconomic characteristics of study participants. Descriptive analyses included distributions of

demographic characteristics and socioeconomic status; workplace psychosocial and physical factors; and occupation by back pain. Second, we calculated each independent variable's crude odds ratio (OR) for back pain with 95% confidence intervals (CIs) using univariate logistic regressions.

Third, we developed a full multivariate logistic regression model to evaluate the associations between back pain and a set of psychosocial factors (job strain, low social support, work-family imbalance, harassment, discrimination, and job insecurity) while controlling for workplace physical factors (lifting and hand movements), occupation, demographic (age, gender, and race, and ethnicity), and socioeconomic variables (education and earning).

Adjusted ORs (aORs) were estimated with 95% CIs. STATA 12 was used to compute descriptive statistics and measures of associations with the logistic regression models. The P value for statistical significance was set as < 0.05.

This study was reviewed by CDC and conducted consistent with applicable federal law and CDC ethics policy.

3. RESULTS

The total number of working adults included in this study was 6,649, with 68.1% Non-Hispanic Whites, 14.3 % Non-Hispanic Blacks, 13.7% Hispanics, 50.5 % females, 94.6 % in the age range of 18–64 years, and, 35.7% with less than a high school or a high school education, and 23.7% with under $15,000 in personal earnings per year.

The prevalence of back pain indicated by this pooled data analysis was 26.4%. Table 3 shows the demographic distribution of respondents by back pain. The female workers reported a slightly higher rate for back pain (26%) than the male workers (25%). There was a decreasing trend in reporting back pain from the youngest age group to the oldest age group. The youngest age group (18 – 25) had the highest percentage of reported back pain (28%) and the oldest age group (65 and above) had the lowest percentage (22%). Compared with those with high school education, those with college (OR 0.64, $p < 0.001$) or Master's and above education (OR 0.59, $p < 0.001$) were less likely to report back pain. Compared with those with earnings of $75,000 and above, the unadjusted ORs for reporting back pain were significantly higher for those with lower earnings.

Table 4 shows the characteristics of the workplace psychosocial and physical factors and the occupational groupings of the study population. For workplace psychosocial factors, the proportion of respondents who reported job strain was 34.1%, low supervisory support 29.0%, work-family imbalance 28.3%, harassment 37.4%, discrimination 32.7% and job insecurity 33.0%. The univariate logistic regressions showed that all 5 workplace psychosocial factors were significantly associated with back pain: job strain (OR 1.63 CI. 1.42,1.87), low social support (OR 1.36 CI. 1.21,1.52), work-family imbalance (OR 1.42 CI. 1.27,1.60), harassment (OR 1.85 CI. 1.58,2.17), discrimination, (OR 1.48 CI. 1.28,1.72), and job insecurity (OR 1.49 CI. 1.27,1.73).

For workplace physical factors, 48% of the respondents answered yes to lifting heavy loads in their work and almost half (49%) of the workers reported yes to repetitive or forceful hand movements or awkward arm positions at work. The univariate logistic regressions demonstrated that these workplace physical factors were also significantly associated with back pain: lifting (OR 1.74 CI. 1.56,1.95) and hand movements (OR 2.05 CI. 1.83,2.30).

For occupational patterns of back pain, the top three occupation groups with significantly higher percentages of back pain were: construction (34.3%), transportation (31.1%) and service related (30.1%). Compared with the professionals, all other occupation groups had a significantly increased risk for back pain in the univariate analyses.

In the multivariate analyses shown in Table 5, workers that reported high job strain were 19% more likely to report back pain, compared with those that reported low job strain (aOR 1.19, CI 1.00,1.41). Workers that reported work-family imbalance (aOR 1.42, CI 1.22–1.64), harassment (aOR 1.40, CI 1.15,1.71), or discrimination (aOR 1.20, CI 1.00,1.44) were significantly more likely to report back pain.

Two physical job factors, lifting heavy loads (aOR 1.22, CI 1.03,1.43) and repetitive/forceful hand movements, or awkward arm postures (aOR 1.62, CI 1.39,1.89), were also significantly associated with back pain. Three occupation groups that had a significantly higher risk for back pain were construction (aOR 1.56, CI 1.18,2.07), transportation (aOR 1.42, CI 1.03,1.96), and office and administrative support (aOR 1.40, CI 1.10,1.77).

4. DISCUSSION

The QWL survey is designed to monitor the changing nature of work, to assess the relationship between job/organizational characteristics and worker health, and to identify strategies for workplace preventive interventions.[64] While the goal of this study is not to monitor the changes in nature of work, the primary goal of this study is to investigate the association between back pain and a set of workplace psychological factors (job strain, low social support, work-family imbalance, harassment, discrimination and job insecurity) with the QWL data.

The main finding of this study was the associations between back pain and psychosocial factors outside of the job strain model. These psychosocial factors were work-family imbalance, harassment, and discrimination. This study provided evidence to support the finding of the associations between back pain and a similar set of psychosocial factors (work-family imbalance and exposure to hostile work environment) in a previous study using the 2010 NHIS data.[45] The proportions of workers reporting work-family imbalance in the QWL were somewhat higher than in the 2010 NHIS.[44,45] These variations may be due to the differences in the measurements of these psychosocial factors and possible sampling differences between the QWL and the NHIS.

Although the back pain definitions were different in the QWL (back pain lasting 7 days or more in one year) and the NHIS surveys (any low back pain episode in past three months), the proportions of workers reporting back pain in the two study populations were similar.[45] Interestingly, the proportions of workers reporting back pain for each of the psychosocial

risk factor categories were also similar. We do not have a specific explanation for this comparable reporting of different pain definitions and exposures to psychosocial stressors. The similar results may be due to the fact that both the QWL and NHIS surveys were drawn from the same US working population. The two national survey instruments do not assess the chronicity of back pain. The Research Task Force on Chronic back pain defined chronic back pain as "a low back pain problem that has persisted at least 3 months and has resulted in pain on at least half the days in the past 6 months" and also called for assessments of low back pain with chronicity, intensity, and interference.[65] These assessments of pain chronicity will be important for future studies on the impact on quality of working life.

The univariate OR (1.7) of lifting heavy loads for back pain in this study was comparable to those (OR 2.01, 1.69, 1.55 and 1.86 for 2002, 2006, 2010 and 2014, respectively) found in previous studies using the QWL survey data from 2002 to 2014.[23–26] The aOR of lifting heavy loads for back pain using the pooled dataset was attenuated slightly to 1.2 but the statistical inference remained significant. Similarly, repetitive hand movements as another physical risk factor for back pain remained significant after controlling for a set of psychosocial risk factors and other confounding variables. Their significance in the multivariate regression model indicates both hand movements and lifting heavy loads remain highly relevant to back pain regardless of exposures to various psychosocial stressors. It is worth noting that the magnitudes of the aORs of several psychosocial stressors were in a similar range of the aORs of the physical risk factors (heavy lifting and hand movements in Table 5), although a direct comparison of the aORs cannot be made.

Compared with the professional group, the univariate ORs for all other occupation groups were significantly higher. After controlling for workplace psychosocial and physical risk factors, and demographic characteristics in the multivariate analysis, construction workers, transportation workers, and office/administrative support workers had a significantly increased risk (a 56%, 42% and 40% increase, respectively) for back pain. The finding of the increased risk for back pain in these three occupation groups is consistent with physical risk exposures in the literature. A longitudinal study of construction workers of the United States showed that jobs that involved a great deal of physical effort significantly increased the risk of back disorders, and the longest-held jobs in construction also increased the risk for back pain.[16] A Swedish study of a randomly selected sample of construction workers found a dose-response relationship between severe back pain and both stooping or kneeling.[66] A study of office workers conducted in Turkey showed that 53% of them complained about back pain, which could be attributed to prolonged sitting without rest breaks.[67] However, a review study of office workers and back pain found little evidence of an association between sitting with a poor posture and back pain among office workers, compared with studies of diverse occupations focusing on associations between exposure to various working postures and back pain. [68] Nevertheless, indicators of socioeconomic status may attenuate the effect estimated for specific occupational exposures. These indicators may include financial or geographic access to healthier food or exercise facilities, health literacy and access to information, social prestige, and perceived relative deprivation.[69,70]

The significant workplace psychosocial factors found in this study may increase the understanding of factors contributing to back pain in workers.[11,71] There have been several

hypothesized mechanisms or pathways between psychosocial risk factors and back pain. Based on recent interdisciplinary physiology and neuroscience research, a conceptual framework was proposed by McEwen and his colleagues to better understand complex stress-related health problems and possible interventions.[72,73] Two major key terms in this framework are “allostasis” and “allostatic load.” Allostasis is defined as a fundamental process of adaptation to both predictable and unpredictable events to restore stability. Allostatic load is defined as the cumulative result of an allostatic state, and it could be understood as "the wear and tear” on the multiple bodily systems through collective exposures to psychosocial stressors, along with the impact of life experiences.[72,74] The brain is the central organ of stress and adaptation (allostatic load) and physiological dysregulation caused by wearing down of multiple body systems and psychosocial factors may also trigger pain.[75,76]

In addition to McEwen’s conceptual framework of allostatic load that provides an explanation of the pathways between psychosocial factors and health problems, there has been research exploring the possible pathways between back pain and psychosocial factors, such as exposure to work-family imbalance, harassment, discrimination, and job insecurity. These speculations are not contradictory, but complementary. For example, work-family imbalance may induce muscle tension due to physical and emotional exhaustion and lack of rest and recovery may be an important risk factor for the development of muscular pain, including back pain.[46,77] The mechanism for back pain related to exposure to a hostile work environment is likely to involve increased psychosocial strain resulting from both biomechanical and physiological processes (e.g., by increasing muscle tension).[78] The “physiological vulnerability” caused by mental strain associated with job insecurity may contribute to the development of back pain.[79]

As the characteristics of work have been changing in the past decades, continuing investigation of workplace psychosocial risk factors in relation to various adverse health outcomes is particularly important. Some driving forces of these changes are: intensifying global economic competition, growing information and communication technologies, an expanding service sector, blurring the boundary between day and night, increasing female labor force participation, increasing political and cultural openness and fluctuating economic growth.[58,80–82] The future of work may involve less manual labor but increasing cognitive demands resulting from collaborating with robots or smart production systems. These cognitive demands may translate into psychosocial stressors that mediate the development of back pain.

There are several strengths of this study. First, we constructed measurements of psychosocial factors by utilizing the QWL’s extensive measures of working conditions. The QWL survey instrument covers a wide range of psychosocial working conditions, including but not limited to workload, worker autonomy, skill utilization, role clarity and conflict, job security, work and family imbalance, discrimination, harassment, physical effort, supervisory support, job satisfaction, and physical health.[64]

Second, the measurements of job strain in this study were based on questions common to both the Job Content Questionnaire (JCQ) and the QWL that were theoretically consistent

with the job strain scale.[60] The measurements consisted of low social support with 4 items, work-family imbalance with 3 items, harassment with 2 items, discrimination with 3 items, and job insecurity with 1 item. Assessing these psychosocial factors with multiple questionnaire items improves the reliability and validly of the measures.[83,84]

Third, we combined five waves of data from the QWL survey to assure a relatively large sample size for an analysis of associations between many psychosocial factors and back pain. Results of this pooled data analysis on the association between back pain and job strain filled a research gap in the linkage between job strain and back pain in the US working people, as most of the research evidence in this area was from Northern European countries.[69,85–87]

Several limitations in this study are worth mentioning. First, this study was in cross-section design, which did not allow us to infer the causality between back pain and related risk factors. Thus, future research using a longitudinal study design is recommended for confirming the associations between psychosocial risk factors and back pain. Second, the health outcome in this study may have unclear onsets or recurrences of back pain that were not defined clearly in the QWL survey. Third, we pooled data from five recent QWL datasets to gain stability and generalizability of the associations between workplace risk factors and back pain. However, the pooled dataset cannot be used to assess the potentially changing nature of work over the years. The effect of time on the variations in both pain outcome and psychosocial variables in the statistical model was ignored. Workplace related health outcomes and risk factors in cross-sectional study waves may vary, even though they are being measured consistently. These fluctuations may be due to various reasons that are difficult to assess. For example, changes in sample size in the study population for each year may be related to variations in workplace related health outcomes. Finally, the respondents' reporting of back pain in the past year may be subject to recall bias.

5. CONCLUSION

This is the first study to explore the associations between back pain and a wide range of psychosocial stressors in the US working population by analyzing a pooled dataset from five QWL surveys. Significant associations were found between new psychosocial factors (work-family imbalance, harassment and discrimination) and back pain, after controlling for job-related physical risk factors, traditional psychosocial risk factors (i.e., job strain and social support), occupation and demographic characteristics. An implication of the findings from this study is a need for future research that uses a longitudinal study design for identifying the potential causal pathways of the new psychosocial risk factors for back pain.

ACKNOWLEDGEMENT

Authors of this paper would like to thank Dr. BongKyoo Choi for his contribution in assisting with the complex coding of job strain scale with the QWL items. Authors of this paper would also like to thank Dr. Jian Li for his suggestion in refining a pychosocial factor, hostile work environment, by spliting it into 2 variables: harassment and discrimination. The findings and conclusions in this paper are those of the authors and do not necessarily represent the official position of National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention.

REFERENCES

1. Hoy D, Brooks P, Blyth F, Buchbinder R. The Epidemiology of low back pain. J Manipulative Physiol Ther 2010;24(6):769–781.
2. Bernard P Musculoskeletal Disorders and Workplace Factors: A Critical Review of Epidemiologic Evidence for Work-Related Musculoskeletal Disorders of the Neck, Upper Extremity, and Low Back. In. Vol DHHS (NIOSH) Publication No. 97B141 Cincinnati, OH Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health; 1997:1–12.
3. Katz JN. Lumbar disc disorders and low-back pain: socioeconomic factors and consequences. J Bone Joint Surg Am 2006;88 Suppl 2:21–24. [PubMed: 16595438]
4. Dieleman JL, Cao J, Chapin A, et al. US Health Care Spending by Payer and Health Condition, 1996–2016. JAMA 2020;323(9):863–884. [PubMed: 32125402]
5. GBD. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet 2018;392(10159):1789–1858. [PubMed: 30496104]
6. Wettstein M, Eich W, Bieber C, Tesarz J. Pain Intensity, Disability, and Quality of Life in Patients with Chronic Low Back Pain: Does Age Matter? Pain medicine (Malden, Mass) 2019;20(3):464–475. [PubMed: 29701812]
7. Breivik H, Collett B, Ventafridda V, Cohen R, Gallacher D. Survey of chronic pain in Europe: prevalence, impact on daily life, and treatment. Eur J Pain 2006;10(4):287–333. [PubMed: 16095934]
8. Keeley P, Creed F, Tomenson B, Todd C, Borglin G, Dickens C. Psychosocial predictors of health-related quality of life and health service utilisation in people with chronic low back pain. Pain 2008;135(1–2):142–150. [PubMed: 17611036]
9. Husky MM, Ferdous Farin F, Compagnone P, Fermanian C, Kovess-Masfety V. Chronic back pain and its association with quality of life in a large French population survey. Health Qual Life Outcomes 2018;16(1):195. [PubMed: 30257670]
10. Dutmer AL, Schiphorst Preuper HR, Soer R, et al. Personal and Societal Impact of Low Back Pain: The Groningen Spine Cohort. Spine (Phila Pa 1976) 2019;44(24):E1443–E1451. [PubMed: 31369481]
11. Institute of Medicine (US) Committee on Advancing Pain Research C, and Education. Relieving pain in America: a blueprint for transforming prevention. Care, Education, and Research Washington (DC): The National Academies Press2011.
12. Punnett L, Wegman DH. Work-related musculoskeletal disorders: the epidemiologic evidence and the debate. J Electromyogr Kinesiol 2004;14(1):13–23. [PubMed: 14759746]
13. Larsson B, Sogaard K, Rosendal L. Work related neck-shoulder pain: a review on magnitude, risk factors, biochemical characteristics, clinical picture and preventive interventions. Best Pract Res Clin Rheumatol 2007;21(3):447–463. [PubMed: 17602993]
14. Harcombe H, McBride D, Derrett S, Gray A. Physical and psychosocial risk factors for musculoskeletal disorders in New Zealand nurses, postal workers and office workers. Inj Prev 2010;16(2):96–100. [PubMed: 20363815]
15. Vandergrift JL, Gold JE, Hanlon A, Punnett L. Physical and psychosocial ergonomic risk factors for low back pain in automobile manufacturing workers. Occupational and Environmental Medicine 2012;69(1):29–34. [PubMed: 21586759]
16. Dong XS, Wang X, Fujimoto A, Dobbin R. Chronic back pain among older construction workers in the United States: a longitudinal study. Int J Occup Environ Health 2012;18(2):99–109. [PubMed: 22762489]
17. Dong XW. Long workhours, work scheduling and work-related injuries among construction workers in the United States. Scandinavian Journal of Work Environment & Health 2005;31(5):329–335.
18. Krause N, Ragland DR, Fisher JM, Syme SL. Psychosocial job factors, physical workload, and incidence of work-related spinal injury: a 5-year prospective study of urban transit operators. Spine (Phila Pa 1976) 1998;23(23):2507–2516. [PubMed: 9854749]

19. Doda DV, Wariki WMV, Wungouw HIS, et al. Work related low back pain, psychosocial, physical and individual risk factors among nurses in emergency care unit. Enferm Clin 2020;30 Suppl 6:31–35.
20. Sterud T, Tynes T. Work-related psychosocial and mechanical risk factors for low back pain: a 3-year follow-up study of the general working population in Norway. Occupational and Environmental Medicine 2013;70(5):296–302. [PubMed: 23322920]
21. Lallukka T, Viikari-Juntura E, Viikari J, et al. Early work-related physical exposures and low back pain in midlife: the Cardiovascular Risk in Young Finns Study. Occupational and Environmental Medicine 2017;74(3):163–168. [PubMed: 27516112]
22. Andersen LL, Vinstrup J, Sundstrup E, Skovlund SV, Villadsen E, Thorsen SV. Combined ergonomic exposures and development of musculoskeletal pain in the general working population: A prospective cohort study. Scandinavian Journal of Work Environment & Health 2021;47(4):287–295.
23. Waters TR, Dick RB, Krieg EF. Trends in Work-Related Musculoskeletal Disorders A Comparison of Risk Factors for Symptoms Using Quality of Work Life Data From the 2002 and 2006 General Social Survey. Journal of Occupational and Environmental Medicine 2011;53(9):1013–1024. [PubMed: 21278598]
24. Dick RB, Lowe BD, Lu ML, Krieg EF. Trends in Work-Related Musculoskeletal Disorders From the 2002 to 2014 General Social Survey, Quality of Work Life Supplement. J Occup Environ Med 2020;62(8):595–610. [PubMed: 32404838]
25. Dick RB, Lowe BD, Lu M-L, Krieg EF. Further Trends in Work-Related Musculoskeletal Disorders A Comparison of Risk Factors for Symptoms Using Quality of Work Life Data From the 2002, 2006, and 2010 General Social Survey. Journal of Occupational and Environmental Medicine 2015;57(8):910–928. [PubMed: 26247646]
26. Waters TR, Dick RB, Davis-Barkley J, Krieg EF. A cross-sectional study of risk factors for musculoskeletal symptoms in the workplace using data from the General Social Survey (GSS). Journal of Occupational and Environmental Medicine 2007;49(2):172–184. [PubMed: 17293757]
27. Carragee EJ. Clinical practice. Persistent low back pain. N Engl J Med 2005;352(18):1891–1898. [PubMed: 15872204]
28. Steglitz J, Buscemi J, Ferguson MJ. The future of pain research, education, and treatment: a summary of the IOM report "Relieving pain in America: a blueprint for transforming prevention, care, education, and research". Translational behavioral medicine 2012;2(1).
29. Karasek R, Choi B, Ostergren PO, Ferrario M, De Smet P. Testing two methods to create comparable scale scores between the Job Content Questionnaire (JCQ) and JCQ-Like questionnaires in the European JACE study. International Journal of Behavioral Medicine 2007;14(4):189–201. [PubMed: 18001234]
30. Karasek RA. Job Demands, Job Decision Latitude, and Mental Strain - Implications for Job Redesign. Administrative Science Quarterly 1979;24(2):285–308.
31. Schnall PL, Landsbergis PA, Baker D. Job strain and cardiovascular disease. Annu Rev Public Health 1994;15:381–411. [PubMed: 8054091]
32. Theorell T, Karasek RA. Current issues relating to psychosocial job strain and cardiovascular disease research. J Occup Health Psychol 1996;1(1):9–26. [PubMed: 9547038]
33. Hoogendoorn WE, Bongers PM, de Vet HCW, et al. Psychosocial work characteristics and psychological strain in relation to low-back pain. Scand J Work Environ Health 2001;27(4):258–267. [PubMed: 11560340]
34. Canjuga M, Läubli T, Bauer GF. Can the job demand control model explain back and neck pain? Cross-sectional study in a representative sample of Swiss working population. International Journal of Industrial Ergonomics 2010;40(6):663–668.
35. Magnusson Hanson LL, Madsen IE, Rugulies R, Peristera P, Westerlund H, Descatha A. Temporal relationships between job strain and low-back pain. Scandinavian Journal of Work Environment & Health 2017;43(5):396–404.
36. Kausto J, Miranda H, Pehkonen I, Heliovaara M, Viikari-Juntura E, Solovieva S. The distribution and co-occurrence of physical and psychosocial risk factors for musculoskeletal disorders in

a general working population. Int Arch Occup Environ Health 2011;84(7):773–788. [PubMed: 21120664]

37. Yu S, Lu M-L, Gu G, Zhou W, He L, Wang S. Musculoskeletal symptoms and associated risk factors in a large sample of Chinese workers in henan province of China. Am J Ind Med 2012;55(3).
38. Wang J, Afifi TO, Cox B, Sareen J. Work-family conflict and mental disorders in the United States: cross-sectional findings from The National Comorbidity Survey. Am J Ind Med 2007;50(2):143–149. [PubMed: 17238143]
39. Berkman LF, Buxton O, Ertel K, Okechukwu C. Managers' practices related to work-family balance predict employee cardiovascular risk and sleep duration in extended care settings. J Occup Health Psychol 2010;15(3):316–329. [PubMed: 20604637]
40. Hansen AM, Hogh A, Persson R, Karlson B, Garde AH, Orbaek P. Bullying at work, health outcomes, and physiological stress response. Journal of Psychosomatic Research 2006;60(1):63–72. [PubMed: 16380312]
41. Kivimaki M, Virtanen M, Vartia M, Elovainio M, Vahtera J, Keltikangas-Jarvinen L. Workplace bullying and the risk of cardiovascular disease and depression. Occupational and Environmental Medicine 2003;60(10):779–783. [PubMed: 14504368]
42. Ferrie JE, Shipley MJ, Stansfeld SA, Marmot MG. Effects of chronic job insecurity and change in job security on self reported health, minor psychiatric morbidity, physiological measures, and health related behaviours in British civil servants: the Whitehall II study. Journal of Epidemiology and Community Health 2002;56(6):450–454. [PubMed: 12011203]
43. Cheng Y, Chen CW, Chen CJ, Chiang TL. Job insecurity and its association with health among employees in the Taiwanese general population. Soc Sci Med 2005;61(1):41–52. [PubMed: 15847960]
44. Alterman T, Luckhaupt SE, Dahlhamer JM, Ward BW, Calvert GM. Job insecurity, work-family imbalance, and hostile work environment: Prevalence data from the 2010 National Health Interview Survey. Am J Ind Med 2013;56(6):660–669. [PubMed: 23023603]
45. Yang H, Haldeman S, Lu M, Baker D. Low Back Pain Prevalence and Related Workplace Psychosocial Risk Factors: A Study Using Data From the 2010 National Health Interview Survey. J Manipulative Physiol Ther 2016;39(7):459–472. [PubMed: 27568831]
46. Haemmig O, Knecht M, Laeubli T, Bauer GF. Work-life conflict and musculoskeletal disorders: a cross-sectional study of an unexplored association. Bmc Musculoskeletal Disorders 2011;12:1–12. [PubMed: 21199576]
47. Kim YM, Cho SI. Work-Life Imbalance and Musculoskeletal Disorders among South Korean Workers. Int J Environ Res Public Health 2017;14(11).
48. Glambek M, Nielsen MB, Gjerstad J, Einarsen S. Gender differences in the relationship between workplace bullying and subjective back and neck pain: A two-wave study in a Norwegian probability sample. J Psychosom Res 2018;106:73–75. [PubMed: 29455903]
49. Sabbath EL, Hurtado DA, Okechukwu CA, et al. Occupational Injury Among Hospital Patient-Care Workers: What Is the Association With Workplace Verbal Abuse? Am J Ind Med 2014;57(2):222–232. [PubMed: 24151093]
50. Vignoli M, Guglielmi D, Balducci C, Bonfiglioli R. Workplace Bullying as a Risk Factor for Musculoskeletal Disorders: The Mediating Role of Job-Related Psychological Strain. Biomed Research International 2015.
51. Yang HO, Hitchcock E, Haldeman S, et al. Workplace psychosocial and organizational factors for neck pain in workers in the United States. American Journal of Industrial Medicine 2016;59(7):549–560. [PubMed: 27184340]
52. Lee WW, Park JB, Min KB, Lee KJ, Kim MS. Association between work-related health problems and job insecurity in permanent and temporary employees. Ann Occup Environ Med 2013;25(1):15. [PubMed: 24472497]
53. Khubchandani J, Price JH. Association of Job Insecurity with Health Risk Factors and Poorer Health in American Workers. J Community Health 2017;42(2):242–251. [PubMed: 27614889]

54. NORC. An Introduction to the General Social Survey. The General Social Survey (GSS), a project of the independent research organization NORC at the University of Chicago, with principal funding from the National Science Foundation 2016; http://gss.norc.org/About-The-GSS.
55. National Institute for Occupational Safety and Health. Quality of Worklife Questionnaire 2013; http://www.cdc.gov/niosh/topics/stress/qwlquest.html. Accessed May 1, 2016.
56. Morgan SL. Response Rates and Representativeness: A Benchmark Comparison of the General Social Surveys to the American Community Surveys, 2012–2018. In. GSS Methodological Report No. 131 General Social Survey (GSS): NORC; 2020.
57. NORC. Response rate of GSS 2016; https://gss.norc.org/Documents/other/Response rates.pdf. Accessed June 10, 2021.
58. Myers S, Govindarajulu U, Joseph M, Landsbergis P. Changes in work characteristics over 12 years: Findings from the 2002–2014 US National NIOSH Quality of Work Life Surveys. Am J Ind Med 2019;62(6):511–522. [PubMed: 31046140]
59. Dickinson CE, Campion K, Foster AF, Newman SJ, O'Rourke AM, Thomas PG. Questionnaire development: an examination of the Nordic Musculoskeletal questionnaire. Appl Ergon 1992;23(3):197–201. [PubMed: 15676868]
60. Karasek R, Brisson C, Kawakami N, Houtman I, Bongers P, Amick B. The Job Content Questionnaire (JCQ): an instrument for internationally comparative assessments of psychosocial job characteristics. Journal of occupational health psychology 1998;3(4):322–355. [PubMed: 9805280]
61. Clays E, De Bacquer D, Leynen F, Kornitzer M, Kittel F, De Backer G. The impact of psychosocial factors on low back pain: longitudinal results from the Belstress study. Spine (Phila Pa 1976) 2007;32(2):262–268. [PubMed: 17224824]
62. Hartvigsen J, Lings S, Leboeuf-Yde C, Bakketeig L. Psychosocial factors at work in relation to low back pain and consequences of low back pain; a systematic, critical review of prospective cohort studies. Occupational and Environmental Medicine 2004;61(1).
63. Linton SJ, Warg LE. Attributions (beliefs) and job satisfaction associated with back pain in an industrial setting. Percept Mot Skills 1993;76(1):51–62. [PubMed: 8451151]
64. NIOSH. Quality of Worklife Questionnaire *Workplace Safety and Health Topics* 2013. Accessed June 1, 2021.
65. Deyo RA, Dworkin SF, Amtmann D, et al. Report of The National Institutes of Health Task Force on Research Standards for Chronic Low Back Pain. J Manipulative Physiol Ther 2014;37(7):449–467. [PubMed: 25127996]
66. Holmstrom EB, Lindell J, Moritz U. Low back and neck/shoulder pain in construction workers: occupational workload and psychosocial risk factors. Part 2: Relationship to neck and shoulder pain. Spine (Phila Pa 1976) 1992;17(6):672–677. [PubMed: 1385661]
67. Celik S, Celik K, Dirimese E, Tasdemir N, Arik T, Buyukkara I. Determination of pain in musculoskeletal system reported by office workers and the pain risk factors. Int J Occup Med Environ Health 2018;31(1):91–111. [PubMed: 28972599]
68. Hartvigsen J, Leboeuf-Yde C, Lings S, Corder EH. Is sitting-while-at-work associated with low back pain? A systematic, critical literature review. Scand J Public Health 2000;28(3):230–239. [PubMed: 11045756]
69. Punnett L Musculoskeletal disorders and occupational exposures: How should we judge the evidence concerning the causal association? Scandinavian Journal of Public Health 2014;42:49–58. [PubMed: 24553854]
70. Punnett L, Pruss-Ustun A, Nelson DI, et al. Estimating the global burden of low back pain attributable to combined occupational exposures. Am J Ind Med 2005;48(6):459–469. [PubMed: 16299708]
71. Marras WS. The future of research in understanding and controlling work-related low back disorders. Ergonomics 2005;48(5):464–477. [PubMed: 16040520]
72. McEwen BS. Protective and damaging effects of stress mediators. N Engl J Med 1998;338(3):171–179. [PubMed: 9428819]
73. McEwen BS. Protective and damaging effects of stress mediators: central role of the brain. Prog Brain Res 2000;122:25–34. [PubMed: 10737048]

74. McEwen BS, Stellar E. Stress and the individual. Mechanisms leading to disease. Arch Intern Med 1993;153(18):2093–2101. [PubMed: 8379800]

75. Lunde CE, Sieberg CB. Walking the Tightrope: A Proposed Model of Chronic Pain and Stress. Front Neurosci 2020;14:270. [PubMed: 32273840]

76. Linton SJ. A review of psychological risk factors in back and neck pain. Spine (Phila Pa 1976) 2000;25(9):1148–1156. [PubMed: 10788861]

77. Lundberg U, Melin B. Stress in the development of musculoskeletal pain. New Avenues for the Prevention of Chronic Musculoskeletal Pain and Disability 2002;12:165–179.

78. Sprigg CA, Stride CB, Wall TD, Holman DJ, Smith PR. Work characteristics, musculoskeletal disorders, and the mediating role of psychological strain: A study of call center employees. Journal of Applied Psychology 2007;92(5):1456–1466. [PubMed: 17845098]

79. Kim TJ, von dem Knesebeck O. Is an insecure job better for health than having no job at all? A systematic review of studies investigating the health-related risks of both job insecurity and unemployment. Bmc Public Health 2015;15. [PubMed: 25605404]

80. Commission on Behavioral and Social Sciences and Education DoBaSSaENRC. The Changing Nature of Work: Implications for Occupational Analysis Washington, DC: The National Academies Press; 1999.

81. Johnson JV, Lipscomb J. Long working hours, occupational health and the changing nature of work organization. American journal of industrial medicine 2006;49(11):921–929. [PubMed: 16986150]

82. Landsbergis PA, Grzywacz JG, LaMontagne AD. Work organization, job insecurity, and occupational health disparities. Am J Ind Med 2014;57(5):495–515. [PubMed: 23074099]

83. Carmines EG, Zeller RA. Reliability and validity assessment Beverly Hills, Calif.: Sage Publications; 1979.

84. Checkoway H, Pearce N, Crawford-Brown DJ. Research methods in occupational epidemiology New York: Oxford University Press; 1989.

85. Canjuga M, Laeubli T, Bauer GF. Can the job demand control model explain back and neck pain? Cross-sectional study in a representative sample of Swiss working population. International Journal of Industrial Ergonomics 2010;40(6):663–668.

86. Janwantanakul P, Sitthipornvorakul E, Paksaichol A. Risk Factors for the Onset of Nonspecific Low Back Pain in Office Workers: A Systematic Review of Prospective Cohort Studies. J Manipulative Physiol Ther 2012;35(7):568–577. [PubMed: 22926018]

87. Tissot F, Messing K, Stock S. Studying the relationship between low back pain and working postures among those who stand and those who sit most of the working day. Ergonomics 2009;52(11):1402–1418. [PubMed: 19851907]

Table 1.

Sample Sizes of QWL Surveys that Met the Participant Inclusion Criteria

Number of participants	**Year**					
	2002	2006	2010	2014	2018	Total
Total GSS participants	2765	4506	2041	2536	2346	14194
Did not take part in the QWL	21	1049	7	277	25	1379
Not full-time or part-time worker	1021	1744	890	1033	953	5641
Not worked 20 hours or more per week	109	164	69	82	89	513
Final sample size	1614	1549	1075	1144	1279	6661
Response rate (%)	70.1	71.2	70.3	60.2	59.5	

Table 2.

Workplace Related Risk Factor Measurements, Domains and Question Items, and Response Formats

Domain	Item	Question	Response format
Psychosocial risk factors			
	Job strain		
	Job demands[1]		
	(a) Work fast	My job requires that I work very fast	4-point Likert scale, “Strongly agree” to “Strongly disagree.” Reverse coded.
	(b) Over work	I have too much work to do everything well.	4-point Likert scale, “Strongly agree” to “Strongly disagree.” Reverse coded.
	(c) Work time	I have enough time to get the job done.	A 4-point Likert scale, “Very true” to “Not at all true.”
	(d) Conflicting demands	I am free from the conflicting demands that other people make of me.	4-point Likert scale, “Very true” to “Not at all true.”
	(e) Too few workers	How often are there not enough people or staff to get all the work done?	4-point Likert scale, “Very true” to “Not at all true.” Reverse coded.
	Job Control [2]		
	(a) Learn new things	My job requires that I keep learning new things.	4-point Likert scale, “Strongly disagree” to “Strongly agree.”
	(b) Work freedom	I am given a lot of freedom to decide how to do my own work	4-point Likert scale, “Very true” to “Not at all true.”
	(c) Work variety	I get to do a number of different things on my job.	4-point Likert scale, “Strongly agree” to “Strongly disagree.”
	(d) Develop own ability	I have an opportunity to develop my own abilities.	4 point Likert scale, “Very true” to “Not at all true.”
	(e) Allows own decisions	In your job, how often do you take part with others in making decisions that affect you?	4-point Likert scale, “Often” to “Never.”
	Social support [3]		
	(a) Co-worker help	The people I work with can be relied on when I need help.	4-point Likert scale, “Very true” to “Not at all true.”
	(b) Supervisor care	My supervisor is concerned about the welfare of those under him or her.	4-point Likert scale, “Very true” to “Not at all true.”
	(b) Supervisor help	My supervisor is helpful to me in getting the job done	4-point Likert scale, “Strongly agree” to “Strongly disagree.”
	(c) Co-worker interest	The people I work with take a personal interest in me	4-point Likert scale, “Very true” to “Not at all true.”
	Work-family imbalance [4]		
	(a) Level of difficulty for taking time off from work	How hard is it to take time off during your work to take care of personal or family matters?	4 point Likert scale, “Not at all hard” to “Very hard.”
	(b) Job interfered with family life	How often your job interfered with your family life?	4-point Likert scale, “Often” to “Never,” reverse coded.
	(c) Family interfere with job	How often do the demands of your family interfere with your work on the job?	4-point Likert scale, “Often” to “Never,” reverse coded.
	Harassment [5]		

Domain	Item	Question	Response format
Psychosocial risk factors			
	(a) General harassment at work	In the last 12 months, were you threatened or harassed in any other way by anyone while you were on the job?	Yes/No.
	(b) Sexual harassment	In the last 12 months, were you sexually harassed by anyone while you were on the job?	Yes/No.
	Discrimination [6]		
	(a) Discrimination based on race or ethnic origin	DDo you feel in any way discriminated against on your job because of your race or ethnic origin?	Yes/No
	(b) Discrimination based on gender	DDo you feel in any way discriminated against on your job because of your gender?	Yes/No
	(c) Discrimination based on age	DDo you feel in any way discriminated against on your job because of your age?	Yes/No
	Job security	The job security is good	4 point Likert scale, “Very true” to “Not at all true.”
Physical work environment			
	(a) Lift heavy loads	Does your job require you to do repetitive lifting, pushing, pulling or bending?	Yes/No.
	(b) Awkward body positions and awkward arm positions	Does your job regularly require you to perform repetitive or forceful hand movements or involve awkward postures?	Yes/No.

Notes:

[1]The scores for the 5 items were added and scores above the mean were defined as “high demand.”

[2]The scores for the 5 items were added and scores below the mean were defined as “low control.”

[3]The scores for the 4 items were added and scores below the mean were defined as “low social support.”

[4]The scores for the 3 items were added and scores above the mean were defined as “work-family imbalance.”

[5]“Yes” for “threatened or harassed in any other way by anyone” or “sexually harassed by anyone on the job” was defined as harassment.

[6]Yes” for discriminated against on job “because of race or ethnic origin,” “because of your gender,” or “because of your age” was defined as discriminations.

Table 3.

Distributions of the Study Population by Demographic Characteristics and BACK PAIN, Univariate Odds Ratios

	Demographic Characteristics	% in study pop	% with BACK PAIN	Odds Ratio	95% Conf.	P
BACK PAIN			25.9			
Age						
	18 – 25	10.6	28.2			
	26 – 40	36.1	26.7	0.93	(0.77,1.12)	
	41 – 55	35.2	25.7	0.88	(0.73,1.06)	
	56 – 64	12.7	24.0	0.81	(0.64,1.01)	**
	65+	5.4	21.6	0.70	(0.53,0.95)	*
Sex						
	Male	49.5	25.3	1.00		
	Female	50.5	26.4	1.06	(0.95,1.18)	
Ethnicity and race						
	Non-Hispanic White	68.1	26.7	1.00		
	Non-Hispanic Black	14.3	20.9	0.72	(0.61,0.86)	
	Hispanic	13.7	27.7	1.05	(0.89,1.25)	
	Non-Hispanic Others	4.1	24.6	0.90	(0.68,1.19)	
Education						
	Less than high school	10.3	36.0	2.43	(1.95,3.04)	**
	High school	25.5	28.2	1.70	(1.40,2.05)	**
	Some college	29.9	27.8	1.66	(1.38,2.00)	**
	College	18.9	20.1	1.09	(0.88,1.34)	
	Master and above	15.5	18.8			
Earning						
	< $15,000	23.7	31.3	2.11	(1.62,2.75)	**
	$15,000 - $24,999	19.3	26.6	1.68	(1.28,2.21)	**
	$25,000 - $34,999	15.7	25.7	1.61	(1.21,2.13)	*
	$35,000 - $49,999	19.2	26.0	1.63	(1.24,2.15)	**
	$50,000 - $74,999	13.3	23.6	1.43	(1.07,1.92)	*
	> =$75,000	8.9	17.7	1.00		

* <=0.05

** <=0.001

Table 4.

Proportion of Workers with BACK PAIN by Work-related Psychosocial and Physical Risk Factors, Univariate Odds Ratios

	Variable	% in study pop	% with BACK PAIN	Odds Ratio	95% Conf.	P
BACK PAIN		25.9				
Psychosocial risk factors						
	Job strain	19.0	34.1	1.63	(1.42,1.87)	**
	Low social support	48.7	29.0	1.36	(1.21,1.52)	**
	Work-family imbalance	63.5	28.3	1.42	(1.27,1.60)	**
	Harassment	11.4	37.4	1.85	(1.58,2.17)	**
	Discrimination	15.0	32.7	1.48	(1.28,1.72)	**
	Job insecurity	13.1	33.0	1.49	(1.27,1.73)	**
Physical risk factors						
	Lift heavy loads	47.8	31.4	1.74	(1.56,1.95)	**
	Repetitive/forceful hand movements/ awkward arm positions	48.7	32.9	2.05	(1.83,2.30)	**
Occupation						
	Professional	22.5	19.9	1		
	Management, business and financial related	16.7	20.4	1.03	(0.85,1.26)	*
	Sales and related	9.1	25.2	1.36	(1.08,1.70)	**
	Production related	6.6	28.7	1.62	(1.26,2.07)	**
	Office and administrative support	12.9	27.8	1.54	(1.27,1.88)	**
	Services and related	17.7	30.1	1.73	(1.45,2.07)	**
	Construction related	8.8	34.3	2.10	(1.69,2.60)	**
	Transportation related	5.7	31.1	1.81	(1.41,2.34)	**

*
<=0.05

**
<=0.001

Table 5.

Logistic Analysis of Psychosocial and Physical Risk Factors for Back Pain[***]

	Variable	Odds Ratio	95% confident interval	P
Psychosocial risk factors				
	Job strain	1.19	(1.00,1.41)	*
	Low social support	1.05	(0.91,1.22)	
	Work-family imbalance	1.42	(1.22,1.64)	**
	Harassment	1.40	(1.15,1.71)	**
	Discrimination	1.20	(1.00,1.44)	*
	Job insecurity	1.16	(0.95,1.41)	
Physical risk factors				
	Lift heavy loads	1.22	1.03,1.43)	*
	Repetitive/forceful hand movements/awkward arm positions	1.62	(1.39,1.89)	**
Occupation				
	Professional	1.00		
	Management, business & financial related	1.06	(0.84,1.34)	
	Sales and related	1.17	(0.89,1.55)	
	Production related	1.22	(0.90,1.65)	
	Office and administrative support	1.40	(1.10,1.77)	*
	Services and related	1.21	(0.96,1.53)	
	Construction related	1.56	(1.18,2.07)	*
	Transportation related	1.42	(1.03,1.96)	*

*<=0.05

**<=0.001

***controlling for demographic (age, gender, and race, and ethnicity), and socioeconomic variables