ORIGINAL RESEARCH

Low Back Pain Prevalence and Related Workplace Psychosocial Risk Factors: A Study Using Data From the 2010 National Health Interview Survey

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ABSTRACT

Objectives: The objectives of this study were to estimate prevalence of low back pain, to investigate associations between low back pain and a set of emerging workplace risk factors, and to identify worker groups with an increased vulnerability for low back pain in the United States.

Methods: The data used for this cross-sectional study came from the 2010 National Health Interview Survey, which was designed to collect data on health conditions and related risk factors from the US civilian population. The variance estimation method was used to compute weighted data for prevalence of low back pain. Multivariable logistic regression analyses stratified by sex and age were performed to determine the odds ratios (ORs) and the 95% confidence interval (CI) for low back pain. The examined work-related psychosocial risk factors included work-family imbalance, exposure to a hostile work environment, and job insecurity. Work hours, occupation, and other work organizational factors (nonstandard work arrangements and alternative shifts) were also examined.

Results: The prevalence of self-reported low back pain in the previous 3 months among workers in the United States was 25.7% in 2010. Female or older workers were at increased risk of experiencing low back pain. We found significant associations between low back pain and a set of psychosocial factors, including work-family imbalance (OR 1.27, CI 1.15-1.41), exposure to hostile work (OR 1.39, CI 1.25-1.55), and job insecurity (OR 1.44, CI 1.24-1.67), while controlling for demographic characteristics and other health-related factors. Older workers who had nonstandard work arrangements were more likely to report low back pain. Women who worked 41 to 45 hours per week and younger workers who worked >60 hours per week had an increased risk for low back pain. Workers from several occupation groups, including male health care practitioners, female and younger health care support workers, and female farming, fishing, and forestry workers, had an increased risk of low back pain.

Conclusions: This study linked low back pain to work-family imbalance, exposure to a hostile work environment, job insecurity, long work hours, and certain occupation groups. These factors should be considered by employers, policymakers, and health care practitioners who are concerned about the impact of low back pain in workers. (J Manipulative Physiol Ther 2016;39:459-472)

Key Indexing Terms: *Low Back Pain; Demographic Analysis; Workplace; Behavior; Psychology; Epidemiology*

INTRODUCTION

Low back pain is a common health problem in the workplace, and most workers are expected to experience symptoms of low back pain during their working life.[1,2] Low back pain has a profound impact both directly and indirectly on individual workers and their families, industries, and governments.[3-6] Direct health care expenditure for low back pain has been reported to range from $50 to $90.7 billion annually in the United States.[6-8] Total costs of direct medical expenditures and loss of work productivity combined related to pain, including low back pain, have been estimated to be as high as $635 billion annually in the United States.[9]

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Considerable research conducted on this topic in the past 3 decades has identified a number of demographic, behavioral, and health- and work-related factors associated with low back pain.[2,10-12] The 2 major categories of work-related risk factors for low back pain are physical[13-20] and psychosocial.[12-14,20-25] In the past, much of the research on work-related psychosocial risk factors was conducted within the job strain framework.[26,27] In this framework, job strain occurs when there is a combination of high job demands and low job control. *Job demands* are operationalized as psychosocial demands (work pace, time pressure, competing demands), and *job control* is defined as job autonomy and skill discretion.[22,28,29] This area of research has reported an association between job strain and low back pain, as well as the association between job demands and low back pain.[19,30-33]

In recent years, emphasis has shifted toward identifying some emerging psychosocial risk factors and work organizational characteristics associated with low back pain, including work-family conflict,[34] hostile work environment,[35] job insecurity,[36,37] long work hours, and mandatory overtime work hours.[38-40] Two studies on the US working population reported associations between low back pain and a set of psychosocial variables, including job satisfaction, supervisor support, job freedom, and mandatory overtime work.[13,14] Another US population-based study linked long work hours to occupational injuries and illnesses, including low back pain.[40] Two occupation-based studies on US health care workers also revealed associations of musculoskeletal pain with work-family conflict and with a hostile work environment.[35,41]

The previously mentioned emerging psychosocial and work organizational risk factors for low back pain have been examined for specific occupations in the United States.[42] However, no research has been conducted to explore their associations with low back pain at the population level.

The purposes of this study are (1) to estimate low back pain prevalence in the general working population in different demographic groups in the United States; (2) to explore the associations between low back pain and a set of emerging workplace psychosocial risk factors in different demographic groups in the United States; and (3) to explore the associations between low back pain and a set of work organization– and job-related risk factors in different demographic groups of the working population in the United States.

Methods

Data

Data for this study came from the 2010 National Health Interview Survey (NHIS) core and supplementary occupational health questions. The NHIS is a yearly cross-sectional survey of the civilian and noninstitutionalized population in the United States. The NHIS core questionnaire remains the same each year, whereas the supplementary questions vary from year to year, collecting additional data on special health topics.[43] The 2010 NHIS included an Occupational Health Supplementary Survey (NHIS-OHS),[44] which provided new data on emerging psychosocial and work organizational factors.[42] Two 2010 NHIS data files used for this study were the Person and Sample Adult files. The data of the NHIS-OHS was included in the Sample Adult file. The final response rate for the Sample Adult component was 60.8% for 2010.[45] The measurements of variables used in this study included low back pain, demographics, socioeconomic status, health behavior, mental health, and work-related factors. The data used for this study included respondents aged 18 to 64 years who worked for pay in the week before the interview. The sample size was 13 924 for the variance estimations of the study population. This study used the public use files from the NHIS, which were approved by the Research Ethics Review Board of the National Center for Health Statistics,[46] and the study was exempted by the institutional review board of the University of California, Irvine.

Measurements

Low Back Pain. The low back pain in the NHIS-OHS survey was self-reported and defined by the yes/no question, "During the past three months, did you have low back pain?" This definition is similar to the chronic low back pain classification defined by the Task Force on Research Standards for Chronic Low Back Pain, but it has no assessments of the chronicity, intensity, and interference.[47]

Work-Related Factors. Work-related factors explored in this study were psychosocial risk factors, work organizational factors, work hours per week, and occupation. Psychosocial risk factors included work-family imbalance, exposure to hostile work environment, and job insecurity. Work-family imbalance was measured by the following question: "Please tell me whether you: strongly agree, agree, disagree, or strongly disagree with this statement: It is easy for me to combine work with family responsibilities." Responses of "strongly disagree" and "disagree" were defined as high work-family imbalance. Exposure to hostile work environment was measured by the yes/no question, "During the past 12 months were you threatened, bullied, or harassed by anyone while you were on the job?" Response of "yes" was defined as exposure to hostile work environment. Job insecurity was measured by the question, "Please tell me whether you: strongly agree, agree, disagree, or strongly disagree with this statement: I am worried about becoming unemployed." Responses of "strongly agree" and "agree" were defined as high job insecurity.

The 2 work organizational factors examined were nonstandard work arrangements and alternative shifts. *Nonstandard*

work arrangement was defined as work arrangement with any of the following categories: (a) work/worked as an independent contractor, independent consultant, or freelance worker; (b) are/were on call and work/worked only when called to work; (c) are/were paid by a temporary agency; (d) work/worked for a contractor who provides workers and services to others under contract; and (e) other work arrangement. Alternative shifts were measured by the question, "Which of the following best describes the hours you usually work/worked?" with responses, "a regular evening shift," "a regular night shift," "a rotating shift," or "some other schedule."

Hours of work were assessed using a question about hours of work last week at all jobs or businesses. The variable of hours of work per week was coded into 5 categories: (a) 8 to 39 hours, (b) 40 hours, (c) 41 to 45 hours, (d) 46 to 59 hours, and (e) 60 or more hours. Regular working hours of 40 hours per week was used as the reference group in the analysis.

The variable of occupation used in this study came from the NHIS 22 occupation classifications,[48] which included the following: (1) management; (2) business and financial; (3) computer and mathematical; (4) architecture and engineering; (5) life, physical, and social sciences; (6) community and social services; (7) legal; (8) education, training, and library occupations; (9) arts, design, entertainment, sports, and media; (10) health care practitioners and technical; (11) health care support; (12) protective service; (13) food preparation and serving related; (14) building and ground cleaning and maintenance; (15) personal care and service; (16) sales and related; (17) office and administrative support; (18) farming, fishing, and forestry; (19) construction and extraction; (20) installation, maintenance, and repair; (21) production; and (22) transportation and material moving. The computer and mathematical occupation group, which had the lowest level prevalence for the total population of low back pain, was used as the reference group in the analysis.

Demographic Characteristics and Socioeconomic Status. Demographic characteristics and socioeconomic status were treated as potential confounders. Demographic variables used in the analysis included sex, age, and race and ethnicity. Age was coded into 4 age groups: (a) 18 to 25, (b) 26 to 40, (c) 41 to 55, and (d) 56 to 64 years. The reference group used in the analysis was 18 to 25 years. Race and ethnicity was coded into 5 groups: Hispanic, non-Hispanic White, non-Hispanic Black, non-Hispanic Asian, and non-Hispanic Others. The non-Hispanic White group was used as the reference group. In addition, socioeconomic status variables included education and income earning. Imputation of missing values for earning was not conduced because the missing values for earning were not systematically related to low back pain.

Other Related Risk Factors. Other related risk factors were leisure-time physical activity, serious psychological distress, and obesity. Regular leisure-time physical activity was defined as engaging in moderate physical activity for at least 30 minutes per day for 5 or more days per week or vigorous physical activity for at least 20 minutes per day for 3 or more days per week. A dummy variable was coded based on a set of questions related to intensity, duration, and frequency of physical activity according to the guidelines of Healthy People 2020.[49] Serious psychological distress was measured by the Kessler 6 Scale in the NHIS,[50] which assessed the frequency of 6 symptoms of nonspecific psychological distress in the past 30 days with the following question: "During the past 30 days, how often did you feel..." (a) so sad that nothing could cheer you up, (b) nervous, (c) restless or fidgety, (d) hopeless, (e) that everything was an effort, and (f) worthless. The answering options for each symptom included (a) all of the time, (b) most of the time, (c) some of the time, (d) a little of the time, and (e) none of the time. Serious psychological distress was coded by reversing the scores, giving "none of the time" a value of 0 and "all of the time" 4, and summing up a score for the 6 items. A score of $\geq$13 was used to indicate serious psychological distress. Obesity was determined by a body mass index (weight in kg/height in m^2) of $\geq$30 kg/m^2.[51]

Statistical Analysis

To account for the complex sampling design of the NHIS, direct standardization and the Taylor linearized variance estimation methods in STATA 12 (StataCorp, College Station, TX) were used to compute weighted descriptive statistics and measures of associations. Risk of low back pain was estimated using multivariable logistic regression with odds ratios (ORs) and the 95% confidence interval (CI). The descriptive statistics and measures of associations were stratified by demographic factors.

The rationale for using the variance estimation method is to report the findings representing the US adult population because the NHIS is based on a multistage stratified sample design of households with in-person interviews of persons aged 18 years and older in the United States. The NHIS survey oversamples Black, Hispanic, and Asian persons to allow for improved estimations of special health issues in these minority populations. The probabilities of sample selection, along with adjustments for nonresponse and the minority strata, are reflected in sampling weights used for data analyses with the variance estimation method. The 2010 NHIS data sample weights were calibrated to the 2000 US Census and are based on population estimates for sex, age, and race/ethnicity of the US population. The final proportions of Black, Hispanic, and Asian populations represented in NHIS are comparable to that of the US Census, and, thus, the reported findings are representative of the US adult population.[43,52]

A full multivariate logistic regression model was developed to explore the relationship between low back pain and a set of emerging psychosocial and work organization factors, including work-family imbalance, exposure to hostile work environment, job insecurity, nonstandard work arrangements, alternative shifts, work hours, and occupation. The potential confounding factors controlled in the analyses included demographic and other characteristics, including sex, age, race, ethnicity, socioeconomic variables, education, earning, leisure-time physical activity, serious psychological distress, and obesity. To avoid multiple collinearity, 3 variables were eliminated from the regression models: hourly paid job, multiple jobs, and temporary jobs. In other words, the 3 variables were highly correlated with other work organization–related variables, and the estimate of the associations between low back pain and the key workplace risk factors may have become less precise if these variables were not eliminated in the regression model.

Five logistic regression models were constructed to explore the associations in the general worker population and different demographic subgroups of the working population. The first model (Model A) focused on all workers. Additional multivariate logistic regression models were constructed by stratifying sex and age, male workers, female workers, younger workers (18-40 years), and older workers (41-64 years). Sex-stratified logistic regression analysis was performed using 2 models: Model B focused on male workers, and Model C focused on female workers. Age-stratified logistic regression analysis was performed using 2 other models: Model D focused on younger workers (18-40 years), and Model E focused on older workers (41-64 years).

Results

Prevalence of Low Back Pain in US Workers

The prevalence of low back pain was 25.7% for all workers, 24.5% for men, 27.1% for women, 23.8% for younger workers, and 27.7% for older workers. Table 1 shows sex- and age group-specific prevalence rates for low back pain, with 22.5% for men in the younger age group and 28.8% for women in the older age group. Non-Hispanic White female workers (27.8%) and Hispanic older workers (28.7%) were the 2 groups with the highest prevalence of low back pain. In comparison, the prevalence for low back pain in non-Hispanic Asians in different age and sex groups was much lower, with 14.1% for men, 17.8% for women, 13.3% for younger workers, and 18.5% for older workers.

Demographic and socioeconomic characteristics of workers in the United States are presented in Table 1. The relationships between low back pain and demographic and socioeconomic factors analyzed in the logistic analyses are presented in Table 2. The all-worker group combined model reported that, compared with the 18 to 25 age group, workers in the 26 to 40, 41 to 55, and 60 to 64 age groups had an increased risk for low back pain, controlling for other risk factors. Female workers also had a limited increased risk for low back pain compared with male workers. The demographic stratified analysis indicated that, compared with workers with non-Hispanic White racial and ethnic backgrounds, male workers with non-Hispanic Black, Hispanic, and non-Hispanic Asian had a significantly lower likelihood for low back pain. A similar racial and ethnic low back pain pattern was also observed among younger workers. Model A indicates that workers who had a master's degree or higher education levels had a lower risk for low back pain compared with the workers with high school education.

Emerging Psychosocial and Organizational Risk Factors and Low Back Pain

Table 3 describes characteristics of workers among the emerging psychosocial and organizational factors and low back pain. Workers who reported exposure to work-family imbalance, a hostile work environment, or job insecurity had increased prevalence for low back pain compared with those were not exposed to these risk factors. Female workers who were exposed to a hostile work environment had the highest prevalence of low back pain (37.9%) compared with female workers exposed to other work-related psychosocial factors. A similar pattern was observed among male workers. Younger workers who reported job insecurity had the highest prevalence of low back pain (36.2%) compared with workers in the same age group who were exposed to other work-related psychosocial factors. Male workers (21.5%) and younger workers (22.5%) who worked alternative shifts had the lowest prevalence of low back pain.

Table 4 presents the logistic regression analyses of the associations between low back pain and the psychosocial and work organizational factors with 5 models. Model A on the general population indicated that while controlling for demographic characteristics, socioeconomic status, other health- and health behavior-related factors, and other work-related variables, all workers who experienced work-family imbalance, were exposed hostile work, or had job insecurity were more likely to have low back pain. The sex- and age-stratified logistic analyses for the psychosocial and work organizational factors indicated similar patterns. Model B on male workers, Model C on female workers, Model D on older workers, and Model E on younger workers all revealed similar patterns of associations between low back pain and these emerging psychosocial factors, when controlling for demographic characteristics, socioeconomic status, health- and health behavior-related factors, and other work-related variables.

However, associations between low back pain and work organizational factors were not the same in different demographic groups of workers. Older workers who had

Table 1. *Description of Study Population and Low Back Pain by Sex and Age Group, Demographic Characteristics, Socioeconomic Status, and Other Factors (Weighted Percent)*

	All Workers		Male Workers		Female Workers		Younger Workers (Aged 18-40 y)		Older Workers (Aged 41-64 y)	
Variable	% in Pop	% Low Back Pain	% in Pop	% Low Back Pain	% in Pop	% Low Back Pain	% in Pop	% Low Back Pain	% in Pop	% Low Back Pain
Low Back Pain		25.7	53.0	24.5	47.0	27.13	50.0	23.8	50.0	27.7
Demographics										
Age, y										
18-25	15.3	21.2	14.9	18.3	15.9	24.2				
26-40	34.6	25.0	36.1	24.3	33.0	25.9				
41-55	36.7	27.6	35.9	26.3	37.6	28.9				
56-64	13.4	28.0	13.2	27.4	13.6	28.7				
Sex										
Male	53.1	24.5	53.0	24.5			54.1	22.5	52.0	26.6
Female	46.9	27.1			47.0	27.1	45.9	25.3	48.0	28.8
Ethnicity and race										
Non-Hispanic White	67.8	27.1	67.6	26.6	68.0	27.8	63.7	25.7	71.9	28.4
Non-Hispanic Black	10.9	23.2	9.4	18.5	12.4	27.2	11.6	20.8	10.1	25.9
Hispanic	14.7	24.5	16.7	22.5	12.4	27.5	17.9	21.8	11.5	28.7
Non-Hispanic Asian	4.9	15.9	4.7	14.1	5.2	17.8	5.0	13.3	4.9	18.5
Non-Hispanic others	1.8	26.0	1.6	24.9	2.0	27.1	1.9	24.9	1.6	27.4
Education										
Less than high school	12.2	29.2	14.0	26.1	10.2	34.1	13.3	26.8	11.2	32.1
High school	22.0	25.7	22.8	25.1	21.2	26.6	20.6	22.6	23.5	28.5
Some college	31.8	29.2	29.6	27.3	34.3	31.1	34.5	26.9	29.1	32.0
College	22.0	21.6	22.1	21.4	22.0	21.8	22.2	20.5	21.8	22.7
Master's degree and above	12.0	21.1	11.6	20.9	12.4	21.3	9.5	19.4	14.4	22.2
Earning										
<$14,999	19.0	28.8	14.5	26.3	24.1	30.4	24.1	26.6	13.9	32.5
$15,000-$34,999	30.5	27.1	27.3	26.0	34.2	28.1	34.3	24.8	26.7	30.0
$35,000-$64,999	30.3	25.7	32.0	26.2	28.3	25.0	28.1	24.6	32.4	26.6
≥$65,000	20.2	24.8	26.2	24.1	13.5	26.4	13.5	21.9	27.0	26.2
Other related factors										
Leisure-time physical activity	51.7	24.4	56.0	23.7	46.9	25.4	55.2	24.1	48.2	24.8
Serious psychological distress	2.5	49.3	2.2	44.2	2.8	53.7	2.3	45.6	2.7	52.3
Obesity	26.9	30.1	27.9	27.7	25.7	33.0	23.3	27.2	30.5	32.3

Pop, population.

nonstandard work arrangements were significantly more likely to have low back pain. Model B on male workers, Model D on older workers, and Model E on younger workers indicated that male, younger, and older workers who did alternative shifts were significantly less likely to have low back pain. Model C reported no similar differences in organizational risk factors for low back pain in female workers.

Work Hours and Low Back Pain

Table 3 shows that those who worked regular hours per week (40 hours) seemed to have the lowest prevalence of low back pain in all sex and age groups, whereas those working shorter hours appeared to experience an increased proportion for low back pain compared with those who worked 40 hours per week. Male and younger workers who worked extraordinarily long hours (≥60 hours) also had higher prevalence for low back pain compared with their counterparts who worked fewer hours per week.

Associations between low back pain and long work hours were not the same in different demographic groups of workers. Model C on female workers (Table 4) indicated that, compared with those who worked 40 hours per week, women who worked 41 to 45 hours per week had a higher likelihood of experiencing low back pain when controlling for other demographic, behavioral, and work-related risk factors. Controlling for these same factors, younger workers who worked ≥60 hours were also more likely to have low back pain compared with those who worked 40 hours per week.

Occupational Patterns of Low Back Pain

Table 3 indicates that construction and extraction workers had the highest prevalence for low back pain among all occupation groups. Other occupation groups in different demographic groups with increased prevalence of low back pain included community and social service, installation maintenance and repair, and health care practitioners and technical for men; farming, fishing, and

Table 2. *Logistic Regression of Demographic Characteristics, Socioeconomic Status, and Other Factors for Low Back Pain: Sex- and Age-Stratified Analysis*

Factors	All Workers (Model A)		Male Workers (Model B)		Female Workers (Model C)		Younger Workers (Aged 18-40 y) (Model D)		Older Workers (Aged 41-64 y) (Model E)	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Age, y										
18-25	1.00		1.00		1.00		1.00			
26-40	1.30 [a]	1.11-1.52	1.55 [a]	1.21-2.00	1.13	0.90-1.41	1.31 [a]	1.11-1.55		
41-55	1.39 [a]	1.18-1.64	1.60 [a]	1.24-2.08	1.26	0.99-1.59			1.00	
60-64	1.46 [a]	1.19-1.79	1.74 [a]	1.28-2.37	1.26	0.97-1.63			1.04	0.61-0.89
Sex										
Male	1.00						1.00		1.00	
Female	1.14 [a]	1.01-1.29					1.22 [a]	1.02-1.46	1.08	0.93-1.26
Ethnicity and race										
Non-Hispanic White	1.00		1.00		1.00		1.00		1.00	
Non-Hispanic Black	0.75 [a]	0.65-0.88	0.62 [a]	0.49-0.78	0.86	0.71-1.03	0.71 [a]	0.57-0.89	0.79 [a]	0.64-0.97
Hispanic	0.80 [a]	0.69-0.92	0.76 [a]	0.62-0.94	0.84 [a]	0.70-1.00	0.73 [a]	0.60-0.89	0.90	0.72-1.11
Non-Hispanic Asian	0.58 [a]	0.46-0.72	0.51 [a]	0.36-0.70	0.64 [a]	0.45-0.91	0.51 [a]	0.37-0.71	0.62 [a]	0.46-0.84
Non-Hispanic Others	0.87	0.62-1.21	0.80	0.47-1.34	0.88	0.57-1.38	0.81	0.51-1.27	0.92	0.55-1.52
Education										
High school	1.00		1.00		1.00		1.00		1.00	
Less than high school	0.99	0.97-1.02	1.01	0.98-1.05	0.97	0.93-1.01	0.98	0.94-1.02	1.01	0.97-1.04
Some college	1.19 [a]	1.02-1.39	1.08	0.88-1.32	1.33	1.08-1.63	1.21	0.98-1.50	1.15	0.94-1.42
College	0.82	0.66-1.01	0.74 [a]	0.55-0.99	0.91	0.67-1.23	0.86	0.63-1.19	0.75 [a]	0.56-1.00
Master's degree and above	0.75 [a]	0.57-0.99	0.65 [a]	0.44-0.97	0.85	0.57-1.26	0.82	0.54-1.24	0.68 [a]	0.48-0.96
Earning										
<$14,999	1.22 [a]	1.06-1.41	1.00 [a]	1.07-1.68	1.14	0.93-1.38	1.29*	1.05-1.58	1.12	0.89-1.40
$15,000-$34,999	1.00		1.00		1.00		1.00		1.00	
$35,000-$64,999	1.03	0.91-1.17	1.34	0.91-1.27	0.96	0.80-1.16	1.09	0.90-1.32	0.98	0.82-1.17
≥$65,000	1.13	0.95-1.33	1.07	0.85-1.31	1.21	0.94-1.56	1.00	0.79-1.26	1.21	0.97-1.50
Other related factors										
Leisure-time physical activity	0.93	0.84-1.03	0.93	0.81-1.07	0.94	0.93-1.24	1.08	0.93-1.24	0.81 [a]	0.70-0.93
Serious Psychological distress	2.63 [a]	1.99-3.47	2.56 [a]	1.60-4.00	2.62 [a]	1.70-3.90	2.57 [a]	1.70-3.90	2.69 [a]	1.87-3.85
Obesity	1.27 [a]	1.15-1.41	1.17 [a]	1.01-1.37	1.37 [a]	1.04-1.44	1.23 [a]	1.04-1.44	1.31 [a]	1.14-1.51

Results are weighted to account for the complex survey design.
The work-related factors for low back pain, work-family imbalance, exposure to hostile work environment, job insecurity, nonstandard work arrangements, alternative shifts, work hours, and occupation were controlled.
CI, confidence interval; *OR,* odds ratio; *Pop,* population.
[a] $P \leq .05$.

forestry for women and older workers; health care support and production for women; and arts, design, entertainment, sports, and media and legal occupations for younger workers.

The sex- and age-stratified logistic analyses, presented in Table 4, reported different occupational patterns of low back pain. Model B indicated that male health care practitioners had an increased likelihood for low back pain when controlling for demographic, socioeconomic, health and health behavior, and other work-related risk factors. Model C indicated that female workers in the farming, fishing, and forestry occupation group and the health care support occupation group had a significantly increased risk for low back pain compared with female workers in other occupation groups. Model D indicated that younger workers in the health care support occupation group were more likely to experience low back pain compared with younger workers in other occupation groups. No similar differences in risk for low back pain among occupations were reported in older workers.

Discussion

This study reported that the general prevalence rate of low back pain among US workers in 2010 was 25.7%. This finding is consistent with other studies using the US working population data, which indicate a comparable prevalence rate of 28.0% in 2002 and 2006 and 25.3% in 2010.[13,14] The prevalence rate reported in this study is also similar to the 28.7% reported in the Canadian working population[53] and about 1.5 times the rate of 18% in the United Kingdom.[2,54] This study also revealed demographic differences in low back pain prevalence: 23.8% for younger workers (18-40 years), 27.7% for older workers (41-64 years), 24.5% for male workers, and 27.1% for female

Table 3. *Description of Study Population of Low Back Pain by Sex and Age: Work-Related Factors (Weighted Percent)*

	All Workers		Male Workers		Female Workers		Younger Workers (Aged 18-40 y)		Older Workers (Aged 41-64 y)	
Variable	% in Pop	% Low Back Pain	% in Pop	% Low Back Pain	% in Pop	% Low Back Pain	% in Pop	% Low Back Pain	% in Pop	% Low Back Pain
Workplace psychological factors										
Work-family imbalance	16.8	32.3	16.2	29.6	17.5	35.1	17.0	30.2	16.6	34.4
Exposure to hostile work environment	7.6	35.7	6.3	33.0	9.0	37.9	7.4	28.2	7.8	35.3
Job insecurity	32.4	30.2	33.7	28.6	30.9	32.1	30.5	36.2	34.3	32.0
Work organization characteristics										
Nonstandard work arrangement	28.2	15.8	17.7	27.4	13.6	29.4	14.2	23.1	17.3	32.4
Alternative shifts	27.1	24.4	28.2	21.5	25.8	28.0	33.0	22.5	21.2	27.4
Work hours per week										
8-39	28.4	27.4	20.3	25.4	37.6	28.7	32.7	25.4	24.2	30.2
40	43.5	23.3	44.5	22.5	42.3	24.2	41.8	20.8	45.1	25.6
41-45	6.8	28.5	7.9	25.6	5.6	33.1	6.7	25.2	7.0	31.6
46-59	13.3	26.9	16.8	26.2	9.2	28.3	11.8	26.2	14.7	27.5
≥60	8.0	28.2	10.4	27.0	5.3	30.7	6.9	28.1	9.1	28.3
Occupation										
Management	9.5	24.8	11.4	23.8	7.3	26.5	7.4	25.8	11.6	24.1
Business and financial operations	4.7	21.5	3.9	17.5	5.5	24.7	4.3	19.1	5.0	23.7
Computer and mathematical	3.1	19.4	4.3	19.4	1.7	19.1	3.5	17.8	2.7	21.5
Architecture and engineering	2.1	20.1	3.2	19.6	0.7	22.4	1.8	15.2	2.4	23.8
Life, physical, and social sciences	1.2	22.9	1.1	23.3	1.3	22.6	1.0	23.8	1.3	22.2
Community and social services	1.8	26.3	1.3	29.5	2.3	24.2	1.9	22.9	1.7	30.0
Legal occupations	1.3	25.7	1.3	20.7	1.4	30.9	1.3	26.4	1.3	25.0
Education, training, and library	6.5	23.1	3.6	24.7	9.8	22.4	6.2	21.2	6.9	24.8
Arts, design, entertainment, sports, and media	1.9	26.2	2.1	24.9	1.8	28.0	2.0	27.2	1.9	25.2
Health care practitioners and technical	5.2	26.3	2.4	28.1	8.4	25.7	4.8	22.2	5.6	29.8
Health care support	2.6	33.6	0.6	25.9	4.9	34.7	2.7	31.2	2.5	36.2
Protective service	2.1	23.5	3.1	23.8	0.9	22.2	2.1	23.9	2.1	23.0
Food preparation and serving related	5.7	27.2	4.9	20.6	6.6	32.6	8.0	25.2	3.4	32.0
Building and grounds cleaning and maintenance	4.0	25.3	4.5	22.7	3.4	29.1	3.9	20.9	4.1	29.5
Personal care and service	3.5	28.5	1.4	24.4	5.9	29.6	3.9	23.6	3.2	34.4
Sales and related	10.5	26.9	10.2	25.7	10.7	28.2	11.9	25.6	9.0	28.6
Office and administrative support	13.2	25.1	6.5	21.9	20.7	26.2	13.1	23.2	13.2	27.0
Farming, fishing, and forestry	0.6	28.0	0.9	21.0	0.3	49.5	0.7	15.9	0.5	46.5
Construction and extraction	5.2	31.8	9.7	31.8	0.2	30.8	5.2	29.3	5.2	34.2
Installation, maintenance, and repair	3.7	27.9	6.8	28.1	0.3	24.0	3.4	25.7	4.1	29.8
Production	6.0	26.7	7.8	24.0	3.8	33.0	5.3	23.8	6.6	29.0
Transportation and material moving	5.7	25.7	9.0	26.0	2.0	24.2	5.6	24.4	5.8	26.9

Pop, population.

workers. The finding is consistent with other studies that have reported similar age and sex differences.[9,55,56]

This study reported an occupational pattern of low back pain by sex and age. Male health care practitioners had an increased risk for low back pain. Female workers in the farming, fishing, and forestry and health care support occupations had an increased likelihood of experiencing low back pain. In addition, younger workers in the health care support occupation had an increased risk for low back pain. These gender and age effects reported in this study are in line with the effects reported in several previous studies, especially in health care workers[38,57-59] and farmers.[32,60,61]

Long work hours in female (41-45 work hours) and younger workers (≥60 work hours) were associated with low back pain in this study. This finding appears to be in agreement with those from the population-based longitudinal analysis of workers in the United States by Dembe et al.[40] In that study, a link was reported between overtime and long work hours to all forms of occupational injuries and illnesses, with 34.9% of these injuries and illnesses being musculoskeletal conditions.

Associations between several emerging psychosocial factors and low back pain were reported in this study. Workers who were exposed to a hostile work environment, work-family imbalance, or job insecurity were more likely to report low back pain. The risk associations were similar (OR 1.23-1.49) among different demographic groups, men and women, and younger and older workers. The associations between low back pain and these emerging psychosocial factors are consistent with evidence from a number of studies.[34-36,41,62]

Work organization structures and job characteristics have changed profoundly during the process of globalization. Intensifying global economic competitions, increasing

Table 4. *Logistic Regression of Work-Related Factors for Low Back Pain: Sex- and Age-Stratified Analysis*

	All Workers (Model A)		Male Workers (Model B)		Female Workers (Model C)		Younger Workers (Aged 18-40 y) (Model D)		Older Workers (Aged 41-64 y) (Model E)	
Factors	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Workplace psychological factors										
Work-family imbalance	1.27[a]	1.15-1.41	1.30[a]	1.10-1.54	1.49[a]	1.27-1.75	1.39[a]	1.17-1.66	1.42[a]	1.21-1.66
Exposure to hostile work environment	1.39[a]	1.25-1.55	1.41[a]	1.10-1.80	1.47[a]	1.20-1.80	1.58[a]	1.27-1.97	1.29[a]	1.04-1.60
Job insecurity	1.44[a]	1.24-1.67	1.28[a]	1.11-1.47	1.26[a]	1.10-1.44	1.33[a]	1.15-1.55	1.23[a]	1.08-1.40
Work organization characteristics										
Nonstandard work arrangement	1.09	0.95-1.25	1.10	0.92-1.32	1.08	0.88-1.33	0.92	0.76-1.11	1.27[a]	1.06-1.52
Alternative shifts	0.81[a]	0.73-0.90	0.74[a]	0.64-0.86	0.90	0.76-1.07	0.77[a]	0.66-0.90	0.85[a]	0.72-0.99
Work hours per week										
8-39	1.11	0.97-1.26	1.09	0.90-1.32	1.14	0.97-1.34	1.16	0.96-1.41	1.06	0.90-1.25
40	1.00		1.00		1.00		1.00		1.00	
41-45	1.25[a]	1.03-1.52	1.09	0.82-1.44	1.52[a]	1.16-1.98	1.20	0.92-1.58	1.30	0.98-1.72
46-59	1.15	0.99-1.34	1.15	0.95-1.39	1.12	0.88-1.42	1.25	0.99-1.56	1.08	0.89-1.32
≥60	1.19	0.99-1.43	1.16	0.90-1.49	1.27	0.96-1.67	1.38[a]	1.07-1.78	1.07	0.83-1.37
Occupation										
Computer and mathematical	1.00		1.00		1.00		1.00		1.00	
Management	1.13	0.82-1.55	1.05	0.73-1.51	1.33	0.78-2.25	1.41	0.94-2.10	0.95	0.60-1.50
Business and financial operations	0.98	0.68-1.43	0.78	0.46-1.33	1.30	0.73-2.33	0.99	0.59-1.67	0.95	0.58-1.56
Architecture and engineering	0.94	0.62-1.42	0.86	0.53-1.41	1.33	0.58-3.05	0.81	0.41-1.63	0.96	0.53-1.71
Life, physical, and social sciences	1.25	0.75-2.07	1.18	0.60-2.32	1.43	0.68-3.04	1.47	0.70-3.08	1.06	0.54-2.09
Community and social services	1.35	0.86-2.12	1.74	0.89-3.43	1.29	0.69-2.41	1.26	0.64-2.46	1.42	0.74-2.75
Legal occupations	1.23	0.75-2.02	0.98	0.46-2.10	1.70	0.83-3.52	1.42	0.72-2.79	1.04	0.50-2.15
Education training and library	1.10	0.78-1.53	1.24	0.74-2.08	1.22	0.73-2.05	1.07	0.66-1.73	1.11	0.68-1.81
Arts, design, entertainment, sports, and media	1.29	0.84-2.00	1.22	0.69-2.15	1.53	0.75-3.12	1.50	0.86-2.62	1.09	0.57-2.07
Health care practitioners and technical	1.30	0.92-1.83	1.71[a]	1.01-2.88	1.35	0.80-2.29	1.14	0.72-1.82	1.38	0.84-2.26
Health care support	1.51[a]	1.05-2.18	1.26	0.49-3.20	1.71[a]	1.02-2.86	1.60[a]	1.00-2.56	1.44	0.81-2.57
Protective service	1.01	0.67-1.52	1.06	0.65-1.72	0.93	0.42-2.07	1.23	0.68-2.19	0.82	0.47-1.43
Food preparation and serving related	1.31	0.94-1.84	1.10	0.67-1.81	1.63	0.99-2.70	1.39	0.89-2.16	1.23	0.74-2.04
Building and grounds cleaning and maintenance	1.15	0.79-1.68	1.13	0.69-1.85	1.30	0.74-2.29	1.07	0.65-1.77	1.21	0.73-2.01
Personal care and service	1.27	0.85-1.89	1.20	0.55-2.59	1.44	0.83-2.50	1.13	0.65-1.96	1.43	0.85-2.41
Sales and related	1.25	0.90-1.73	1.23	0.81-1.86	1.34	0.82-2.20	1.37	0.91-2.05	1.11	0.70-1.77
Office and administrative support	1.04	0.76-1.42	0.99	0.63-1.56	1.21	0.75-1.94	1.10	0.73-1.65	0.98	0.63-1.53
Farming, fishing, and forestry	1.25	0.69-2.25	0.86	0.38-1.92	2.66[a]	1.05-6.79	0.80	0.33-1.96	2.11	0.82-5.42
Construction and extraction	1.41[a]	1.00-2.01	1.31	0.88-1.96	1.61	0.37-6.98	1.56	0.98-2.49	1.27	0.77-2.10
Installation, maintenance, and repair	1.21	0.83-1.78	1.15	0.74-1.78	1.15	0.38-3.46	1.31	0.79-2.17	1.13	0.67-1.90
Production	1.20	0.86-1.69	1.06	0.69-1.63	1.61	0.94-2.77	1.21	0.76-1.94	1.17	0.72-1.90
Transportation and material moving	1.14	0.80-1.61	1.16	0.77-1.75	1.01	0.52-1.97	1.33	0.85-2.10	0.96	0.59-1.56

Results are weighted to account for the complex survey design. The demographic, socioeconomic, and behavior-related factors for low back pain were controlled.

CI, confidence interval; *OR,* odds ratio.

[a] $P \leq .05$.

use of information technologies, continuing expansion of the service sectors, increasing female participation in the labor force, deregulations, increasing political and cultural openness, and fluctuating economy growth have been seen as features of globalization that are reshaping the ways people work and have heightened the complexities of the workplace psychological risk factors.[63-66]

Under these circumstances, uncertainties about job security and flexibilities in work arrangements become the hallmark of jobs.[67] An increasing body of research has indicated deleterious health effects of job insecurity, including hypertension, poor sleep, depression, anxiety,[68-70] and work-related musculoskeletal disorders such as back pain.[36,71-73] This is probably due to possible economic deprivation that may occur after a lost job and concerns about future well-being.[74,75] A growing body of research indicates that job insecurity may lead to a threat to the health of workers comparable to or worse than that of unemployment.[76] Mental strain associated with job insecurity may indirectly lead to "physiological vulnerability," which, in turn, may contribute to low back pain.[77-83]

Increasing numbers of women are entering the work force with increasing work intensity in the context of globalized economy. At the same time there has been a change in social norms that emphasizes equal importance of women and men both at work and in the family

responsibilities.[84] These changing roles for family members have heightened the importance of work-family imbalance as a health risk factor.[85] Work-family imbalance is considered to be a factor that is significantly and strongly associated with unhealthy behaviors as well as negative health outcomes.[84,86] There has also been new research linking exposure of work-family conflicts to low back pain.[34,41,87] One possible result of how work-family life imbalance is related to low back pain may be the draining of psychological and physical resources leading to unhealthy behaviors, including alcohol and tobacco use and decreased leisure-time physical activity.[76,88] Another postulated pathway between work-family life imbalance and low back pain is that mental strain can cause muscle tension or other physiological processes that might aggravate low back pain.[89]

Early research in hostile work environments or bullying was conducted primarily in the northern European countries in the 1990s and expanded to other countries in recent years.[90] The recent research regarding the health impact of hostile work environments in the United States has been primarily focused on the area of health care workers.[35,91] An increasing body of research has linked a hostile work environment to sickness-related absenteeism, coronary heart diseases, depression, work-related injuries, sleeping problems, and musculoskeletal disorders.[79,92-95] Although the underlying mechanism for low back pain as a result of the exposure to a hostile work environment is not well understood, it likely involves increased psychosocial strain.[79,96,97] An increase in psychosocial strain has been hypothesized to affect both biomechanical and physiological processes and one's perception of pain.[89,98,99] Recent studies have provided some epidemiologic evidence supporting the hypothesized pain mechanism.[79,100]

Bullying has also become a burning issue in the public arena in the past few years in the United States.[79,101] The Healthy Workplace Campaign launched in 2001 at the national level holds the employer accountable for "abusive work environment" and encourages employers to prevent bullying with policies and procedures that apply to all employees. There have also been legislative efforts in the United States. The Healthy Workplace Bill was proposed in 2001, and so far, 31 legislatures in 29 states and 2 territories have introduced this bill.[102] California started mandating training to prevent abusive conduct for supervisors at workplaces with more than 50 workers in 2015.[103] These changes in law hold the potential for reducing workplace abuse and therefore reducing the impact of these factors on low back pain.

Implications

One of the implications of the findings in the present study is a need to develop public health and occupational health strategies, programs, and guidelines to reduce, manage, and prevent low back pain among different worker groups.[9,104,105] This need is particularly urgent as the labor force will continue to age in the next decade. The total labor force is projected to increase 6.8% during the period of 2010-2020 in the United States, and the number of workers aged 55 and older will increase 25.8% during the same period.[106]

To our knowledge, this study is the first population-based study to focus on the emerging work-related psychosocial risk factors for low back pain. This study also revealed the importance of the emerging work-related psychosocial risk factors for low back pain in future research. Much of the research in the field of psychosocial risk factors for low back pain in the past few decades has been guided by the job strain framework.[26,27] The job strain framework was fully developed in the late 1980s, and much of the research has been devoted to the field of cardiovascular health.[107,108] In addition, the associations between low back pain and job strain variables have been conducted in workers in several European countries[15,72,109,110] and in Asian countries such as China.[111,112] However, the traditional psychosocial job strain model may not account for the studied psychosocial stressors that have emerged in recent years.

In short, the findings of this study shed light on the field of research linking risk factors to low back pain and also provide support for intervention programs aimed at reducing and preventing low back pain in the workplace.[88,113,114] Understanding these emerging work-related risk factors for low back pain is important if the resultant suffering, activity limitations, and loss of productivity for individuals and the social and economic impact of this condition at the societal level are to be addressed.[9] These risk factors should be kept in mind by health care practitioners (eg, nurses, psychologists, physicians, physical therapists, and chiropractors)[9] by employers who might wish to develop future multifactorial interventions at the workplace,[115] and by policymakers in developing population-based public health strategies for prevention, treatment, management, and research of low back pain.[9]

Limitations

There are several limitations in this study. First, low back pain defined in this study does not provide information on pain intensity and pain interference, both of which may be more important than simply the presence of low back pain in the workplace.[116] Second, the assessment of the psychological risk factors used in the present study was derived from single items for each psychological domain. Having only 1 question may result in low reliability and validity for each of the domains.[117] Third, because of lack of information for constructing the traditional job strain

variables, the effects of the emerging work-related psychosocial risk factors and the job strain psychosocial variables were not compared. Fourth, information on work-related physical risk factors for low back pain, such as repetitive work, awkward posture, and heavy physical work, was not available in the 2010 NHIS survey. Although work hours and occupations may be considered indirect measurements for the physical risk factors, the lack of physical risk information may underestimate exposure to work-related physical risk factors and overestimate psychosocial factors.[13,118] Finally, because of the nature of the cross-sectional data used in this study, the directionality of the risk associations cannot be confirmed. The use of 1-year data in this study may contribute to instability in risk variance estimation.

Conclusions

This population-based study reported that the prevalence of self-reported low back pain in the previous 3 months among workers in the United States was 25.7% in 2010. Female or older workers were at increased risk of experiencing low back pain. Work-family imbalance, exposure to a hostile work environment, and job insecurity were associated with low back pain after adjusting for different demographic, socioeconomic, and occupational factors. Among all male workers' occupations, health care practitioners had the highest risk for low back pain, whereas among female workers, farming, fishing, and forestry occupations had the highest risk. Long work hours (41-45 hours) were associated with an increased risk of low back pain. In particular, younger workers working for ≥60 hours and female workers working for 41 to 45 hours were associated with increased reporting of low back pain. Future research focusing on the associations of the emerging psychosocial factors and low back pain is recommended.

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Contributorship Information

Concept development (provided idea for the research): H.Y., S.H.

Design (planned the methods to generate the results): H.Y., S.H.

Supervision (provided oversight, responsible for organization and implementation, writing of the manuscript): H.Y., S.H., D.B.

Data collection/processing (responsible for experiments, patient management, organization, or reporting data): H.Y.

Analysis/interpretation (responsible for statistical analysis, evaluation, and presentation of the results): H.Y., D.B., M.L.

Literature search (performed the literature search): H.Y., M.L.

Writing (responsible for writing a substantive part of the manuscript): H.Y., S.H., M.L.

Critical review (revised manuscript for intellectual content, this does not relate to spelling and grammar checking): D.B., S.H., M.L.

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Practical Application

- In the US population, workers who were exposed to hostile work, work-family imbalance, or job insecurity, irrespective of age or sex, were more likely to report having low back pain.
- These factors should be considered in developing strategies for prevention, treatment, management, and research of low back pain.

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