

Workplace Psychosocial and Organizational Factors for Neck Pain in Workers in the United States

Haiou Yang, PhD,^{1*} Edward Hitchcock, PhD,² Scott Haldeman, DC, MD, PhD, FRCP,^{3,4} Naomi Swanson, PhD,² Ming-Lun Lu, PhD,² BongKyoo Choi, ScD, MPH,¹ Akinori Nakata, PhD,⁵ and Dean Baker, MD, MPH¹

Background Neck pain is a prevalent musculoskeletal condition among workers in the United States. This study explores a set of workplace psychosocial and organization-related factors for neck pain.

Methods Data used for this study come from the 2010 National Health Interview Survey which provides a representative sample of the US population. To account for the complex sampling design, the Taylor linearized variance estimation method was used. Logistic regression models were constructed to measure the associations.

Results This study demonstrated significant associations between neck pain and a set of workplace risk factors, including work-family imbalance, exposure to a hostile work environment and job insecurity, non-standard work arrangements, multiple jobs, and long work hours.

Conclusion Workers with neck pain may benefit from intervention programs that address issues related to these workplace risk factors. Future studies exploring both psychosocial risk factors and physical risk factors with a longitudinal design will be important. *Am. J. Ind. Med.* 59:549–560, 2016. © 2016 Wiley Periodicals, Inc.

KEY WORDS: neck pain; occupational health; psychosocial risk factors; work organization; epidemiology

INTRODUCTION

Neck pain is a prevalent and costly musculoskeletal condition in the United States (US) adult working

population. A recent estimate of the prevalence of neck pain in the US adult population is about 15% [Schiller et al., 2012] and the cost for people with back and neck problems is estimated as \$86 billion in associated with medical care a year [Martin et al., 2008]. In addition, there are economic costs in productivity, workers compensation, as well as a reduction in worker sustainability and lifelong well-being [Hoy et al., 2010].

A growing body of evidence suggests that neck pain is associated with many workplace factors, including physical job demands and work-related psychosocial and work organization factors [Ariëns et al., 2001a; Cote et al., 2008]. Specifically, studies have identified awkward postures, heavy physical work, repetitive and precision work as physical risk factors for neck pain [Punnett, 2004; Carroll et al., 2008a; Côté et al., 2009]. Much of what is known about work-related psychosocial factors for neck pain has been research based on the Demand-Control model [Karasek,

¹Center for Occupational and Environmental Health, University of California, Irvine, California

²Division of Applied Research and Technology, National Institute of Occupational Safety and Health, Cincinnati, Ohio

³Department of Neurology, University of California, Irvine, California

⁴Department of Epidemiology, School of Public Health, University of California, Los Angeles, California

⁵School of Health Sciences, University of Occupational and Environmental Health, Kitakyushu, Japan

*Correspondence to: Haiou Yang, PhD, Center for Occupational and Environmental Health, University of California, Irvine 100 Theory, Suite 100, Irvine, CA 92617.

E-mail: hyang@uci.edu

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1979]. This area of research has identified associations between neck pain and psychosocial factors, such as high job demands, low job control, or high job strain [Devereux et al., 2002; Huang et al., 2002; Bongers et al., 2006; Carroll et al., 2008b; Joling et al., 2008; Canjuga et al., 2010; Christensen and Knardahl, 2010; Lang et al., 2012], low social support [Luime et al., 2004, Rugulies and Krause, 2005], and low job satisfaction [Eriksen et al., 1999; Smedley et al., 2003; Brandt et al., 2004].

Swanson and Sauter [1996] proposed a framework to explain the roles that work-related psychosocial and work organization factors play in the development of musculoskeletal disorders, such as neck pain. In that framework, two etiological pathways were proposed. First, psychosocial factors may lead to psychosocial strain and biomechanical strain, resulting in neck pain. For example, increased job demands may result in increased and/or sustained muscle tension in the neck/shoulder region that may lead to musculoskeletal pain. Second, increased psychosocial job demands and work organization changes may alter the physical stress of the job and in turn have an impact on the likelihood of neck pain. For example, increased time pressure may result in changes in physical risk factors for musculoskeletal pain, such as increases in repetition, force, or awkward postures [Sauter and Swanson, 1996; Swanson and Sauter, 2006]. Support for the second pathway was found in a study by MacDonald et al. [2001]. In that study, moderate to high correlations between some physical and psychosocial stressors provided evidence of covariation both across and within job groups [MacDonald et al., 2001]. MacDonald and her co-workers further called attention to the organizational context of job level hazards related to worker's health, such as work schedule and pay structure [MacDonald et al., 2008]. Some of these work organization factors linked to neck pain, such as long and irregular work hours, were also explored in several studies conducted in North European countries [Fredriksson et al., 2001; Lipscomb et al., 2002; Trinkoff et al., 2006; Nicoletti et al., 2014].

The research foci in recent years has shifted to a set of emerging psychosocial risk factors at the workplace. Research has linked neck pain with job insecurity [Ariens et al., 2001b; Shan et al., 2012; Bugajska et al., 2013], workplace bullying [Kaaria et al., 2012; Stock and Tissot, 2012; Takaki et al., 2013; Vignoli et al., 2015], and work-family conflict [Haemmig et al., 2011; Kim et al., 2013].

How do these emerging psychological risk factors at the workplace affect neck pain? A large body of research that links these factors to profound deleterious physiological and psychological health and unhealthy behaviors provides clues to answer this question [Frone et al., 1997; Grzywacz, 2000; McDonough, 2000; Cheng et al., 2005; Hammer et al., 2005; Burgard et al., 2009; Finne et al., 2011; Vignoli et al., 2015]. One of the major speculations is that workplace psychosocial risk factors, job insecurity, workplace bullying, and

work-family conflict may produce mental strain, such as powerlessness [Greenhalgh and Rosenblatt, 1984], irritability, depression and anxiety [Vignoli et al., 2015], that may indirectly cause muscle tension or impact on other physiological processes of muscle activity. This, in turn, can result in the development of chronic neck pain [Lundberg et al., 2002; Lundberg and Melin, 2002; Hansen et al., 2006; Shahidi et al., 2015; Vignoli et al., 2015; De Witte et al., 2016].

However, the level of evidence in previous studies has been limited. Most of the research has been single occupation-based, focusing on healthcare workers [Kim et al., 2013], drivers [Krause et al., 1998], and production or construction workers [Dong, 2005, Wang et al., 2007]. No studies have broadly examined these psychosocial risk factors for neck pain at the US adult working population level.

Recognizing a growing need to evaluate the effects of workplace psychosocial and work organization factors on work-related health and safety conditions, the US National Institute for Occupational Safety and Health (NIOSH) sponsored the Occupational Health Supplemental Survey in the National Health Interview Survey (NHIS) [Luckhaupt and Burris, 2013]. The 2010 NHIS supplemental survey included a set of survey items on workplace psychosocial factors (work-family imbalance, exposure to hostile work environment and job insecurity) and another set of survey items on work organization characteristics (non-standard work arrangements, temporary positions and alternative shifts) [Alterman et al., 2013a]. The national profiles of these work organization characteristics and workplace psychosocial risk factors using the NHIS data have been investigated in recent years [Alterman et al., 2013b] to evaluate the associations of these risk factors for health conditions, such as hypertension and obesity [Kaur et al., 2014; Luckhaupt et al., 2014]. To our knowledge, no research using this data set has been conducted to explore psychosocial and work organization factors in relation to neck pain among workers in the United States. Therefore, the goal of this study was to use the NHIS data to assess the associations between neck pain, workplace psychosocial factors, and work organization characteristics in US workers.

MATERIALS AND METHODS

Data

Data from the 2010 National Health Interview Survey (NHIS) and the 2010 Occupational Health Supplementary Survey (NHIS-OHS) were used in this study. The NHIS is a health survey of the civilian, noninstitutionalized population in the US that has been conducted yearly since 1957. The NHIS consists of a core questionnaire, which remains the

same from year to year, and a supplementary questionnaire which varies from year to year. The core questionnaire collects demographic and health data of individuals in the household and the supplementary interview collects additional data covering special health topics [Parsons et al., 2014]. The NHIS data used for this study were constructed by merging the core data set and the NHIS-OHS supplementary survey data. The final response rate for the 2010 core survey component was 60.8% [Division of Health Interview Statistics, 2011]. For the purpose of examining work-related factors, the study population was defined as 18–64 years of age and working for pay at a job or business. Non-civilian workers were excluded from the analyses. The resulting sample size for the study was 13,915.

Measures

The risk factors for neck pain used in this study were based on systematic reviews of past research evidence and recent research findings linking work and non-work related risk exposures for neck pain [Carroll et al., 2008a; Cote et al., 2008; Haldeman et al., 2008; Carroll et al., 2009; Hogg-Johnson et al., 2009] and the relevant data in the NHIS. The potential risk factors for neck pain available in the NHIS included work-related psychosocial variables (work-family imbalance, exposure to hostile work environment, and job insecurity) and work organization factors (non-standard work arrangements, alternative shifts, multiple jobs, and hours of work). Other relevant factors available in the NHIS included: demographic characteristics (age, gender, race, and ethnicity) and socioeconomic status (education and income), as well as other health-related factors (leisure-time physical activity and serious psychological distress).

Definition of Neck Pain

Neck pain was defined as self-reported non-specific neck pain within the past three months using a single questionnaire item, “During the PAST THREE MONTHS, did you have ...Neck pain?” This definition of neck pain is consistent with the measurement of chronic neck pain defined by the Bone and Joint Decade 2000–2010 Task Force on Neck Pain and Its Associated Disorders [Guzman et al., 2009; Misailidou et al., 2010].

Demographic Characteristics and Socioeconomic Status

Demographic variables used in the analysis included gender, age, and race/ethnicity. Age was coded into four age groups: (i) 18–25; (ii) 26–40; (iii) 41–55; and (iv) 56–64 years. Race/ethnicity was coded into five groups: (i)

Hispanic; (ii) Non-Hispanic White; (iii) Non-Hispanic Black; (iv) Non-Hispanic Asian; and (v) Non-Hispanic Others. Socioeconomic status (SES) variables were education and income. Education was coded into four categories: (i) less than high school; (ii) high school; (iii) some college; (iv) college; and (v) Master and above. Income was defined as personal yearly earnings coded into five categories, (i) under \$14,999; (ii) \$15,000–34,999; (iii) \$35,000–64,999; and (iv) \$65,000 and above. Imputation of missing values for earnings was not conducted as the missing values for earnings were not systematically related to neck pain.

Other Health-Related Factors

Two other health-related factors available in the NHIS were leisure-time physical activity and serious psychological distress. Leisure-time physical activity was defined as engaging in moderate physical activity for at least 30 min per day for 5 or more days per week or vigorous physical activity for at least 20 min 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 frequencies of physical activity according to the Healthy People 2020 guidelines [US Department of Health and Human Services, 2013]. Serious psychological distress was measured by the Kessler 6 (K6) Scale in the NHIS [Pratt et al., 2007], assessing the frequency of six symptoms of nonspecific psychological distress in the past 30 days with the following question: “During the past 30 days, how often did you feel...” (i) So sad that nothing could cheer you up; (ii) Nervous; (iii) Restless or fidgety; (iv) Hopeless; (v) That everything was an effort; and (vi) Worthless. The answer options included (i) All of the time; (ii) Most of the time; (iii) Some of the time; (iv) A little of the time; and (v) None of the time. Serious psychological distress was coded by reversing the scores, giving “None of the time” 0, “All of the time” 4. The scores for the six items were added and then dichotomized. A score of 13 or above was used to indicate serious psychological distress [Pratt et al., 2007].

Workplace Psychosocial Factors

The workplace psychosocial variables in this study were: job insecurity, work-family imbalance and exposure to hostile work environment. Job insecurity was measured by the following question: “Please tell me whether you: strongly agree, agree, disagree, or strongly disagree with this statement: I am/was worried about becoming unemployed.” Responses of “strongly agree” and “agree” were defined as high job insecurity and “disagree” and “strongly disagree” were used to define low 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/was easy for me to combine work with family responsibilities.” Responses of “strongly disagree” and “disagree” were defined as high work-family imbalance and “disagree” and “strongly disagree” were used to define low work-family imbalance. Exposure to a hostile work environment was defined as answering “yes” to the question “During the past 12 months were you threatened, bullied, or harassed by anyone while you were on the job?”

Work Organization Characteristics

The work organization characteristics included in this study were: non-standard work arrangements, alternative shifts, multiple jobs, and work hours. The variable “non-standard work arrangement” was assessed using the question “Which of the following best describes your work arrangement?” The following work arrangements were all considered as nonstandard work arrangements: (i) work/worked as an independent contractor, independent consultant, or freelance worker; (ii) are/were on-call and work/worked only when called to work; (iii) are/were paid by a temporary agency; (iv) work/worked for a contractor who provides workers and services to others under contract; and (v) other work arrangement. The question on “Non-standard work arrangement” was coded as a dichotomized variable: “No” for those selecting the “are/were a regular, permanent employee (standard work arrangement)” option and “Yes” for those selecting one of the remaining work arrangement options. The variable “alternative shifts” was measured by the question “Which of the following best describes the hours you usually work/worked?” with responses of: “a regular evening shift,” “a regular night shift,” “a rotating shift,” or “some other schedule?” The question on “Alternative shifts” was coded as a dichotomized variable: “No” for those selecting “A regular daytime schedule” and “Yes” for those selecting any one of the other response options. The variable, multiple jobs, was assessed through a positive response to the question, “Do you have more than one job or business?” Number of work hours was assessed with the question: “How many hours did you work last week at all jobs or businesses?” The variable, hours of work per week, was coded into five categories: (i) 8–39 hr; (ii) 40 hr; (iii) 41–45 hr; (iv) 46–59 hr; and (v) 60 and more hours. Regular working hours (40 hr) was used as the reference group in the analysis.

Occupation

Occupation was coded as a 12 category variable according to the 2000 Standard Occupational Classification System [US Bureau of Labor Statistics, 2010]. Workers from military specific occupations were excluded from the analysis as the numbers were not representative in this dataset. These

12 occupation groups included: (i) Management, business and financial; (ii) Computer, engineering, and science (Computer and mathematical; Architecture and engineering and Life and physical and social science); (iii) Education, legal, community service, arts and media (Education, training, and library occupations, Arts, design, entertainment, sports, and media); (iv) Healthcare practitioners and technical (Healthcare practitioners and technical and healthcare support); (v) Service related (Protective service; Food preparation and serving related; Building and ground cleaning and maintenance; and Personal care and service); (vi) Sales and related; (vii) Office and administrative support; (viii) Farming, fishing and forestry, (ix) Construction and extraction; (x) Installation, maintenance and repair; (xi) Production; and (xii) Transportation and material moving. The computer, engineering, and science occupation group, with the lowest prevalence for neck pain, was used as the reference group in the logistic regression analyses.

Statistical Analysis

To account for the complex sampling design of the NHIS, direct standardization and the Taylor linearized variance estimation method in the statistical software, STATA 12, was used to compute weighted descriptive statistics and measures of associations with the logistic regression model. Odds ratios with 95% confidence intervals (CI) were calculated to determine the association between neck pain and each psychosocial factor/work organization factor. Demographic characteristics, socioeconomic status and health behaviors were controlled as potential confounders for the analysis. Three logistic regression models were developed. Model 1 examined the associations between neck pain in relation to work-related psychosocial factors and work organizational characteristics, while controlling for demographic characteristics and socioeconomic variables. Model 2 examined the same set of factors used in Model 1 while controlling for other health related factors in addition to demographic characteristics and socioeconomic variables. Model 3 controlled for occupation in addition to demographic characteristics, and other health related factors, that were controlled in Model 2.

RESULTS

The overall proportion of neck pain in the study population was 14.3% with an estimated 18 million working adults reporting neck pain in the past 3 months. Table I shows the descriptive statistics of all variables and the crude odds ratios of each risk variable for neck pain. In Table I, a higher proportion of neck pain was reported by females (16.9%) than by males (12.0%). The two age groups reporting a higher proportion of neck pain were the 41–55 age group (16.4%)

TABLE I. Description of Study Population by Neck Pain, Demographic Characteristics

Variable	Weighted count (million)	Weighted% in the population	Weighted % neck pain	Unadjusted OR	95% Conf.	P
Demographic characteristics						
Age						
18–25	19	15.3	10.0	1.0		
26–40	44	34.6	13.1	1.4	(1.1–1.7)	<0.001
41–55	46	36.7	16.4	1.8	(1.4–2.2)	<0.001
56–64	17	13.4	16.5	1.8	(1.4–2.3)	<0.001
Gender						
Male	67	53.1	12.0	1.0		
Female	59	46.9	16.9	0.7	(0.6–0.8)	<0.001
Ethnicity and race						
Non-Hispanic White	85	67.8	15.2	1.0		
Non-Hispanic Black	14	10.9	11.4	0.7	(0.6–0.9)	<0.001
Hispanic	18	14.7	13.2	0.9	(0.7–1.0)	<0.001
Non-Hispanic Asian	6	4.9	10.2	0.6	(0.5–0.8)	<0.001
Non-Hispanic others	2	1.8	17.8	1.2	(0.8–1.8)	<0.001
Socioeconomic status						
Education						
Less than high school	15	12.2	15.0	1.0		
High school	28	22.0	12.4	0.8	(0.7–1.0)	0.03
Some college	40	31.8	17.3	1.2	(1.0–1.4)	0.03
College	28	22.0	12.4	0.8	(0.7–1.0)	0.04
Master and above	15	12.0	12.8	0.9	(0.7–1.1)	0.17
Earning						
<\$14,999	19	19.0	14.9	1.0		
\$15,000–34,999	31	30.5	15.0	1.2	(1.0–1.4)	0.10
\$35,000–64,999	31	30.3	14.8	1.1	(1.0–1.3)	0.10
≥\$65,000	20	20.3	14.8	1.1	(1.0–1.4)	0.20
Other health related factors						
Leisure-time physical activity						
No	61	48.3	14.7	1.0		
Yes	65	51.7	13.8	0.9	(0.8–1.0)	0.20
Serious psychological distress						
No	120	97.5	13.7	1.0		
Yes	3	2.5	34.7	3.3	(2.4–4.5)	<0.001

and the 56–64 age group (16.5%). Non-Hispanic Other and Non-Hispanic White workers had a higher prevalence of neck pain (17.8% and 15.2%, respectively), while non-Hispanic Asians had the lowest prevalence of neck pain (10.2%). With regard to education, workers who had some college education reported the highest prevalence (17.3%) of neck pain. There was no significant difference in neck pain prevalence by income level. The proportion of reported neck pain among those who engaged in leisure-time physical activity (13.8%) was slightly lower than the general level (14.3%). About a

third of those (34.7%) who reported serious psychological distress also reported having neck pain.

Table II shows that the proportion of workers reporting work-family imbalance was 16.8% and 19.7% of them reported neck pain. The proportion of those who were exposed to a hostile work environment was 7.6%, of whom 26.5% reported neck pain. About one-third (32.4%) of the workers reported job insecurity and, among those who did, 17.6% had neck pain. Less than one fifth (16.8%) of workers who had a non-standard work arrangement reported neck

TABLE II. Description of Study Population by Neck Pain, Workplace Related Factors

Variable	Weighted count (million)	Weighted% in population	Weighted % Neck pain	Unadjusted OR	95% Conf.	P
Psychosocial factors						
Work-family imbalance						
No	100	83.2	13.2			
Yes	21	16.8	19.7	1.6	(1.4–1.9)	<0.001
Exposure to hostile work environment						
No	120	92.4	13.3			
Yes	10	7.6	26.5	2.3	(2.0–2.8)	<0.001
Job insecurity						
No	85	67.6	12.7			
Yes	41	32.4	17.6	1.5	(1.3–1.7)	<0.001
Work organization characteristics						
Non-standard work arrangement						
No	110	84.2	13.8			
Yes	20	15.8	16.8	1.3	(1.1–1.5)	<0.001
Alternative shift						
No	92	72.9	14.4			
Yes	34	27.1	13.9	1.0	(0.8–1.1)	0.60
Multiple jobs						
No	110	91.3	13.9			
Yes	11	8.7	18.0	1.4	(1.1–1.6)	<0.001
Work hours						
40	54	42.9	12.2	1.0		
8–39	35	28.1	15.9	1.4	(1.2–1.5)	<0.001
41–45	8	6.8	14.9	1.3	(1.0–1.6)	0.1
46–59	16	13.1	16.0	1.4	(1.2–1.6)	<0.001
60 and over	10	7.9	16.5	1.4	(1.1–1.8)	<0.001
Occupation ^a						
Management, business, and financial	4.4	14.2	14.87	1.38	(1.07–1.77)	0.013
Computer, engineering, and science ^a	2.0	6.3	11.99			
Education, legal, Community service, arts, and media	3.6	11.6	14.84	1.38	(1.05–1.8)	0.02
Healthcare practitioners and technical	1.6	5.2	17.26	1.65	(1.2–2.26)	0.002
Service related	5.6	18.0	13.61	1.24	(0.96–1.61)	0.10
Sales related	3.2	10.5	16.01	1.50	(1.13–2.01)	0.006
Office and administrative support	4.1	13.2	14.78	1.37	(1.06–1.77)	0.02
Farming, fishing, and forestry	0.2	0.6	17.59	1.68	(0.8–3.54)	0.17
Construction and extraction	1.6	5.2	12.88	1.17	(0.83–1.64)	0.38
Installation, maintenance, and repair	1.2	3.7	13.66	1.25	(0.86–1.81)	0.24
Production	1.8	6.0	12.61	1.01	(0.98–1.04)	0.44
Transportation and material moving	1.8	5.7	13.6	1.24	(0.9–1.72)	0.19

^aComputer, engineering, and science occupation group was treated as the control group in the univariate analysis.

pain. For those who had multiple jobs, 18.0% of them reported neck pain.

Table III shows the associations between neck pain and a set of workplace-related variables using the three logistic regression models. Model 1 focused on the association

between neck pain and a set of work-related variables, including psychosocial factors and work organization characteristics, controlling for demographic characteristics and socioeconomic status. Model 1 indicated that those workers who were exposed to a hostile work environment

TABLE III. Three Models of Logistic Regression of Neck Pain, Workplace Psychological Factors, Work Organization Characteristics, Job Factors, and Occupation

Factors	Model 1 ^a			Model 2 ^b			Model 3 ^c		
	Adjusted OR	95% Conf	P	Adjusted OR	95% Conf	P	Adjusted OR	95% Conf	P
Psychosocial Factors									
Work-family imbalance	1.47	(1.27–1.70)	<0.001	1.43	(1.23–1.66)	<0.001	1.43	(1.23–1.66)	<0.001
Exposure to hostile work environment	2.05	(1.72–2.54)	<0.001	1.94	(1.62–2.32)	<0.001	1.96	(1.64–2.34)	<0.001
Job insecurity	1.36	(1.21–1.53)	<0.001	1.32	(1.18–1.49)	<0.001	1.33	(1.19–1.5)	<0.001
Work organization characteristics									
Non-standard work arrangement	1.26	(1.08–1.47)	<0.001	1.25	(1.08–1.46)	<0.001	1.26	(1.08–1.47)	<0.001
Alternative shift	0.92	(0.80–1.06)	0.25	0.91	(0.79–1.04)	0.17	0.89	(0.77–1.03)	0.13
Job factors									
Multiple jobs	1.26	(1.04–1.53)	0.02	1.27	(1.05–1.54)	0.01	1.28	(1.06–1.55)	0.01
Work hours									
40	1.00			1.00			1.00		
8–39	1.25	(1.08–1.45)	<0.001	1.24	(1.07–1.44)	<0.001	1.23	(1.06–1.43)	0.01
41–45	1.21	(0.95–1.54)	0.12	1.20	(0.94–1.54)	0.14	1.20	(0.94–1.53)	0.15
46–59	1.29	(1.09–1.55)	<0.001	1.30	(1.10–1.56)	<0.001	1.29	(1.08–1.54)	0.01
60 and over	1.27	(1.01–1.62)	0.05	1.27	(1.00–1.60)	0.05	1.24	(0.98–1.56)	0.07
Occupation									
Computer, engineering, and science							1.00		
Management, business, and financial							1.17	(0.90–1.52)	0.23
Education, legal, community service, arts, and media							1.16	(0.87–1.56)	0.31
Healthcare practitioners and technical							1.28	(0.91–1.78)	0.15
Service related							0.97	(0.73–1.30)	0.86
Sales related							1.25	(0.93–1.68)	0.14
Office and administrative support							1.00	(0.75–1.32)	0.98
Farming, fishing, and forestry							1.55	(0.70–3.46)	0.28
Construction and extraction							0.99	(0.69–1.42)	0.96
Installation, maintenance, and repair							1.02	(0.67–1.54)	0.94
Production							11.00	(0.97–1.03)	0.97
Transportation and material moving							1.15	(0.82–1.63)	0.42

^aModel 1 is controlled for demographic characteristics and socioeconomic status.

^bModel 2 is controlled for demographic characteristics and socioeconomic status and other health-related factors.

^cModel 3 is controlled for demographic characteristics and socioeconomic status, other health-related factors, and occupation.

(OR 2.05; 95%CI 1.72–2.54), experienced work-family imbalance (OR 1.47; CI 1.27–1.70), or experienced job insecurity (OR 1.36; CI 1.21–1.53) had significantly higher risks for neck pain. The likelihood for neck pain among those who had a non-standard work arrangement (OR 1.26; CI 1.08–1.47) was also higher than among those who did not. Those who had multiple jobs were also more likely to report neck pain (OR 1.26; CI 1.04–1.53). Compared with those who worked 40 hr per week, those who worked 46–59 hr per week (OR 1.29; CI 1.09–1.55) and those who worked 60 and or more hours per week (OR 1.27, CI 1.01–1.62) were more likely to have neck pain.

Model 2 examined the psychosocial and work organization factors while controlling for demographic characteristics, socioeconomic status, and other health-related factors. Those workers who had exposure to a hostile work environment (OR 1.94; CI 1.62–2.32), experienced work-family imbalance (OR 1.43; CI 1.23–1.66), or experienced job insecurity (OR 1.32; CI 1.18–1.49) had significant associations with reported neck pain. The risk for those who had a non-standard work arrangement to have neck pain was also significantly higher (OR 1.25; CI 1.08–1.46) than those who did not have a non-standard work arrangement. However, working alternative shifts was not significantly

related to neck pain. Model 2 also assessed the association between neck pain and hours of work. Compared with those who worked 40 hours per week, those who worked 46–59 hours per week (OR 1.30; CI 1.10–1.56) and 60 hours and over (OR 1.27 CI 1.00–1.60) were more likely to have neck pain. Those who had multiple jobs (OR 1.27; CI 1.05–1.54) also had an increased risk for neck pain.

Model 3 examined the psychosocial and work organization factors while controlling for occupation, in addition to demographic characteristics, socioeconomic status, and other health-related factors. The strength of the relationships between neck pain and the psychosocial and work organization factors presented in Model 3 was similar to that of Model 2. In Model 3, no significant occupational variations in neck pain were seen when psychosocial and work organization factors were controlled for.

DISCUSSION

This study used data from the 2010 NHIS to show that an estimated 18 million working adults reported experiencing neck pain in the past 3 months. This study also used additional supplementary 2010 NHIS-OHS data to assess the associations between neck pain and a number of important work-related psychosocial and work organization factors.

Focusing on workplace psychosocial factors and work organization factors for neck pain is important for mitigating the risk for neck pain, as the changing nature of work during the past two decades has increased the complexity of assessing work environmental risk factors for neck pain. These recent changes are shown in many previous studies. For example, demographic diversities in the work force have intensified [Hymel et al., 2011]; 24-hr-per-day operations in the manufacturing and service sectors have been widespread [Brink, 2000; Costa, 2001; Kompier, 2006]; new features of work organization, such as non-standard work arrangements, alternative shifts and temporary positions have been pervasive [Commission on Behavioral and Social Sciences and Education, 1999, Sauter et al., 2001; Landsbergis et al., 2014]; job security has become illusory [Ferrie et al., 2002, Landsbergis et al., 2014]; and a blurring of the boundaries between work, recovery and leisure, and work-family conflict have also become more common [Grzywacz and Marks, 2000; Caruso et al., 2004; Grosch et al., 2006; Hanson et al., 2006; Wayne et al., 2007; Artazcoz et al., 2009; Hammer et al., 2010; Kossek et al., 2014]. In addition, bullying within work organizations has become an emerging topic of research [Einarsen, 2000; Schat et al., 2006; Nielsen et al., 2009; Notelaers et al., 2010].

This study explores the relationship between psychosocial factors and work organization factors and neck pain. The

major finding was that these workplace psychosocial and work organization factors were all significantly associated with reported neck pain, after controlling for many relevant socio-demographic characteristics and other health related and work related factors. The findings suggest that neck pain may be caused by multiple psychosocial and work organization factors in the workplace. The findings are consistent with the associations between workplace bullying and neck pain previously shown in several studies conducted in Canada, Finland, Japan, Korea and Norway, Switzerland and the United States [Haemmig et al., 2011; Kaaria et al., 2012; Stock and Tissot, 2012; Vie et al., 2012; Takaki et al., 2013]. Studies on healthcare workers in the United States and Korea also provide support for the association between workplace verbal abuse and musculoskeletal injuries [Lu et al., 2014; Sabbath et al., 2014]. Support for the finding of a significant relationship between work-family conflict and neck pain or other musculoskeletal pains came from two studies of healthcare professionals conducted in Switzerland and the United States [Haemmig et al., 2011; Kim et al., 2013]. The findings of this study show job insecurity as a risk factor for neck pain although evidence linking job security and neck pain has been inconsistent thus far [Ariëns et al., 2001a; Lang et al., 2012]. Two studies indicate that job insecurity may lead to a small increase in neck pain in Dutch workers [Ariëns et al., 2001b] and Malaysian male workers [Shan et al., 2012], respectively. However, no significant relationship between job insecurity and neck pain is found in a study population in Poland [Bugajska et al., 2013]. It is important to note that the implications of job insecurity may vary from country to country depending on the unemployment benefits in the public welfare system.

Long work hours in the United States are linked to neck pain in this study. This finding is supported by the mechanism of insufficient recovery time shown in the neck pain research on healthcare workers and construction workers [Fredriksson et al., 1999; Lipscomb et al., 2002; Dong, 2005; Trinkoff et al., 2006]. The finding on the effect of long work hours is consistent with a neck pain study on the US workers based on a 4 year combined NHIS data set [Yang et al., 2015]. However, it is unclear in the present study why those who worked fewer hours were more likely to report neck pain and why those workers who did alternative shifts were less likely to report neck pain. The “healthy worker effect” may be a possible explanation. Another explanation may be that people who had neck pain may reduce their work hours or avoid alternative work shifts as a result of their symptoms. These alternative explanations cannot be ruled out due to the cross-sectional survey design as discussed below.

This study explores psychosocial and work organization stressors in relation to neck pain. While the effects of the work organization and psychosocial factors may be linked to neck pain, the overall role that these factors plays in the

development of neck pain is unclear [Sauter and Swanson, 1996; Swanson and Sauter, 2006].

The past research on the impact of psychosocial and work organization factors on workers' health has mostly been limited to the impacts of these factors on immune, cardiovascular, and metabolic systems [Ganster and Rosen, 2013]. Research into the effects of psychosocial factors on musculoskeletal disorders including neck pain has been under-recognized [Sauter and Swanson 1996; Bongers et al., 2006; Swanson and Sauter 2006]. This study adds evidence regarding the association between work-related psychosocial factors and neck pain.

There are several limitations in using population data from the NHIS to explore work-related risk factors for neck pain. First, the psychosocial risk factors used in the present study were assessed using a single question for each domain. Using a single question for assessing a psychosocial risk factor may have resulted in some level of exposure misclassification. However, we do not know whether the misclassification was differential or non-differential by the status of neck pain in this study. Second, the study did not assess work-related physical risk factors for neck pain, which limits our investigation about the mechanisms by which the psychosocial and work organizational factors affect neck pain. Lack of assessment of workplace physical risk factors for neck pain may underestimate workplace risk factors for neck pain. Long work hours and multiple jobs may be considered indirect measurements of physical risk factors at work, but these measures are not specific. Finally, the study was based on cross-sectional data, which makes it difficult to examine the complex time-dependent etiology of neck pain in workers. A longitudinal study design would be better suited for investigating the changes in work-related risk factors and their latency effects, since neck pain often is episodic in nature [Carroll et al., 2008b; Côté et al., 2009]. Future studies of the effects of work-related risk factors on neck pain will benefit from a study design that can assess latency effects, health history, prognosis and the healthy worker effect [Punnett, 2004].

This study suggests several emerging psychosocial and work organization risk factors that may be associated with neck pain in the US working population. Interventions for reducing these risk factors could be developed to assist workers to reduce irregular work arrangements and long hours of work, dealing with job insecurity, and effectively managing work-life imbalances [Hammer et al., 2010; Kim et al., 2013]. Consultation and educational programs could also be developed to address workplace bullying and hostile work environments [Love et al., 2003]. Much of the prior research and policy recommendations have been limited to the occupational hazards of verbal coercion and physical assaults for healthcare workers. Some of the policy goals for promoting and protecting healthcare workers should be

applicable for workers in a wide range of occupations. The two relevant policy goals could include: first, recognizing exposure to a hostile work environment as a pressing and preventable occupation hazard and, second, earmarking research funding and promoting workplace intervention programs for factors related to hostile work environments [Love et al., 2003, Sabbath et al., 2014]. A growing body of research has suggested the detrimental effect of work-family imbalance on workers' mental health, wellbeing, and physical health outcomes and it could be considered as an important area for health promotion strategies [Kim et al., 2013].

AUTHORS' CONTRIBUTIONS

Haiou Yang made substantial contributions to the conception and design of the work, data acquisition, analysis, interpretation of data for the work, drafting the work or revising it critically for important intellectual content; final approval of the version to be published, and agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Edward Hitchcock, Akinori Nakata, Naomi Swanson, Ming-Lun Lu, Bongkyoo Choi and Dean Baker made substantial contributions to interpretation of data for the work, revising it critically for important intellectual content, final approval of the version to be published, and agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Scott Haldeman made substantial contributions to the conception of the work interpretation of data for the work, final approval of the version to be published, and agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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ETHICS APPROVAL AND INFORMED CONSENT

The study used the de-identified secondary data set which involved no informed consent for the analysis. The data set is a public use file from the NHIS, which were approved by the National Human Subjects Protection Advisory Committee (<http://www.hhs.gov/ohrp/archive/nhrpac/documents/dataltr.pdf>).

CONFLICT OF INTEREST

None of the authors have conflicts of interest to disclose.

DISCLOSURE BY AJIM EDITOR OF RECORD

Steven Markowitz declares that he has no competing or conflicts of interest in the review and publication decision regarding this article.

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