



# HHS Public Access

Author manuscript

*Am J Ind Med.* Author manuscript; available in PMC 2016 August 10.

Published in final edited form as:

*Am J Ind Med.* 2016 July ; 59(7): 549–560. doi:10.1002/ajim.22602.

## Work Related Psychosocial and Organizational Factors for Neck Pain in Workers in the United States

Haiou Yang, PhD<sup>1,\*</sup>, Edward Hitchcock, PhD<sup>2</sup>, Scott Haldeman, DC, MD, PhD, FRCP<sup>3,4</sup>, Naomi Swanson, PhD<sup>2</sup>, Ming-Lun Lu, PhD<sup>2</sup>, BongKyoo Choi, ScD, MPH<sup>1</sup>, Akinori Nakata, PhD<sup>5</sup>, and Dean Baker, MD, MPH<sup>1</sup>

<sup>1</sup>Center for Occupational and Environmental Health, University of California, Irvine, California

<sup>2</sup>Division of Applied Research and Technology, National Institute of Occupational Safety and Health, Cincinnati, Ohio

<sup>3</sup>Department of Neurology, University of California, Irvine, California

<sup>4</sup>Department of Epidemiology, School of Public Health, University of California, Los Angeles, California

<sup>5</sup>School of Health Sciences, University of Occupational and Environmental Health, Kitakyushu, Japan

### Abstract

**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 comes 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.

### Keywords

neck pain; occupational health; psychosocial risk factors; work organization; epidemiology

---

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

## 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. 2001, Cote, et al. 2008]. Specifically, studies have identified awkward postures, heavy physical work, repetitive and precision work as physical risk factors for neck pain [Carroll, et al. 2008, Côté, et al. 2009, Punnett 2004]. Much of what is known about work-related psychosocial factors for neck pain has been research based on the Demand-Control model [Karasek 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 [Bongers, et al. 2006, Canjuga, et al. 2010, Carroll, et al. 2008, Carroll, et al. 2008, Christensen and Knardahl 2010, Devereux, et al. 2002, Huang, et al. 2002, Joling, et al. 2008, Lang, et al. 2012], low social support [Luime, et al. 2004, Rugulies and Krause 2005], and low job satisfaction [Brandt, et al. 2004, Eriksen, et al. 1999, Smedley, et al. 2003].

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 leads 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 and her colleagues (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 colleagues 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, Nicoletti, et al. 2014, Trinkoff, et al. 2006] [Fredriksson, et al. 2001, Lipscomb, et al. 2002, Nicoletti, et al. 2014, Trinkoff, et al. 2006].

The research foci in recent years has shifted to a set of emerging psychological risk factors at the workplace. Research has linked neck pain with job insecurity [Ariëns, et al. 2001,

Bugajska, et al. 2013, Shan, et al. 2012], workplace bullying [Kaaria, et al. 2012, Stock and Tissot 2012, Takaki, et al. 2013, Vignoli, et al. 2015], and work and 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 [Burgard, et al. 2009, Cheng, et al. 2005, Finne, et al. 2011, Frone, et al. 1997, Grzywacz 2000, Hammer, et al. 2005, McDonough 2000, Vignoli, et al. 2015]. One of the major speculations is that workplace psychological 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 [De Witte, et al. 2016, Hansen, et al. 2006, Lundberg, et al. 2002, Lundberg and Melin 2002, Shahidi, et al. 2015, Vignoli, et al. 2015].

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. 2013]. 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. 2013, Alterman, et al. 2013] to evaluate the associations of these risk factors with 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 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 to 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. 2008, Carroll, et al. 2009, Cote, et al. 2008, Haldeman, et al. 2008, 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: (a) 18–25, (b) 26–40, (c) 41–55 and (d) 56–64 years. Race/ethnicity was coded into five groups: (a) Hispanic, (b) Non-Hispanic White, (c) Non-Hispanic Black, (d) Non-Hispanic Asian, and (e) Non-Hispanic Others. Socioeconomic status (SES) variables were education and income. Education was coded into four categories: (a) less than high school, (b) high school, (c) some college, (d) college and (c) Master and above. Income was defined as personal yearly earnings coded into five categories, (a) under \$14,999, (b) \$15,000–\$34,999, (c) \$35,000–\$64,999, (d) \$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 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 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 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 answer options included (a) All of the time, (b) Most of the time, (b) Some of the time, (c) A little of the time, and (d) 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 6 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 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: (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. The question on “Nonstandard 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: (a) 8–39 hours, (b) 40 hours, (c) 41–45 hours, (d) 46–59 hours and (e) 60 and more hours. Regular working hours (40 hours) 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: (1) Management, business and financial, (2) Computer, engineering, and science (Computer and mathematical; Architecture and engineering and Life and physical and social science) (3) Education, legal, community service, arts and media (Education, training, and library occupations, Arts, design, entertainment, sports and media), (4) Healthcare practitioners and technical (Healthcare practitioners and technical and healthcare support), (5) Service related (Protective service; Food preparation and serving related; Building and ground cleaning and maintenance; and Personal care and service), (6) Sales and related, (7) Office and administrative support, (8) Farming, fishing and forestry, (9) Construction and extraction, (10) Installation, maintenance and repair, (11) Production, and (12) 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. 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 to 55 age group (16.4%) and the 56 to 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 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 (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 hours per week, those who worked 46 to 59 hours 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 to 59 hours per week (OR 1.30; CI 1.10–1.56) and 60 hours and over (OR 1.27 CI 1.09–1.60) were more likely to have neck pain. Those who had multiple jobs (OR 1.27; CI 1.00–1.60) 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. Additional supplementary 2010 NHIS OHS data were used 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-hour-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, Landsbergis, et al. 2014, Sauter, et al. 2002]; 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 [Artazcoz, et al. 2009, Caruso, et al. 2004, Grosch, et al. 2006, Grzywacz and Marks 2000, Hammer, et al. 2010, Hanson, et al. 2006, Kossek, et al. 2014, Wayne, et al. 2007]. In addition, bullying within work organizations has become an emerging topic of research [Einarsen 2000, Nielsen, et al. 2009, Notelaers, et al. 2010, Schat, et al. 2006].

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, Takaki, et al. 2013,



Vie, et al. 2012]. 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 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. 2001, 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. 2001] 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 [Dong 2005, Fredriksson, et al. 1999, Lipscomb, et al. 2002, 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 play 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 [Bongers, et al. 2006, Sauter and Swanson 1996, 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. 2008, 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 new 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 in reducing 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 focused on 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].

## Acknowledgments

The findings and conclusions in this study are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health.

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>).

## References

- 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; 56:660–669. [PubMed: 23023603]
- Alterman T, Luckhaupt SE, Dahlhamer JM, Ward BW, Calvert GM. Prevalence rates of work organization characteristics among workers in the US: Data from the 2010 National Health Interview Survey. *Am J Ind Med.* 2013; 56:647–659. [PubMed: 22911666]
- Ariëns GA, Bongers PM, Hoogendoorn WE, Houtman IL, van der Wal G, van Mechelen W. High quantitative job demands and low coworker support as risk factors for neck pain: results of a prospective cohort study. *Spine (Phila Pa 1976).* 2001; 26:1896–1901. discussion 1902–1893. [PubMed: 11568702]

- Ariëns GA, van Mechelen W, Bongers PM, Bouter LM, van der Wal G. Psychosocial risk factors for neck pain: a systematic review. *Am J Ind Med.* 2001; 39:180–193. [PubMed: 11170160]
- Artazcoz L, Cortes I, Escriba-Aguir V, Cascant L, Villegas R, Tsukasaki K, Makimoto K, Kido T, Borrell C, Mikurube H, Kaneko M, Murata C, Komaki Y, Ishikawa N, Higashiyama R, Fukasawa K, Watanabe T, Portela LF, Rotenberg L, Waissmann W, Landsbergis P, Brown DE, Sievert LL, Aki SL, Mills PS, Etrata MB, Paopao RN, James GD, Kobayashi T, Nishikido N, Kageyama T, Kashiwazaki H, Ho KH, Benjamin KC, Yamasaki F, Schwartz JE, Gerber LM, Warren K, Pickering TG, Loimaala A, Turjanmaa V, Vuori I, Oja P, Pasanen M, Uusitalo A, Tochikubo O, Ikeda A, Miyajima E, Ishii M, Brownley KA, West SG, Hinderliter AL, Light KC, Stiefel P, Gimenez J, Miranda ML, Villar J, Muniz-Grijalvo O, Pamies E, Martin-Sanz V, Carneado J, Devereux RB, Schnall PL, Landsbergis PA, Mansour P, Bostrom PA, Mattiasson I, Lilja B, Berglund G, Baba S, Suzuki A, Mandai T, Konishi M, Nakamoto Y, Amano K, Sakamoto T, Sugimoto T, Feng JZ, Sun H, Clark LA, Denby L, Pregibon D, Harshfield GA, Blank S, Laragh JH, Kleinert HD, Schneider RA, Costiloe JP. Understanding the relationship of long working hours with health status and health-related behaviours. *J Epidemiol Community Health.* 2009; 63:521–527. [PubMed: 19254912]
- Bongers PM, Ijmker S, van den Heuvel S, Blatter BM. Epidemiology of work related neck and upper limb problems: Psychosocial and personal risk factors (Part I) and effective interventions from a bio behavioural perspective (Part II). *J Occup Rehabil.* 2006; 16:279–302. [PubMed: 16850279]
- Brandt LPA, Andersen JH, Lassen CF, Kryger A, Overgaard E, Vilstrup I, Mikkelsen S. Neck and shoulder symptoms and disorders among Danish computer workers. *Scand J Work Environ Health.* 2004; 30:399–409. [PubMed: 15529803]
- Brink S. Sleepless society. In staying up half the night, we may risk our health. *US News World Rep.* 2000; 129:62–66. 68, 70–62.
- Bugajska J, Zolnierczyk-Zreda D, Jedryka-Goral A, Gasik R, Hildt-Ciupinska K, Malinska M, Bedynska S. Psychological factors at work and musculoskeletal disorders: a one year prospective study. *Rheumatol Int.* 2013; 33:2975–2983. [PubMed: 23934521]
- Burgard SA, Brand JE, House JS. Perceived job insecurity and worker health in the United States. *Soc Sci Med.* 2009; 69:777–785. [PubMed: 19596166]
- 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. *Int J Ind Ergon.* 2010; 40:663–668.
- Carroll LJ, Cassidy JD, Peloso PM, Giles-Smith L, Cheng CS, Greenhalgh SW, Haldeman S, van der Velde G, Hurwitz EL, Côté P, Nordin M, Hogg-Johnson S, Holm LW, Guzman J, Carragee EJ. Disorders BaJD-TFoNPaIA. Methods for the best evidence synthesis on neck pain and its associated disorders: the Bone and Joint Decade 2000–2010 Task Force on Neck Pain and Its Associated Disorders. *Spine (Phila Pa 1976).* 2008; 33:S33–38. [PubMed: 18204397]
- Carroll LJ, Hogg-Johnson S, Cote P, van der Velde G, Holm LW, Carragee EJ, Hurwitz EL, Peloso PM, Cassidy JD, Guzman J, Nordin M, Haldeman S. Course and prognostic factors for neck pain in workers - Results of the Bone and Joint Decade 2000–2010 Task Force on neck pain and its associated disorders. *Spine.* 2008; 33:S93–100. [PubMed: 18204406]
- Carroll LJ, Hogg-Johnson S, van der Velde G, Haldeman S, Holm LW, Carragee EJ, Hurwitz EL, Côté P, Nordin M, Peloso PM, Guzman J, Cassidy JD. Course and prognostic factors for neck pain in the general population: results of the Bone and Joint Decade 2000–2010 Task Force on Neck Pain and Its Associated Disorders. *J Manipulative Physiol Ther.* 2009; 32:S87–96. [PubMed: 19251079]
- Caruso, C.; Hitchcock, E.; Dick, R.; Russo, J.; Schmit, J. Overtime and Extended Work Shifts: Recent Findings on Illnesses, Injuries and Health Behaviors. National Institute for Occupational Safety and Health (NIOSH), NIOSH Publication No 2004–143; Cincinnati, OH: 2004.
- 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; 61:41–52. [PubMed: 15847960]
- Christensen JO, Knardahl S. Work and neck pain: A prospective study of psychological, social, and mechanical risk factors. *Pain.* 2010; 151:162–173. [PubMed: 20655144]

- 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.
- Costa G. The 24-hour society between myth and reality. *J Hum Ergol (Tokyo)*. 2001; 30:15–20. [PubMed: 14564852]
- Cote P, van der Velde G, Cassidy JD, Carroll LJ, Hogg-Johnson S, Holm LW, Carragee EJ, Haldeman S, Nordin M, Hurwitz EL, Guzman J, Peloso PM. The burden and determinants of neck pain in workers - Results of the bone and joint decade 2000–2010 task force on neck pain and its associated disorders. *Eur Spine J*. 2008; 17:S60–S74.
- Côté P, van der Velde G, Cassidy JD, Carroll LJ, Hogg-Johnson S, Holm LW, Carragee EJ, Haldeman S, Nordin M, Hurwitz EL, Guzman J, Peloso PM. The burden and determinants of neck pain in workers: results of the Bone and Joint Decade 2000–2010 Task Force on Neck Pain and Its Associated Disorders. *J Manipulative Physiol Ther*. 2009; 32:S70–86. [PubMed: 19251078]
- De Witte H, Pienaar J, De Cuyper N. Review of 30 Years of Longitudinal Studies on the Association Between Job Insecurity and Health and Well-Being: Is There Causal Evidence? *Aust Psychol*. 2016; 51:18–31.
- Devereux JJ, Vlachonikolis IG, Buckle PW. Epidemiological study to investigate potential interaction between physical and psychosocial factors at work that may increase the risk of symptoms of musculoskeletal disorder of the neck and upper limb. *Occup Environ Med*. 2002; 59:269–277. [PubMed: 11934955]
- Division of Health Interview Statistics. 2010 National Health Interview Survey (NHIS) Public Use Data Release, Survey Description. Hyattsville, Maryland: Division of Health Interview Statistics, National Center for Health Statistics Centers for Disease Control and Prevention, U.S. Department of Health and Human Services; 2011.
- Dong XW. Long workhours, work scheduling and work-related injuries among construction workers in the United States. *Scand J Work Environ Health*. 2005; 31:329–335. [PubMed: 16273958]
- Einarsen S. Harassment and bullying at work: A review of the Scandinavian approach. *Aggress Violent Beh*. 2000;5.
- Eriksen W, Natvig B, Knardahl S, Bruusgaard D. Job characteristics as predictors of neck pain - A 4-year prospective study. *J Occup Environ Med*. 1999; 41:893–902. [PubMed: 10529945]
- 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. *J Epidemiol Community Health*. 2002; 56:450–454. [PubMed: 12011203]
- Finne LB, Knardahl S, Lau B. Workplace bullying and mental distress - a prospective study of Norwegian employees. *Scandinavian Journal of Work Environment & Health*. 2011; 37:276–287.
- Fredriksson K, Alfredsson L, Koster M, Thorbjornsson CB, Toomingas A, Torgen M, Kilbom A. Risk factors for neck and upper limb disorders: results from 24 years of follow up. *Occup Environ Med*. 1999; 56:59–66. [PubMed: 10341748]
- Fredriksson K, Bildt C, Hagg G, Kilbom A. The impact on musculoskeletal disorders of changing physical and psychosocial work environment conditions in the automobile industry. *Int J Ind Ergon*. 2001:28.
- Frone MR, Russell M, Cooper ML. Relation of work-family conflict to health outcomes: A four-year longitudinal study of employed parents. *J Occup Organ Psychol*. 1997; 70:325–335.
- Ganster DC, Rosen CC. Work stress and employee health: A multidisciplinary review. *Journal of Management*. 2013; 39:1085–1122.
- Greenhalgh L, Rosenblatt Z. Job insecurity - toward conceptual clarity. *Acad Manage Rev*. 1984; 9:438–448.
- Grosch JW, Caruso CC, Rosa RR, Sauter SL. Long hours of work in the US: Associations with demographic and organizational characteristics, psychosocial working conditions, and health. *Am J Ind Med*. 2006; 49:943–952. [PubMed: 17036350]
- Grzywacz JG. Work-family spillover and health during midlife: is managing conflict everything? *Am J Health Promot*. 2000; 14:236–243. [PubMed: 10915535]

- Grzywacz JG, Marks NF. Reconceptualizing the work-family interface: an ecological perspective on the correlates of positive and negative spillover between work and family. *J Occup Health Psychol*. 2000; 5:111–126. [PubMed: 10658890]
- Guzman J, Hurwitz EL, Carroll LJ, Haldeman S, Côté P, Carragee EJ, Peloso PM, van der Velde G, Holm LW, Hogg-Johnson S, Nordin M, Cassidy JD. A new conceptual model of neck pain: linking onset, course, and care: the Bone and Joint Decade 2000–2010 Task Force on Neck Pain and Its Associated Disorders. *J Manipulative Physiol Ther*. 2009; 32:S17–28. [PubMed: 19251062]
- Haemmig O, Knecht M, Laeubli T, Bauer GF. Work-life conflict and musculoskeletal disorders: a cross-sectional study of an unexplored association. *BMC Musculoskelet Disord*. 2011;12. [PubMed: 21232150]
- Haldeman S, Carroll L, Cassidy JD, Schubert J, Nygren A. The bone and joint decade 2000–2010 task force on neck pain and its associated disorders - Executive summary. *Eur Spine J*. 2008; 17:S5–S7.
- Hammer LB, Cullen JC, Neal MB, Sinclair RR, Shafiro MV. The longitudinal effects of work-family conflict and positive spillover on depressive symptoms among dual-earner couples. *J Occup Health Psychol United States*. 2005:138–154. 2005 APA, all rights reserved.
- Hammer LB, Kossek EE, Anger WK, Bodner T, Zimmerman KL. Clarifying work-family intervention processes: The roles of work-family conflict and family-supportive supervisor behaviors. *J Appl Psychol*. 2010; 96:134–150. [PubMed: 20853943]
- Hansen AM, Høgh A, Persson R, Karlson B, Garde AH, Orbaek P. Bullying at work, health outcomes, and physiological stress response. *J Psychosom Res*. 2006; 60:63–72. [PubMed: 16380312]
- Hanson GC, Hammer LB, Colton CL. Development and validation of a multidimensional scale of perceived work-family positive spillover. *J Occup Health Psychol*. 2006; 11:249–265. [PubMed: 16834473]
- Hogg-Johnson S, van der Velde G, Carroll LJ, Holm LW, Cassidy JD, Guzman J, Côté P, Haldeman S, Ammendolia C, Carragee E, Hurwitz E, Nordin M, Peloso P. The burden and determinants of neck pain in the general population: results of the Bone and Joint Decade 2000–2010 Task Force on Neck Pain and Its Associated Disorders. *J Manipulative Physiol Ther*. 2009; 32:S46–60. [PubMed: 19251074]
- Hoy DG, Protani M, De R, Buchbinder R. The epidemiology of neck pain. *Best Practice & Research Clinical Rheumatology*. 2010; 24:783–792. [PubMed: 21665126]
- Huang GD, Feuerstein M, Sauter SL. Occupational stress and work-related upper extremity disorders: Concepts and models. *Am J Ind Med*. 2002; 41:298–314. [PubMed: 12071486]
- Hymel PA, Loeppke RR, Baase CM, Burton WN, Hartenbaum NP, Hudson TW, McLellan RK, Mueller KL, Roberts MA, Yarborough CM, Konicki DL, Larson PW. Workplace health protection and promotion: a new pathway for a healthier--and safer--workforce. *J Occup Environ Med*. 2011; 53:695–702. [PubMed: 21654443]
- Joling CI, Blatter BM, Ybema JF, Bongers PM. Can favorable psychosocial work conditions and high work dedication protect against the occurrence of work-related musculoskeletal disorders? *Scand J Work Environ Health*. 2008; 34:345–355. [PubMed: 18853071]
- Kaaria S, Laaksonen M, Rahkonen O, Lahelma E, Leino-Arjas P. Risk factors of chronic neck pain: A prospective study among middle-aged employees. *Eur J Pain*. 2012; 16:911–920. [PubMed: 22337254]
- Karasek RA. Job Demands, Job Decision Latitude, and Mental Strain - Implications for Job Redesign. *Adm Sci Q*. 1979; 24:285–308.
- Kaur H, Luckhaupt SE, Li J, Alterman T, Calvert GM. Workplace Psychosocial Factors Associated With Hypertension in the U.S. Workforce: A Cross-Sectional Study Based on the 2010 National Health Interview Survey. *Am J Ind Med*. 2014; 57:1011–1021. [PubMed: 25137617]
- Kim S-S, Okechukwu CA, Buxton OM, Dennerlein JT, Boden LI, Hashimoto DM, Sorensen G. Association between work-family conflict and musculoskeletal pain among hospital patient care workers. *Am J Ind Med*. 2013; 56:488–495. [PubMed: 23019044]
- Kompier MAJ. New systems of work organization and workers' health. *Scand J Work Environ Health*. 2006; 32:421–430. [PubMed: 17173199]
- Kossek EE, Hammer LB, Kelly EL, Moen P. Designing Work, Family & Health Organizational Change Initiatives. *Organ Dyn*. 2014; 43:53–63. [PubMed: 24683279]



- 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; 23:2507–2516. [PubMed: 9854749]
- Landsbergis PA, Grzywacz JG, LaMontagne AD. Work organization, job insecurity, and occupational health disparities. *Am J Ind Med*. 2014; 57:495–515. [PubMed: 23074099]
- Lang J, Ochsmann E, Kraus T, Lang JWB. Psychosocial work stressors as antecedents of musculoskeletal problems: A systematic review and meta-analysis of stability-adjusted longitudinal studies. *Soc Sci Med*. 2012; 75:1163–1174. [PubMed: 22682663]
- Lipscomb JA, Trinkoff AM, Geiger-Brown J, Brady B. Work-schedule characteristics and reported musculoskeletal disorders of registered nurses. *Scandinavian Journal of Work Environment & Health*. 2002; 28:394–401.
- Lipscomb JA, Trinkoff AM, Geiger-Brown J, Brady B. Work-schedule characteristics and reported musculoskeletal disorders of registered nurses. *Scand J Work Environ Health*. 2002; 28:394–401. [PubMed: 12539799]
- Love CC, Morrison E. American Academy of Nursing Expert Panel on V. American Academy of Nursing Expert Panel on Violence policy recommendations on workplace violence (adopted 2002). *Issues Ment Health Nurs*. 2003; 24:599–604. [PubMed: 12907377]
- Lu M-L, Nakata A, Park JB, Swanson NG. Workplace Psychosocial Factors Associated with Work-Related Injury Absence: A Study from a Nationally Representative Sample of Korean Workers. *Int J Behav Med*. 2014; 21:42–52. [PubMed: 23794229]
- Luckhaupt, SE.; Burriss, DL. How Does Work Affect the Health of the U.S. Population? Free Data from the 2010 NHIS-OHS Provides the Answers. NIOSH Science Blog. 2013. <http://blogs.cdc.gov/niosh-science-blog/2013/06/24/nhis:/NIOSH>
- Luckhaupt SE, Cohen MA, Li J, Calvert GM. Prevalence of obesity among U.S. workers and associations with occupational factors. *Am J Ind Med*. 2014; 46:237–248.
- Luime JJ, Kuiper JI, Koes BW, Verhaar JAN, Miedema HS, Burdorf A. Work-related risk factors for the incidence and recurrence of shoulder and neck complaints among nursing-home and elderly-care workers. *Scand J Work Environ Health*. 2004; 30:279–286. [PubMed: 15458010]
- Lundberg U, Forsman M, Zachau G, Eklof M, Palmerud G, Melin B, Kadefors R. Effects of experimentally induced mental and physical stress on motor unit recruitment in the trapezius muscle. *Work Stress*. 2002; 16:166–178.
- 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.
- MacDonald LA, Harenstam A, Warren ND, Punnett L. Incorporating work organisation into occupational health research: an invitation for dialogue. *Occup Environ Med*. 2008; 65:1–3. [PubMed: 18089855]
- MacDonald LA, Karasek RA, Punnett L, Scharf T. Covariation between workplace physical and psychosocial stressors: evidence and implications for occupational health research and prevention. *Ergonomics*. 2001; 44:696–718. [PubMed: 11437204]
- Martin BI, Deyo RA, Mirza SK, Turner JA, Comstock BA, Hollingworth W, Sullivan SD. Expenditures and health status among adults with back and neck problems. *JAMA*. 2008; 299:656–664. [PubMed: 18270354]
- McDonough P. Job insecurity and health. *Int J Health Serv*. 2000; 30:453–476. [PubMed: 11109176]
- Misailidou V, Malliou P, Beneka A, Karagiannidis A, Godolias G. Assessment of patients with neck pain: a review of definitions, selection criteria, and measurement tools. *J Chiropr Med*. 2010; 9:49–59. [PubMed: 21629550]
- Nicoletti C, Spengler CM, Laeubli T. Physical workload, trapezius muscle activity, and neck pain in nurses' night and day shifts: A physiological evaluation. *Appl Ergon*. 2014; 45:741–746. [PubMed: 24140243]
- Nielsen MB, Skogstad A, Matthiesen SB, Glaso L, Aasland MS, Notelaers G, Einarsen S. Prevalence of workplace bullying in Norway: Comparisons across time and estimation methods. *Eur J Work Organ Psy*. 2009; 18:81–101.
- Notelaers G, De Witte H, Einarsen S. A job characteristics approach to explain workplace bullying. *European Journal of Work and Organizational Psychology*. 2010; 19:487–504.



- Parsons VL, Moriarity C, Jonas K, Moore TF, Davis KE, Tompkins L. Design and estimation for the national health interview survey, 2006–2015. *Vital and health statistics Series 2, Data evaluation and methods research*. 2014;1–53. [PubMed: 24775908]
- Pratt LA, Dey AN, Cohen AJ. Characteristics of adults with serious psychological distress as measured by the K6 scale: United States, 2001–04. *Adv Data*. 2007;1–18. [PubMed: 17432488]
- Punnett L. Work related neck pain: how important is it, and how should we understand its causes? *Occup Environ Med*. 2004; 61:954–955. [PubMed: 15550599]
- Rugulies R, Krause N. Job strain, iso-strain, and the incidence of low back and neck injuries. A 7.5-year prospective study of San Francisco transit operators. *Soc Sci Med*. 2005; 61:27–39. [PubMed: 15847959]
- Sabbath EL, Hurtado DA, Okechukwu CA, Tamers SL, Nelson C, Kim S-S, Wagner G, Sorenson G. Occupational Injury Among Hospital Patient-Care Workers: What Is the Association With Workplace Verbal Abuse? *Am J Ind Med*. 2014; 57:222–232. [PubMed: 24151093]
- Sauter, SL.; Brightwell, WS.; Colligan, MJ.; Hurrell, JJJ.; Katz, TM.; LeGrande, DE.; Lessin, N.; Lippin, RA.; Lipscomb, JA.; Murphy, LR.; Peters, RH.; Keita, GP.; Robertson, SR.; Stellman, JM.; Swanson, NG.; Tetrick, LE. *The Changing Organization of Work and the Safety and Health of Working People: Knowledge Gaps and Research Directions*. Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health; 2002.
- Sauter, SL.; Swanson, NG. An ecological model of musculoskeletal disorders in office work. In: Sauter, SL.; Moon, SD., editors. *Beyond Biomechanics: Psychosocial Aspects of Musculoskeletal Disorders in Office Work*. London, United Kingdom: Taylor & Francis, Inc; 1996. p. 3-20.
- Schat, A.; Frone, M.; Kelloway, E. Prevalence of workplace aggression in the US workforce: Findings from a national study. In: Kelloway, E.; Barling, J.; Hurrell, J., editors. *Handbook of workplace violence*. Thousand Oaks, CA: Sage; 2006. p. 47-90.
- Schiller, J.; Lucas, J.; Ward, B.; Peregoy, J. *Summary Health Statistics for US Adults: National Health Interview Survey, 2010*. National Center for Health Statistics yattsville; Maryland: 2012 Jan. DHHS Publication No. (PHS) 2012–1580
- Shahidi B, Curran-Everett D, Maluf KS. Psychosocial, Physical, and Neurophysiological Risk Factors for Chronic Neck Pain: A Prospective Inception Cohort Study. *J Pain*. 2015; 16:1288–1299. [PubMed: 26400680]
- Shan CL, Bin Adon MY, Rahman ABA, Hassan STS, Ismail KB. Prevalence of neck pain and associated factors with personal characteristics, physical workloads and psychosocial among male rubber workers in FELDA settlement Malaysia. *Glob J Health Sci*. 2012;4.
- Shan CL, Bin Adon MY, Rahman ABA, Hassan STS, Ismail KB. Prevalence of neck pain and associated factors with personal characteristics, physical workloads and psychosocial among male rubber workers in FELDA settlement Malaysia. *Glob J Health Sci*. 2012; 4:94–104. [PubMed: 22980103]
- Smedley J, Inskip H, Trevelyan F, Buckle P, Cooper C, Coggon D. Risk factors for incident neck and shoulder pain in hospital nurses. *Occup Environ Med*. 2003;60. [PubMed: 12499459]
- Stock SR, Tissot F. Are there health effects of harassment in the workplace? A gender-sensitive study of the relationships between work and neck pain. *Ergonomics*. 2012; 55:147–159. [PubMed: 21864223]
- Stock SR, Tissot F. Are there health effects of harassment in the workplace? A gender-sensitive study of the relationships between work and neck pain. *Ergonomics*. 2012;55. [PubMed: 22176484]
- Swanson NG, Sauter SL. A multivariate evaluation of an office ergonomic intervention using longitudinal data. *Theor Issues Ergon Sci*. 2006; 7:3–17.
- Takaki J, Taniguchi T, Hirokawa K. Associations of Workplace Bullying and Harassment with Pain. *Int J Environ Res Public Health*. 2013; 10:4560–4570. [PubMed: 24071921]
- Trinkoff AM, Le R, Geiger-Brown J, Lipscomb J, Lang G. Longitudinal relationship of work hours, mandatory overtime, and on-call to musculoskeletal problems in nurses. *Am J Ind Med*. 2006; 49:964–971. [PubMed: 16691609]
- US Bureau of Labor Statistics. [Accessed on May 1, 2014] *Standard Occupational Classification and Coding Structure* US Bureau of Labor Statistics. 2010. <http://www.bls.gov/soc/>

- US Department of Health and Human Services. Overarching Goals. U.S. Department of Health and Human Services; 200 Independence Avenue, S.W., Washington, DC 20201: 2013. Healthy People 2020, The Vision, Mission, and Goals of Healthy People 2020.
- Vie TL, Glaso L, Einarsen S. How does it feel? Workplace bullying, emotions and musculoskeletal complaints. *Scand J Psychol.* 2012; 53:165–173. [PubMed: 22150575]
- 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
- Wang PC, Rempel DM, Harrison RJ, Chan J, Ritz BR. Work-organisational and personal factors associated with upper body musculoskeletal disorders among sewing machine operators. *Occup Environ Med.* 2007; 64:806–813. [PubMed: 17522131]
- Wayne JH, Grzywacz JG, Carlson DS, Kacmar KM. Work-family facilitation: A theoretical explanation and model of primary antecedents and consequences. *Hum Resour Manage R.* 2007; 17:63–76.
- Yang H, Haldeman S, Nakata A, Choi B, Delp L, Baker D. Work-Related Risk Factors for Neck Pain in the United States Working Population. *Spine (Phila Pa 1976).* 2015; 40:184–192. [PubMed: 25384052]

**Table 1**

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
<b>Demographic characteristics</b>						
<b>Age</b>						
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
<b>Gender</b>						
Male	67	53.1	12.0	1.0		
Female	59	46.9	16.9	0.7	(0.6–0.8)	<0.001
<b>Ethnicity and race</b>						
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
<b>Socioeconomic Status</b>						
<b>Education</b>						
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
<b>Earning</b>						
< \$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
<b>Other Health related factors</b>						

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Variable	Weighted Count (million)	Weighted% in the population	Weighted % Neck pain	Unadjusted OR	95%Conf.	p
<b>Leisure-time physical activity</b>						
No	61	48.3	14.7	1.0		
Yes	65	51.7	13.8	0.9	(0.8-1.0)	0.20
<b>Serious Psychological Distress</b>						
No	120	97.5	13.7	1.0		
Yes	3	2.5	34.7	3.3	(2.4-4.5)	<0.001

**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
<b>Psychosocial factors</b>						
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
<b>Work organization characteristics</b>						
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 hours	54	42.9	12.2	1.0		
8 to 39	35	28.1	15.9	1.4	(1.2-1.5)	<0.001
41 to 45	8	6.8	14.9	1.3	(1.0-1.6)	0.1
46 to 59	16	13.1	16.0	1.4	(1.2-1.6)	<0.001
60 hours and over	10	7.9	16.5	1.4	(1.1-1.8)	<0.001
<b>Occupation*</b>						
Management, business and financial	4.4	14.2	14.87	1.38	(1.07-1.77)	0.013

Variable	Weighted Count (million)	Weighted % in population	Weighted % Neck pain	Unadjusted OR	95% Conf.	p
Computer, engineering, and Science*	2.0	6.3	11.99			
Education, legal, Community service, arts & 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

\* Computer, engineering, and science occupation group was treated as the control group in the univariate analysis.



**Table III**

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

Factors	Model 1*			Model 2**			Model 3***		
	Adjusted OR	95% Conf	p	Adjusted OR	95% Conf	p	Adjusted OR	95% Conf	p
<b>Psychosocial Factors</b>									
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
<b>Work organization characteristics</b>									
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
<b>Job factors</b>									
<b>Multiple jobs</b>	1.26	(1.04–1.53)	0.02	1.27	(1.05–1.54)	0.01	1.28	(1.06–1.55)	0.01
<b>Work Hours</b>									
40 hours	1.00			1.00			1.00		
8 to 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 to 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 to 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 hours 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
<b>Occupation</b>									
Computer, engineering, and science							1.00		
Management, business and financial							1.17	(0.90–1.52)	0.23
Education, legal, community service, arts & 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

Factors	Model 1 *			Model 2 **			Model 3 ***		
	Adjusted OR	95% Conf	P	Adjusted OR	95% Conf	P	Adjusted OR	95% Conf	P
Production							11.00	(0.97–1.03)	0.97
Transportation and material moving							1.15	(0.82–1.63)	0.42

\* Model 1 is controlled for demographic characteristics and socioeconomic status.

\*\* Model 2 is controlled for demographic characteristics and socioeconomic status and other health-related factors.

\*\*\* Model 3 is controlled for demographic characteristics and socioeconomic status, other health-related factors and occupation.