



Published in final edited form as:

Workplace Health Saf. 2020 July ; 68(7): 346–354. doi:10.1177/2165079919897285.

The comorbidity of musculoskeletal disorders and depression: Associations with working conditions among hospital nurses

Yuan Zhang^a, Mazen ElGhaziri^a, Sarah Nasuti^a, Jeanne F. Duffy^b

^aSolomont School of Nursing, Zuckerberg College of Health Sciences, 113 Wilder Street, University of Massachusetts Lowell, Lowell, MA 01854.

^bDivision of Sleep and Circadian Disorders, Department of Medicine, Brigham and Women's Hospital, and Division of Sleep Medicine, Harvard Medical School, 221 Longwood Avenue, BLI438, Boston, MA 02115.

Abstract

Background: Musculoskeletal disorders (MSDs) are the leading cause of pain and disability among nurses and is frequently accompanied by depression. However, the association between the comorbidity of MSDs and depression on working conditions has not been studied, which was the aim of this study.

Methods: In 2015, all nurses (n=1,102) employed at a community hospital in the northeast U.S. were invited to participate in this cross-sectional study. A survey was distributed in which participants were asked to report on MSDs, depressive symptoms, as well as subjective working conditions assessed including physical demands, psychological demands, decision authority, social support, and work-family conflict.

Findings: 397 nurses responded (36%), and the prevalence of the comorbidity of MSDs and depression was 14.5%. Poisson regression models suggested that work-family conflict was associated with increased risk of the comorbidity (PR=2.18; 95% CI: 1.33–3.58), as was 8-hour night shift (PR=2.77; 95% CI: 1.22–6.31) or 12-hour day shift (PR=2.20; 95% CI: 1.07–4.50). Other working conditions were not directly associated with the comorbidity.

Conclusions/Application to Practice: The comorbidity of MSDs and depression is prevalent among hospital nurses, and work-family conflict and night or longer shift were significantly associated with this. Effective workplace programs are needed to address nurses' working conditions in order to reduce their work-family conflict, thereby improving their musculoskeletal and mental health.

Corresponding Author: Address correspondence to Yuan Zhang, PhD, RN, Solomont School of Nursing, Zuckerberg College of Health Sciences, 113 Wilder Street, University of Massachusetts Lowell, Lowell, MA 01854., Yuan_Zhang@uml.edu Telephone: 978-934-4421 Fax number: 978-934-2015.

IRB Protocol Number:

This study was approved by the Institutional Review Boards at Lowell General Hospital and the University of Massachusetts Lowell (No. 2015-001).

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Keywords

work-family conflict; musculoskeletal disorders; depressive symptoms; job demands; job control

Background

Musculoskeletal disorders (MSDs) are the leading cause of pain and disability in the United States (U.S.) workforce (Bureau of Labor Statistics, 2016). Nursing is among the highest-risk occupations for MSDs, which account for nearly half of the total injury and illness cases that occur in this occupational group annually (Bureau of Labor Statistics, 2016). The hospital setting ranks as the top most expensive for occupational injuries and illnesses among more than 300 U.S. industries, with nurses contributing to the greatest costs (Dressner, 2017). MSDs among nurses are associated with high direct and indirect costs with respect to workers' compensation claims, lost workdays, and job turnover (Shraim, Cifuentes, Willetts, Marucci-Wellman, & Pransky, 2015). The indirect costs associated with MSDs, such as increased nurse turnover and reduced work productivity, can increase the total costs by two to four times (Hunter, Branson, & Davenport, 2010). For example, the estimated costs associated with replacing a nurse who leaves the profession, including recruiting, hiring, and productivity loss and training, can range from \$27,000 to \$103,000 per nurse (Li & Jones, 2013). The direct and indirect expenditures resulting from MSDs in the general public were estimated to be 5.7% of the national gross domestic product in the United States (United States Bone and Joint Decade, 2014).

Nurses are susceptible to MSDs because they are exposed to heavy lifting, transferring, and repositioning of patients; frequent bending and twisting of their body; and a rapid work pace with patient handling conferring the highest risk for MSDs (Yassi & Lockhart, 2013). Irregular and long work hours lead to insufficient recovery between shifts, exacerbating MSDs among nurses (Caruso & Waters, 2008). Psychosocial work factors may have small but significant lagged effects on the development of MSDs (Lang, Ochsmann, Kraus, & Lang, 2012). A literature review and meta-analysis found that high psychosocial demands (aspects of the job that require sustained psychological effort or skills), low job control (the ability to influence what happens in the work environment), low social support, and effort-reward imbalance were associated with prevalent and incident MSDs in hospital nurses and nursing aides (Bernal et al., 2015).

Depression has been identified as the second leading cause of disability in the U.S. (US Burden of Disease Collaborators, 2013). With work responsibilities around the clock and high occupational stress (Geiger-Brown & Lipscomb, 2010), nurses suffer a higher incidence of depressive symptoms relative to the general U.S. adult population (Letvak, Ruhm, & McCoy, 2012), which may lead to a high rate of burnout, absenteeism, and turnover (Gilmartin, 2013; Khamisa, Oldenburg, Peltzer, & Ilic, 2015). Work stress has been reported as a strong predictor of depression in different occupational groups (Ganster & Rosen, 2013; Wang, Patten, Currie, Sareen, & Schmitz, 2012), including nurses (Khamisa, Peltzer, & Oldenburg, 2013; Lin, Lin, Cheng, Wu, & Ou-Yang, 2016). Generally, work stress is negatively related to psychological wellbeing and health among nurses (Khamisa,

Oldenburg, Peltzer, & Ilic, 2015). Specifically, high job demands (aspects of the job that requires sustained physical and/or psychological effort or skills), low job control, and lack of social support were associated with mental health problems among nurses (Friemann & Merisalu, 2015; Roelen et al., 2018).

Work-family conflict is a type of interrole conflict experienced when role pressures from the work and family domains are incompatible with one another (Greenhaus & Beutell, 1985). Previous studies have reported a significant association between work-family conflict and depressive symptoms among nurses (Hao, Wu, Liu, Li, & Wu, 2015; Sugawara et al., 2017) and other healthcare professionals such as nursing assistants (Zhang, Punnett, & Nannini, 2017) and physicians (Hao, Wang, Liu, Wu, & Wu, 2016). Studies have also reported possible effects of work-family conflict on musculoskeletal pain in nurses (Baur, Grebner, & Blasimann, 2018; Nutzi, Koch, Baur, & Elfering, 2015) and other patient care workers (Kim et al., 2013).

Comorbidity describes the simultaneous presence of two or more disorders or illnesses in one person. MSDs are frequently accompanied by comorbid symptoms such as depression (Baek, Kim, & Yi, 2015). Previous studies have reported that employees with depression were more likely to develop MSDs (Del Campo, Romo, de la Hoz, Villamor, & Mahillo-Fernandez, 2017); and similarly, depression was found to be more prevalent in employees with MSDs relative to employees without MSDs (Baek et al., 2015). The comorbidity of MSDs and depression (Amin, Quek, Oxley, Noah, & Nordin, 2018; Del Campo et al., 2017), if existing in nurses, may cause negative safety and health outcomes for both nurses themselves and their patients, given nurses' responsibility in providing most of the front-line care to patients.

Although the effect of work stress on physical outcomes such as MSDs or mental outcomes such as depression has been studied in nurses, little research has described the prevalence of the comorbidity of MSDs and depression in hospital nurses, nor has any research examined the association of this particular comorbidity (MSDs and depression) with physical and psychosocial working conditions. Therefore, the objectives of this study were to describe the prevalence of the comorbidity of MSDs and depression in hospital nurses, and to examine the association of this comorbidity with a range of physical and psychosocial working conditions among hospital nurses.

Methods

Study Participants

We employed a cross-sectional study in which data were collected from a sample of registered nurses (RNs) and licensed practical nurses (LPNs) at an independent, not-for-profit community hospital in the northeast U.S. in March 2015. A non-probability convenience sampling method was used to recruit study participants. All RNs and LPNs over 18 years of age and working full-time, part-time, or per-diem in the hospital were eligible to participate (n=1,102). This work is part of a larger study in which details have been published elsewhere (Zhang, Duffy, Ronan de Castellero & Wang, 2018).

Recruitment and Data Collection

Study recruitment flyers were posted in each hospital unit two weeks before the onsite survey collection. Paper surveys were distributed and collected by the research team over five days at the Annual Nurse Skill Days in March 2015, which all nurses at the hospital were required to attend. The study purpose, procedures, and potential benefits and risks were explained to the participants in person and they were requested to complete the survey onsite. Participants were assured that their employer would not receive any identifying information from the surveys, and that participation in the study would not affect their work status. Participants received a compensation of \$5 cash for completing the survey. The study was approved by the Institutional Review Boards at the hospital and at the University of Massachusetts Lowell (No. 2015–001).

Study Measures

Musculoskeletal disorders (MSDs) were assessed for six body regions: low back, shoulder, neck, wrist/forearm, knee, and ankle/feet (Zhang, Punnett, McEnany, & Gore, 2016). Participants were asked to rate the severity of pain in the past week for each of the six body regions. A five-point Likert scale was used to categorize the answers (1=none; 2=mild; 3=moderate; 4=severe; and 5=extreme). MSDs was defined as “yes” for participants who reported moderate, severe, or extreme pain (3 on a 1–5 scale) in any region (Zhang et al., 2016).

Depression was assessed with the Center for Epidemiologic Studies Depression Scale (CES-D) (Radloff, 1977), the 10-item version (Andresen, Malmgren, Carter, & Patrick, 1994). This scale is used to identify current depressive symptomatology in individuals aged 18 years and older during the past week Each item is rated on a 4-point Likert scale (0=rarely or none of the time; 1=some or a little of the time; 2=occasionally or a moderate amount of the time; and 3=most or all of the time) with a range in total score from 0 to 30, with higher scores indicating greater severity of depressive symptomatology. A total score of 10 or more is indicative of depression (Andresen et al., 1994). The scale demonstrated acceptable reliability for this study sample (Cronbach’s alpha=0.77).

Participants were defined as having comorbidity of musculoskeletal disorders and depression if they had both MSDs (score ≥ 3) and depression (CES-D ≥ 10).

Working conditions was measured using the Job Content Questionnaire (JCQ) (Karasek et al., 1998). The physical demands (5 items), psychological demands (4 items), job control (3 items), and social support (4 items) items were selected from the subscales. The JCQ subscales have demonstrated good validity and acceptable reliability in large study populations from six countries (Karasek et al., 1998). Work-family conflict was assessed with the interrole conflict scale from the original instrument, measured with three items from Kopelman et al. (Kopelman, Greenhaus, & Connolly, 1983). The three items asked whether, “After work I come home too tired to do some of the things I’d like to do,” “On the job, I have so much work to do that it takes away from my personal interests,” and “My family and/or friends dislike how often I am preoccupied with my work while I am at home.” All three items were assessed using a 4-point Likert scale (1=strongly disagree;

2=disagree; 3=agree; and 4=strongly agree). The three items were averaged to give a mean score, with a higher score indicating more work-family conflict.

Nurses mainly worked permanent shifts at the study hospital. Participants' were asked to provide their primary work schedule with the choices including an 8-hour day (7am-3pm), 8-hour evening (3pm-11pm), 8-hour night (11pm-7am), 12-hour day (7am-7pm), 12-hour evening (including schedules of 9am-9pm, 11am-11pm, and 12pm-12am), and 12-hour night shifts (including schedules of 7pm-7am and 3pm-3am).

The survey collected information on nurses' socio-demographics, including age, gender, race, height and weight, and frequency of exercise. Body Mass Index (BMI) was calculated from self-reported weight and height, expressed as weight/height² and was categorized as normal (<25.0 kg/m²), overweight (25–29.9 kg/m²), or obese (≥ 30 kg/m²). Frequency of exercise was measured with one single item "How many times a week on average do you exercise to work up a sweat (at least 20 minutes per session, for example, fast walking, jogging, bicycling, swimming, rowing, etc.)?" on a 5-point Likert scale (0=None; 1=less than once/week; 2=1–2 times/week; 3=3 times/week; and 4=more than 3 times/week). Regular exercise was defined as "exercised three or more times per week."

Data Analysis

All analyses were conducted using SPSS software 24.0. The associations of the comorbidity of MSDs and depression (yes or no) with socio-demographics and working conditions were examined using t-tests (comparing means) and chi-squared tests (comparing categorical variables) (Field, 2013). Correlations among working conditions were examined using Spearman correlations (Rho), given that some of the variables were not continuous or not normally distributed (Field, 2013).

Given the prevalence of the comorbidity in the study participants was 14.5%, Poisson regression modeling with robust variance estimate was used for these analyses (Barros & Hirakata, 2013), because it is more conservative and accurate than logistic regression modeling, and it was therefore used to calculate prevalence ratios among groups, and to investigate potential confounding (Barros & Hirakata, 2003). Multivariate modeling was employed to identify working conditions associated with the comorbidity was adjusted for age, gender, race, BMI and regular exercise. Further, the effect modification of age (≤ 40 vs. >40) on the association between working conditions and the comorbidity was examined in the Poisson regression modeling. Two-tail significance level was reported at $p < 0.05$.

Results

A total of 397 RNs and LPNs completed the survey in March 2015 (response rate: 36%). The participants were primarily (95.2%) middle-aged women (Table 1). More than half (55.6%) of the participants were overweight or obese, and over half (56.9%) reported not exercising regularly. Over one-third (35.9%) of these participants worked 8-hour days, 13.7% worked 8-hour evenings, 6.9% worked 8-hour nights, 20.1% worked 12-hour days, 3.6% worked 12-hour evenings, and 19.8% worked 12-hour nights.

Nearly half (47.4%) of the participants reported MSDs (moderate, severe, or extreme pain in one or more body regions). Musculoskeletal pain (mild, moderate, severe, or extreme pain) was reported in the following body regions: low back (63.0%), shoulder (42.4%), neck (50.6%), wrist/forearm (24.2%), knee (35.0%), and ankle/feet (39.3%). Nearly one-quarter (24.4%) reported depression (CES-D 10), with 14.5% prevalence with the comorbidity of MSDs and depression.

Significant associations were found between the comorbidity with job control (8.6 ± 1.4 vs. 9.2 ± 1.4 , $t = -2.82$, $p < 0.01$) and work-family conflict (2.8 ± 0.6 vs. 2.4 ± 0.5 , $t = 4.47$, $p < 0.01$). Although nurses with the comorbidity worked more on 8-hour nights (10.9% vs. 6.5%) or 12-hour days (30.9% vs. 19.0%) compared to nurses without the comorbidity, the association between shift work and the comorbidity was not significant (Chi-square=8.62, $p = 0.13$).

Significant correlations were found between work-family conflict with physical demands (Rho=0.25, $p < 0.01$), psychological demands (Rho=0.31, $p < 0.01$), and job control (Rho=-0.15, $p < 0.01$) (data not shown). Younger age was significantly associated with more work-family conflict ($t = 2.47$, $p < 0.05$) and higher depression score ($t = 3.13$, $p < 0.01$), but was not associated with MSDs (Chi-square=0.57, $p > 0.05$) or the comorbidity (Chi-square=0.76, $p > 0.05$) (data not shown).

For the multivariate analysis, work-family conflict was significantly associated with the comorbidity (PR=2.18; 95% CI: 1.33–3.58) after adjusting for covariates (Table 2). With every one-unit increase of work-family conflict, the prevalence of the comorbidity increased by 118%. Compared to 8-hour days, nurses working 8-hour nights (PR=2.77; 95% CI: 1.22–6.31) or 12-hour days (PR=2.20; 95% CI: 1.07–4.50) reported higher prevalence of the comorbidity. Age, gender, race, BMI, regular exercise, and physical demands, psychological demands, job control, and social support were not significantly associated with the comorbidity.

The effect modification of age on the association between work-family conflict and the comorbidity by age (< 40 years versus >40 years) was not statistically significant (PR=1.10; 95% CI: 0.41–2.93) (data not shown), suggesting age was not an effect modifier of this association.

Discussion

In this study, nearly half of the nurses reported MSDs in at least one of the six body regions. Consistent with previous studies, we found that the reported prevalence of musculoskeletal pain in nurses was greatest in the lower back, followed by the neck and shoulders (Davis & Kotowski, 2015). One quarter of these nurses reported depressive symptoms in the past week, which is a higher prevalence than that reported from the general population in the U.S. (Centers for Diseases Control and Prevention, 2013), and a higher prevalence than that reported from a random sample of hospital nurses (Letvak et al., 2012). The prevalence of the comorbidity of MSDs and depression was 14.5% in the study sample. A previous study with over 6,500 Danish female healthcare workers reported an 18% comorbidity including

one or more musculoskeletal pain locations and medium or higher levels of depressive symptoms (Melkevik et al., 2018). The comorbid pain and depression have been widely reported in the patient population (Goesling, Clauw, & Hassett, 2013). This comorbidity should be of particular concern to hospital administrators and other employers, because either symptom or their comorbidity could have critical implications for the safety and health of nurses themselves and their patients, considering nurses' role in direct contact with patients and providing most of the front-line services in hospitals. Nurses' ability to physically and mentally function at a high level is essential to ensure a high quality of care and patient safety.

As expected, work-family conflict was significantly associated with the comorbidity of MSDs and depression among nurses. Nurses, as formal caregivers at work and informal caregivers at home, are often engaged in multiple work and family responsibilities and therefore have a high risk for work-family conflict and negative outcomes (Cortese, Colombo, & Ghislieri, 2010). Previous studies have reported the high prevalence of both family interference with work and work interference with family among nurses (Alazzam, AbuAlRub, & Nazzal, 2017). Work-family conflict was previously reported to be associated with poor physical health such as musculoskeletal pain (Kim et al., 2013) and poor mental health such as depressive symptoms (Hao et al., 2015) in nurses. One study reported that work-to-family conflict was a strong predictor of MSDs, and this association was mediated by work stress (Hammig, Knecht, Laubli, & Bauer, 2011). Nützi et al. (2015) reported that work-family conflict significantly predicted lumbar and cervical pain, which are the most prevalent musculoskeletal complaints among operating room nurses. Two meta-analyses have reported significant correlations between work-family conflict and mental health outcomes including depression (Amstad, Meier, Fasel, Elfering, & Semmer, 2011).

As expected, compared to 8-hour day shift, nurses working 8-hour night shift and 12-hour day shift reported a higher prevalence of the MSDs-depression comorbidity. Shift work, especially night shift and long work hours, have been associated with increased risk for a wide range of chronic diseases (Caruso, 2014). A systematic review has identified eight studies which linked long work hours to adverse musculoskeletal disorders (Caruso & Waters, 2008). Another systematic review and meta-analysis reported that night shift work was significantly associated with an increased risk of depression (Lee et al., 2017).

In contrast to our expectation, this study did not find an association of the MSDs-depression comorbidity with any of the other working conditions we tested (physical demands, psychological demands, job control, and social support). However, work-family conflict, specifically the work interference with family life assessed in this study, may be greatly affected by these working conditions. For example, work-family conflict was significantly associated with physical demands, psychological demands, and job control in this study sample. Yildirim and Aycan (2008) found that heavy workload and demanding work schedules were important predictors of work-to-family conflict, which was associated with lower job and life satisfaction among nurses. This finding indicates that while some working conditions may not directly affect the comorbidity, they may indirectly contribute to the comorbidity through work-family conflict. Previous studies have recommended that increasing employee control over work assignments (job control) and supportive behaviors

from supervisors (social support) may buffer the negative influence of work-family conflict on employees' health and well-being (Kelly, Moen, & Tranby, 2011; Kossek, Pichler, Bodner, & Hammer, 2011).

In this study, age was not observed as an effect modifier in the association between work-family conflict and the comorbidity, suggesting that the association between work-family conflict and the comorbidity was not different in either age group (40y vs. >40y). As expected in this study, nurses of 40 years or younger reported more work-family conflict than nurses over 40 years, likely due to childcare responsibilities. In addition, nurses 40 years or younger reported higher depression than nurses over 40, likely due to better coping abilities and strategies with irregular work schedules and work stress among older and experienced nurses (Chiang & Chang, 2012), or older nurses who became depressed may have terminated their jobs and are not reflected in our sample. However, there was no difference reported in the prevalence of MSDs or the comorbidity between the two age groups. Previous studies have reported potential higher prevalence of MSDs in older nurses (Trinkoff, Lipscomb, Geiger-Brown, Storr, & Brady, 2003), for example, Trinkoff et al. reported a significant positive association between age (>40y) and shoulder complaints in nurses.

The strengths of this study are the consideration of a variety of physical and psychosocial working conditions, the adjustment for multiple confounders, and the testing of age as an effect modifier in the data analyses. This study has several limitations. First, although the study avoids some possible confounders at the organizational level because all nurses were employed by a single not-for-profit community hospital, the generalizability of the findings is limited as a result. Second, the response rate of 36% is comparatively low, which may have led to a selection bias of the nursing population. A follow-up study using a more nationally representative, random sample would improve the generalizability of the study findings. Lastly, definitive conclusions about causal relationships cannot be drawn with a cross-sectional design. Future analyses of longitudinal data would be desirable to verify the study findings.

Implications for Occupational Health Nursing Practice

This quantitative cross-sectional study found that the comorbidity of MSDs and depression is prevalent among hospital nurses, and work-family conflict and night or longer shift were significantly associated with the comorbidity. The results from the study suggest that, in addition to efforts that directly address prevention of MSDs and depression, future workplace education and training programs that reduce work-family conflict or help nurses cope better with night or longer shifts may also be able to reduce the MSD-depression comorbidity indirectly, thereby promoting the physical and mental health of nurses.

In addition to structuring work schedules to allow sufficient recovery between shifts, workplaces may provide education to nurses on coping strategies with night or longer shifts and behavior or life style changes to adapt to shift work. It has been reported that the health effect of irregular shift is less severe when it is selected by nurses (Buessing, 1996), therefore, providing nurses with the authority to choose their work shifts may reduce the negative health and safety consequences resulting from it.

Workplace programs should involve both the organization and nurses themselves in the prevention and intervention of work-family conflict. Previous studies have suggested that enhancing career development opportunities, encouraging nurses to participate in policy decisions, and supporting nurses' communication about risks at work and active participation in safety and health activities may reduce their demands at work and in turn reduce work-family conflict (Camerino et al., 2010; Leineweber, Chungkham, Westerlund, Tishelman, & Lindqvist, 2014). Nursing management should be actively involved in the process of reducing nurses' work-family conflict through supporting staff in achieving collective goals, modeling effective work-family management strategies, and providing useful information and advice (Gillet, Fouquereau, Bonnaud-Antignac, Mokoukolo, & Colombat, 2013). In addition, developing hospital policies and practices to facilitate the successful combination of work with family life for nurses would promote better work-family balance, and promote a better and more collaborative atmosphere between coworkers, which may itself have positive effects on the safety, health, and productivity of the workforce (Leineweber et al., 2014).

Since we found that work family conflict was associated with physical demands, psychological demands and job control, our study suggests that to reduce nurses' work-family conflict, organizations could involve nurses in making decisions about work activities; reduce nurses' work load through increasing staffing; genuinely listen to nurses' expectations and opinions when difficulties arise from their work or family life; and provide an Employee Assistance Program (EAP) to nurses for psychological counseling. A specific focus on mitigating work-family conflict should be considered in future efforts to promote musculoskeletal and mental health in nursing employees.

Applying Research to Occupational Health Practice Insert/Box

This study provides innovative information about the prevalence of musculoskeletal disorders (MSDs)-depression comorbidity and its association with working conditions among hospital nurses. Both physical and mental health of nurses are critical because nurses' ability to physically and mentally function at a high level is essential to ensure a high quality of care and patient safety. The results from this study suggest that, in addition to efforts that directly address prevention of MSDs and depression, future workplace education and training programs that reduce work-family conflict or help nurses cope better with night or longer shifts may also be able to reduce the MSD-depression comorbidity indirectly, thereby promoting the physical and mental health of nurses. To reduce nurses' work-family conflict, workplaces may involve nurses in making decisions about work activities; reduce nurses' work load through increased staffing; genuinely listen to nurses' expectations and opinions when difficulties arise from their work or family life; and provide an Employee Assistance Program (EAP) to nurses for psychological counseling.

Funding:

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Yuan Zhang and Jeanne Duffy were supported by a grant from the National Institutes of Health (R01 AG044416). The funder played no role in the study design, data collection, data analysis, manuscript preparation, or decision to publish the report.

Author Biographies:

Yuan Zhang, PhD, RN is an Associate Professor of Nursing at the University of Massachusetts Lowell. Her research focuses on the broader effect of work environment on sleep quality, physical and mental health of healthcare workers; and workplace participatory interventions to improve employee health and safety.

Mazen ElGhaziri, PhD, MPH, RN is an Assistant Professor of Nursing at the University of Massachusetts Lowell. His research focuses on workplace violence prevention and its impact on physical and mental health of the healthcare and correctional workforce, with a bio-behavioral approach to preventive interventions.

Sarah Nasuti is a student nurse at the University of Massachusetts Lowell. She has worked as a research assistant on this study and is interested in research related to nurses' shift work, working conditions, and safety and health outcomes.

Jeanne F. Duffy, MBA, PhD is an Associate Professor of Medicine at Harvard Medical School and a Neuroscientist at Brigham and Women's Hospital. Her research focuses on understanding individual differences in sleep timing, duration, quality, and response to sleep loss, and exploring ways to improve sleep so as to reduce the risk of accidents, errors, and adverse health outcomes.

References

- AlAzzam M, AbuAlRub RF, & Nazzal AH (2017). The relationship between work-family conflict and job satisfaction among hospital nurses. *Nursing Forum*, 52, 278–288. doi:10.1111/nuf.12199 [PubMed: 28407250]
- Amin NA, Quek KF, Oxley JA, Noah R, & Nordin R (2018). Emotional distress as a predictor of work-related musculoskeletal disorders in Malaysian nursing professionals. *The International Journal of Occupational and Environmental Medicine*, 9, 69–78. doi:10.15171/ijoem.2018.1158 [PubMed: 29667644]
- Amstad FT, Meier LL, Fasel U, Elfering A, & Semmer NK (2011). A meta-analysis of work-family conflict and various outcomes with a special emphasis on cross-domain versus matching-domain relations. *Journal of Occupational Health Psychology*, 16, 151–169. doi:10.1037/a0022170 [PubMed: 21280939]
- Andresen EM, Malmgren JA, Carter WB, & Patrick DL (1994). Screening for depression in well older adults: Evaluation of a short form of the CES-D (Center for Epidemiologic Studies Depression Scale). *American Journal of Preventive Medicine*, 10, 77–84. [PubMed: 8037935]
- Baek JH, Kim YS, & Yi KH (2015). Relationship between comorbid health problems and musculoskeletal disorders resulting in musculoskeletal complaints and musculoskeletal sickness absence among employees in Korea. *Safety and Health at Work*, 6, 128–133. doi:10.1016/j.shaw.2015.03.002 [PubMed: 26106512]
- Barros AJ, & Hiraakata VN (2003). Alternatives for logistic regression in cross-sectional studies: An empirical comparison of models that directly estimate the prevalence ratio. *BMC Medical Research Methodology*, 3, 21. doi:10.1186/1471-2288-3-21 [PubMed: 14567763]
- Baur H, Grebner S, & Blasimann A (2018). Work-family conflict and neck and back pain in surgical nurses. *International Journal of Occupational Safety and Ergonomics*, 24, 35–40. doi:10.1080/10803548.2016.1263414 [PubMed: 27871209]
- Bernal D, Campos-Serna J, Tobias A, Vargas-Prada S, Benavides FG, & Serra C (2015). Work-related psychosocial risk factors and musculoskeletal disorders in hospital nurses and nursing aides: A

- systematic review and meta-analysis. *International Journal of Nursing Studies*, 52, 635–648. doi:10.1016/j.ijnurstu.2014.11.003 [PubMed: 25480459]
- Buessing A (1996). Social tolerance of working time scheduling in nursing. *Work & Stress*, 10, 238–250. doi:10.1080/02678379608256803
- U.S. Department of Labor, Bureau of Labor Statistics. (2016). Nonfatal Occupational Injuries and Illnesses Requiring Days Away From Work. Retrieved from https://www.bls.gov/news.release/archives/osh_11092017.pdf
- Camerino D, Sandri M, Sartori S, Conway PM, Campanini P, & Costa G (2010). Shiftwork, work-family conflict among Italian nurses, and prevention efficacy. *Chronobiology International*, 27, 1105–1123. doi:10.3109/07420528.2010.490072 [PubMed: 20636219]
- Caruso CC (2014). Negative impacts of shiftwork and long work hours. *Rehabilitation Nursing*, 39, 16–25. doi:10.1002/rmj.107 [PubMed: 23780784]
- Caruso CC, & Waters TR (2008). A review of work schedule issues and musculoskeletal disorders with an emphasis on the healthcare sector. *Industrial Health*, 46, 523–534. [PubMed: 19088404]
- Centers for Diseases Control and Prevention. (2013). Burden of mental illness. Retrieved from <https://www.cdc.gov/mentalhealth/basics/burden.htm>
- Chiang YM, & Chang Y (2012). Stress, depression, and intention to leave among nurses in different medical units: Implications for healthcare management/nursing practice. *Health Policy*, 108, 149–157. doi:10.1016/j.healthpol.2012.08.027 [PubMed: 23017221]
- Cortese CG, Colombo L, & Ghislieri C (2010). Determinants of nurses' job satisfaction: The role of work-family conflict, job demand, emotional charge and social support. *Journal of Nursing Management*, 18(1), 35–43. doi:10.1111/j.1365-2834.2009.01064.x [PubMed: 20465727]
- Davis KG, & Kotowski SE (2015). Prevalence of musculoskeletal disorders for nurses in hospitals, long-term care facilities, and home health care: A comprehensive review. *Human Factors*, 57, 754–792. doi:10.1177/0018720815581933 [PubMed: 25899249]
- Del Campo MT, Romo PE, de la Hoz RE, Villamor JM, & Mahillo-Fernandez I (2017). Anxiety and depression predict musculoskeletal disorders in health care workers. *Archives of Environmental & Occupational Health*, 72, 39–44. doi:10.1080/19338244.2016.1154002 [PubMed: 26895069]
- Dressner M (2017). Hospital workers: An assessment of occupational injuries and illnesses. *Monthly Labor Review*, U.S. Bureau of Labor Statistics. Retrieved from <https://www.bls.gov/opub/mlr/2017/article/pdf/hospital-workers-an-assessment-of-occupational-injuries-and-illnesses.pdf>
- Field AP (2013). *Discovering Statistics Using SPSS* London, England: SAGE Publications Ltd.
- Friemann T, & Merisalu E (2015). Work-related psychosocial risk factors and mental health problems amongst nurses at a university hospital in Estonia: A cross-sectional study. *Scandinavian Journal of Public Health*, 43, 447–452. doi:10.1177/1403494815579477 [PubMed: 25851017]
- Ganster DC, & Rosen CC (2013). Work stress and employee health: A multidisciplinary review. *Journal of Management*, 39, 1085–1122. doi:10.1177/0149206313475815
- Geiger-Brown J, & Lipscomb J (2010). The health care work environment and adverse health and safety consequences for nurses. *Annual Review of Nursing Research*, 28, 191–231.
- Gillet N, Fouquereau E, Bonnaud-Antignac A, Mokoukolo R, & Colombat P (2013). The mediating role of organizational justice in the relationship between transformational leadership and nurses' quality of work life: A cross-sectional questionnaire survey. *International Journal of Nursing Studies*, 50, 1359–1367. doi:10.1016/j.ijnurstu.2012.12.012 [PubMed: 23298792]
- Gilmartin MJ (2013). Thirty years of nursing turnover research: Looking back to move forward. *Medical Care Research and Review*, 70, 3–28. doi:10.1177/1077558712449056 [PubMed: 22679280]
- Goesling J, Clauw DJ, & Hassett AL (2013). Pain and depression: An integrative review of neurobiological and psychological factors. *Current Psychiatry Reports*, 15, 421. doi:10.1007/s11920-013-0421-0 [PubMed: 24214740]
- Greenhaus JH, & Beutell NJ (1985). Sources of conflict between work and family roles. *Academy of Management Review*, 10, 76–88. doi:10.5465/AMR.1985.4277352
- Hämmig O, Knecht M, Laubli T, & Bauer GF (2011). Work-life conflict and musculoskeletal disorders: A cross-sectional study of an unexplored association. *BMC Musculoskeletal Disorders*, 12, 60. doi:10.1186/1471-2474-12-60

- Hao J, Wang J, Liu L, Wu W, & Wu H (2016). Perceived organizational support impacts on the associations of work-family conflict or family-work conflict with depressive symptoms among Chinese doctors. *International Journal of Environmental Research and Public Health*, 13, 326. doi:10.3390/ijerph13030326
- Hao J, Wu D, Liu L, Li X, & Wu H (2015). Association between work-family conflict and depressive symptoms among Chinese female nurses: The mediating and moderating role of psychological capital. *International Journal of Environmental Research and Public Health*, 12, 6682–6699. doi:10.3390/ijerph120606682 [PubMed: 26075725]
- Hunter B, Branson M, & Davenport D (2010). Saving costs, saving health care providers' backs, and creating a safe patient environment. *Nursing Economic\$, 28*, 130–134. [PubMed: 20446387]
- Karasek R, Brisson C, Kawakami N, Houtman I, Bongers P, & Amick B (1998). The Job Content Questionnaire (JCQ): An instrument for internationally comparative assessments of psychosocial job characteristics. *Journal of Occupational Health Psychology*, 3, 322–355. [PubMed: 9805280]
- Kelly EL, Moen P, & Tranby E (2011). Changing workplaces to reduce work-family conflict: Schedule control in a white-collar organization. *American Sociological Review*, 76, 265–290. doi:10.1177/0003122411400056 [PubMed: 21580799]
- Khamisa N, Oldenburg B, Peltzer K, & Ilic D (2015). Work related stress, burnout, job satisfaction and general health of nurses. *International Journal of Environmental Research and Public Health*, 12, 652–666. doi:10.3390/ijerph120100652 [PubMed: 25588157]
- Khamisa N, Peltzer K, & Oldenburg B (2013). Burnout in relation to specific contributing factors and health outcomes among nurses: A systematic review. *International Journal of Environmental Research and Public Health*, 10, 2214–2240. doi:10.3390/ijerph10062214 [PubMed: 23727902]
- Kim SS, Okechukwu CA, Buxton OM, Dennerlein JT, Boden LI, Hashimoto DM, & Sorensen G (2013). Association between work-family conflict and musculoskeletal pain among hospital patient care workers. *American Journal of Industrial Medicine*, 56, 488–495. doi:10.1002/ajim.22120 [PubMed: 23019044]
- Kopelman RE, Greenhaus JJ, & Connolly TF (1983). A model of work, family, and interrole conflict: A construct validation study. *Organizational Behavior and Human Performance*, 32, 198–215. doi:10.1016/0030-5073(83)90147-2
- Kossek EE, Pichler S, Bodner T, & Hammer LB (2011). Workplace social support and work-family conflict: a meta-analysis clarifying the influence of general and work-family-specific supervisor and organizational support. *Personnel Psychology*, 64, 289–313. doi:10.1111/j.1744-6570.2011.01211.x [PubMed: 21691415]
- Lang J, Ochsmann E, Kraus T, & Lang JW (2012). Psychosocial work stressors as antecedents of musculoskeletal problems: A systematic review and meta-analysis of stability-adjusted longitudinal studies. *Social Science & Medicine*, 75, 1163–1174. doi:10.1016/j.socscimed.2012.04.015 [PubMed: 22682663]
- Lee A, Myung S, Cho JJ, J, Y., Yoon JL, & Kim MY (2017). Night shift work and risk of depression: Meta-analysis of observational studies. *Journal of Korean Medical Science*, 32, 1091–1096. doi:10.3346/jkms.2017.32.7.1091 [PubMed: 28581264]
- Leineweber C, Chungkham HS, Westerlund H, Tishelman C, & Lindqvist R (2014). Hospital organizational factors influence work-family conflict in registered nurses: Multilevel modeling of a nation-wide cross-sectional survey in Sweden. *International Journal of Nursing Studies*, 51, 744–751. doi:10.1016/j.ijnurstu.2013.09.010 [PubMed: 24144276]
- Letvak S, Ruhm CJ, & McCoy T (2012). Depression in hospital-employed nurses. *Clinical Nurse Specialist*, 26, 177–182. doi:10.1097/NUR.0b013e3182503ef0 [PubMed: 22504476]
- Li Y, & Jones CB (2013). A literature review of nursing turnover costs. *Journal of Nursing Management*, 21, 405–418. doi:10.1111/j.1365-2834.2012.01411.x [PubMed: 23406301]
- Lin TC, Lin HS, Cheng SF, Wu LM, & Ou-Yang MC (2016). Work stress, occupational burnout and depression levels: A clinical study of paediatric intensive care unit nurses in Taiwan. *Journal of Clinical Nursing*, 25, 1120–1130. doi:10.1111/jocn.13119 [PubMed: 26914523]
- Melkevik O, Clausen T, Pedersen J, Garde AH, Holtermann A, & Rugulies R (2018). Comorbid symptoms of depression and musculoskeletal pain and risk of long term sickness absence. *BMC Public Health*, 18, 981. doi:10.1186/s12889-018-5740-y [PubMed: 30081870]

- Murray CJ, & Lopez AD (1996). Evidence-based health policy--Lessons from the Global Burden of Disease Study. *Science*, 274, 740–743. [PubMed: 8966556]
- Nutzi M, Koch P, Baur H, & Elfering A (2015). Work-family conflict, task interruptions, and influence at work predict musculoskeletal pain in operating room nurses. *Safety and Health at Work*, 6, 329–337. doi:10.1016/j.shaw.2015.07.011 [PubMed: 26929846]
- Radloff LS (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*, 1, 385–401. doi:10.1177/014662167700100306
- Roelen CA, van Hoffen MFA, Waage S, Schaufeli WB, Twisk JWR, Bjorvatn B, ... Pallesen S (2018). Psychosocial work environment and mental health-related long-term sickness absence among nurses. *International Archives of Occupational and Environmental Health*, 91, 195–203. doi:10.1007/s00420-017-1268-1 [PubMed: 29032390]
- Shraim M, Cifuentes M, Willetts JL, Marucci-Wellman HR, & Pransky G (2015). Length of disability and medical costs in low back pain: Do state workers' compensation policies make a difference? *Journal of Occupational and Environmental Medicine*, 57, 1275–1283. doi:10.1097/JOM.0000000000000593 [PubMed: 26492383]
- Sugawara N, Danjo K, Furukori H, Sato Y, Tomita T, Fujii A, ... Yasui-Furukori N (2017). Work-family conflict as a mediator between occupational stress and psychological health among mental health nurses in Japan. *Neuropsychiatric Disease and Treatment*, 13, 779–784. doi:10.2147/ndt.s127053 [PubMed: 28331330]
- Trinkoff AM, Lipscomb JA, Geiger-Brown J, Storr CL, & Brady BA (2003). Perceived physical demands and reported musculoskeletal problems in registered nurses. *American Journal of Preventive Medicine*, 24, 270–275. [PubMed: 12657347]
- Khamisa N, Oldenburg B, Peltzer K, & Ilic D (2015). Work-related stress, burnout, job satisfaction and general health of nurses. *International Journal of Environmental Research and Public Health*, 12, 652–666. doi:10.3390/ijerph120100652 [PubMed: 25588157]
- United States Bone and Joint Decade. (2014). *The burden of musculoskeletal disease in the United States: Prevalence, societal, and economic cost, third edition*. Rosemont, IL: American Academy of Orthopedic Surgeons.
- US Burden of Disease Collaborators. (2013). The state of US health, 1990–2010: Burden of diseases, injuries, and risk factors. *The Journal of the American Medical Association*, 310, 591–608. doi:10.1001/jama.2013.13805 [PubMed: 23842577]
- Wang J, Patten SB, Currie S, Sareen J, & Schmitz N (2012). A population-based longitudinal study on work environmental factors and the risk of major depressive disorder. *American Journal of Epidemiology*, 176, 52–59. doi:10.1093/aje/kwr473 [PubMed: 22556191]
- Yassi A, & Lockhart K (2013). Work-relatedness of low back pain in nursing personnel: A systematic review. *International Journal of Occupational and Environmental Health*, 19, 223–244. doi:10.1179/2049396713Y.0000000027 [PubMed: 23885775]
- Yildirim D, & Aycan Z (2008). Nurses' work demands and work-family conflict: A questionnaire survey. *International Journal of Nursing Studies*, 45, 1366–1378. doi:10.1016/j.ijnurstu.2007.10.010 [PubMed: 18262529]
- Zhang Y, Punnett L, McEnany GP, & Gore R (2016). Contributing influences of work environment on sleep quantity and quality of nursing assistants in long-term care facilities: A cross-sectional study. *Geriatric Nursing*, 37, 13–18. doi:10.1016/j.gerinurse.2015.08.010 [PubMed: 26384714]
- Zhang Y, Punnett L, & Nannini A (2017). Work-family conflict, sleep, and mental health of nursing assistants working in nursing homes. *Workplace Health & Safety*, 65, 295–303. doi:10.1177/2165079916665397 [PubMed: 27794076]
- Zhang Y, Duffy JF, Ronan de Castellero E, & Wang K (2018). Chronotype, sleep characteristics, and musculoskeletal disorders among hospital nurses. *Workplace Health & Safety*, 66, 8–15. doi:10.1177/2165079917704671 [PubMed: 28732185]

Table 1.

Socio-demographics, working conditions, MSDs and depression among nurses (n=397)

Variables	Mean±SD or Percentage		
	Total	Comorbidity	Non-comorbidity
	(n=397)	(n=55)	(n=324)
Age	43.2±12.0	42.6±11.6	43.3±12.1
40y	42.0%	47.3%	41.0%
>40y	58.0%	52.7%	59.0%
Gender			
Female	95.2%	98.2%	94.7%
Male	4.8%	1.8%	5.3%
Race			
White	91.9%	89.1%	92.9%
Black	3.1%	1.8%	2.8%
Others	5.0%	9.1%	4.3%
Body Mass Index	26.8±6.0	27.2±6.8	26.6±5.8
Normal	44.4%	40.4%	45.3%
Overweight	31.9%	38.5%	31.0%
Obese	23.7%	21.2%	23.7%
Regular exercise (yes)	43.1%	37.0%	44.4%
Shift work			
8-hour day	35.9%	29.1%	36.4%
8-hour evening	13.7%	5.5%	15.6%
8-hour night	6.9%	10.9%	6.5%
12-hour day	20.1%	30.9%	19.0%
12-hour evening	3.6%	3.6%	3.4%
12-hour night	19.8%	20.0%	19.0%
Physical demands (range 5–20)	13.4±3.3	14.1±3.3	13.3±3.3
Psychological demands (range 4–16)	11.4±1.8	11.7±1.9	11.3±1.8
Job control (range 3–12)	9.1±1.4	8.6±1.4**	9.2±1.4
Social support (range 4–16)	12.1±1.9	11.8±1.8	12.2±1.9
Work-family conflict (range 1–4)	2.5±0.6	2.8±0.6**	2.4±0.5

Note.

*
 $p < 0.05$ **
 $p < 0.01$.

Nurses mainly work permanent shifts at the study hospital. 12-hour evening includes work schedules of 9am-9pm, 11am-11pm, and 12pm-12am. 12-hour night includes work schedules of 7pm-7am and 3pm-3am.

Physical demands, psychological demands, job control, social support were measured with items from the Job Content Questionnaire (Karasek et al., 1998). Work-family conflict was measured with items from Kopelman et al. (1983). Depression was measured with the Center for Epidemiologic Studies Depression Scale, the 10-item version (Andresen et al., 1994).

Table 2.

Multivariate robust Poisson regression models for the association between working conditions and the comorbidity of musculoskeletal disorders and depression among nurses (n=397)

Predictors	Model 1		Model 2	
	PR	95%CI	PR	95%CI
Work-family conflict	2.51 **	1.63–3.85	2.18 **	1.33–3.58
Physical demands	1.02	0.93–1.12	0.99	0.89–1.09
Psychological demands	0.98	0.84–1.14	0.98	0.85–1.13
Job control	0.90	0.75–1.08	0.90	0.75–1.07
Social support	0.93	0.80–1.09	0.96	0.81–1.13
Shift work				
8-hour day			1.00	
8-hour evening			0.66	0.20–2.20
8-hour night			2.77 *	1.22–6.31
12-hour day			2.20 *	1.07–4.50
12-hour evening			1.56	0.45–5.45
12-hour night			1.86	0.83–4.18

Note.

*
 $p < 0.05$

**
 $p < 0.01$.

Model 2 was also adjusted for age, gender, race, BMI, and regular exercise, which were not associated with the comorbidity.