Nursing Research • January/February 2013 • Vol 62, No 1, 36–44

Risk Perception of Musculoskeletal Injury Among Critical Care Nurses

Soo-Jeong Lee ▾ Julia Faucett ▾ Marion Gillen ▾ Niklas Krause ▾ Lynette Landry

▶ **Background:** Nursing is known as an occupation with high risk of musculoskeletal injury. Nurses' perceptions about the risk of injury may have a role in preventing such injury.

▶ **Objectives:** The aim of this study was to investigate how nurses perceived the risk of musculoskeletal injury from work and identify factors associated with their risk perception.

▶ **Methods:** In a cross-sectional study using a postal survey, 361 critical care nurses reported on risk perception, physical workload, psychosocial job factors, safety climate, musculoskeletal symptoms, and safe work behavior.

▶ **Results:** Of all critical care nurse respondents, 83% perceived that they were more likely than not to have a musculoskeletal injury within 1 year. On average, nurses perceived the risk of musculoskeletal injury as lower to themselves than to coworkers. This more positive perception of risk to self had stronger correlations with symptom experiences. Multiple linear regression analysis revealed that higher risk perception of injury was associated with greater job strain, greater physical workload, lack of availability of lifting devices or lifting teams, and more symptoms.

▶ **Discussion:** Study findings indicated that most critical care nurses were concerned about their ergonomic job risks. Their risk perceptions about musculoskeletal injury risk were affected by physical work exposures, psychosocial job stressors, and experience with musculoskeletal symptoms, but not by perceived workplace safety climate. The findings underscore the need for management efforts to improve physical and psychosocial working conditions and create a safe work environment.

▶ **Key Words:** job strain · injury · musculoskeletal · nursing · patient handling · risk perception

Musculoskeletal (MSK) injuries remain a major occupational health problem among nurses. In 2010, 10,900 registered nurses in the United States had MSK problems leading to lost workdays, with the incidence rate of 53.8 per 10,000 full-time equivalents and the median of 7 days of work loss (Bureau of Labor Statistics, 2011). Critical care nurses are among the highest risk groups for MSK injury (Goldman, Jarrard, Kim, Loomis, & Atkins, 2000). Critical care nurses provide care for patients who are physically dependent and in need of complex medical interventions and frequent bedside procedures and are often required to handle heavy equipment and perform patient handling with limited space between patient beds and equipment (Carayon, Alvarado, & Systems Engineering Initiative for Patient Safety, 2007). Such working conditions contribute to the risk of MSK injury. Among hospital units, intensive care units (ICUs) have been shown to experience the greatest shortage of nurses (Buerhaus, Staiger, & Auerbach, 2000). Stone et al. (2006) reported that 17% of ICU nurses intended to leave their jobs in the coming year, mostly because of poor work environments. In a study of critical care nurses (Lee, 2007), 6.1% of nurses reported having changed jobs due to low back pain. Therefore, preventing MSK injuries is imperative for the well-being of individuals and for retaining healthy nursing workforce.

Intervention programs have been implemented to reduce the risk of MSK injury. Interventions using patient-handling devices or lifting teams and particularly multifaceted programs including lift equipment, training, ergonomic assessment, and no lift policy have been shown to be effective in reducing the risk of MSK injury (Black, Shah, Busch, Metcalfe, & Lim, 2011; Charney, 1997; Collins, Wolf, Bell, & Evanoff, 2004; Hignett, 2003; Nelson et al., 2006; Yassi et al., 2001). In 2003, the American Nurses Association (ANA) launched a campaign called *Handle With Care* to prevent MSK injuries among nurses, and the group has promoted education and legislative efforts (ANA, 2012). Since 2006, 10 states have enacted legislations requiring the development and implementation of safe patient-handling programs and policies. In 2009, a curriculum of safe patient-handling training for nursing schools was developed through collaborative efforts (ANA, 2012). All these efforts contribute to creation of safer work environments. However, existing interventions do not eliminate ergonomic risks to nurses, and occupational injury statistics continue to show that MSK injuries are a significant problem. Therefore, to protect their safety and health, individual nurses need to assess their risks of MSK injury

Soo-Jeong Lee, PhD, RN, ANP, *is Assistant Professor;* ***Julia Faucett, PhD, RN, FAAN,*** *is Professor Emerita; and* ***Marion Gillen, RN, MPH, PhD,*** *is Clinical Professor, School of Nursing, University of California, San Francisco.*

Niklas Krause, MD, MPH, PhD, *is Professor, School of Public Health, University of California, Los Angeles.*

Lynette Landry, PhD, RN, *is Associate Professor, School of Nursing, San Francisco State University, California.*

DOI: 10.1097/NNR.0b013e31827334d6

properly while performing patient care tasks, especially in dynamic and often unpredictable work environments.

Perception of risk has been proposed as a determinant for preventive health behaviors in a number of behavioral theories such as the Health Belief Model and Protection Motivation Theory (Rogers, 1975; Rosenstock, Strecher, & Becker, 1988). Adequate perception of occupational risks can be expected to function as a motivator for adopting safe work behaviors. Although many studies failed to demonstrate their significant association (Lee, Faucett, Gillen, Krause, & Landry, 2010; Rickett, Orbell, & Sheeran, 2006; Rundmo, 1996; Seo, 2005), understanding risk perception of workers can be useful in designing intervention programs. In addition, risk perception studies have identified an optimistic tendency to perceive a risk lower to oneself than to others (Caponecchia & Sheils, 2011; Weinstein, 1987). Caponecchia and Sheils (2011) reported that such an optimistic bias was not associated with a reduction in safe work behaviors in their construction worker study but noted that it could present a significant problem of reducing the efficacy of safety programs.

Musculoskeletal injuries have been identified as one of the top health and safety concerns among nurses (ANA, 2001). However, no in-depth research was found about nurses' risk perceptions of MSK injury, and occupational determinants of their risk perceptions have not been explored. Nurses' perceptions of occupational risk have been studied mostly with regard to infectious diseases such as influenza and severe acute respiratory syndrome (Koh, Hegney, & Drury, 2012; Leppin & Aro, 2009; Listyowardojo, Nap, & Johnson, 2010). For MSK injury, one researcher investigated risk perception among general women workers and identified associated factors such as bodily pain, physical exposure, perceived seriousness and controllability of risk, and perception of risk to other (Landry, 2006).

The purpose of this study of critical care nurses was to investigate how nurses perceived their risk of work-related MSK injury and to identify factors that influenced their risk perceptions. This study also explored differences in perceptions of risk between to self and to others.

Conceptual Framework

This study was based on the conceptual framework of work-related MSK disorders presented in Figure 1. The framework was developed by Lee (2007) to integrate risk perception and work behavior with main concepts in previous theoretical or epidemiological models of work-related MSK disorders. Proposed in the framework are physical and psychosocial job factors as two main risk factors for work-related MSK disorders. Physical job factors (e.g., patient handling) refer to physical workload with ergonomic risk factors such as force, posture, and repetition. Psychosocial factors refer to nonphysical work factors such as job demand, job control, and supervisor and coworker support. The physical and psychosocial job factors are influenced by macrolevel workplace organizational factors (e.g., facility characteristics, management commitment to safety, safety culture, and staffing). There is an abundance of literature supporting the associations of MSK injuries or symptoms with physical and psychosocial factors (Bernard, 1997; Gillen et al., 2007; Josephson, Lagerström, Hagberg, & Wigaeus Hjelm, 1997). Organizational climate has also been shown to be associated with work-related injury (Eriksen, Bruusgaard, & Knardahl, 2004; Felknor, Aday, Burau, Delclos, & Kapadia, 2000; Stone & Gershon, 2006). The effects of physical and psychosocial factors potentially are mediated by internal biomechanical (e.g., tissue strength or tolerance to the load), physiological, and psychological responses and, ultimately, may cause MSK injuries, symptoms, or illnesses. Perception and behaviors of the worker may modify the effect of the risk factors on the MSK outcome; the perception and behaviors may be affected also by occupational factors.

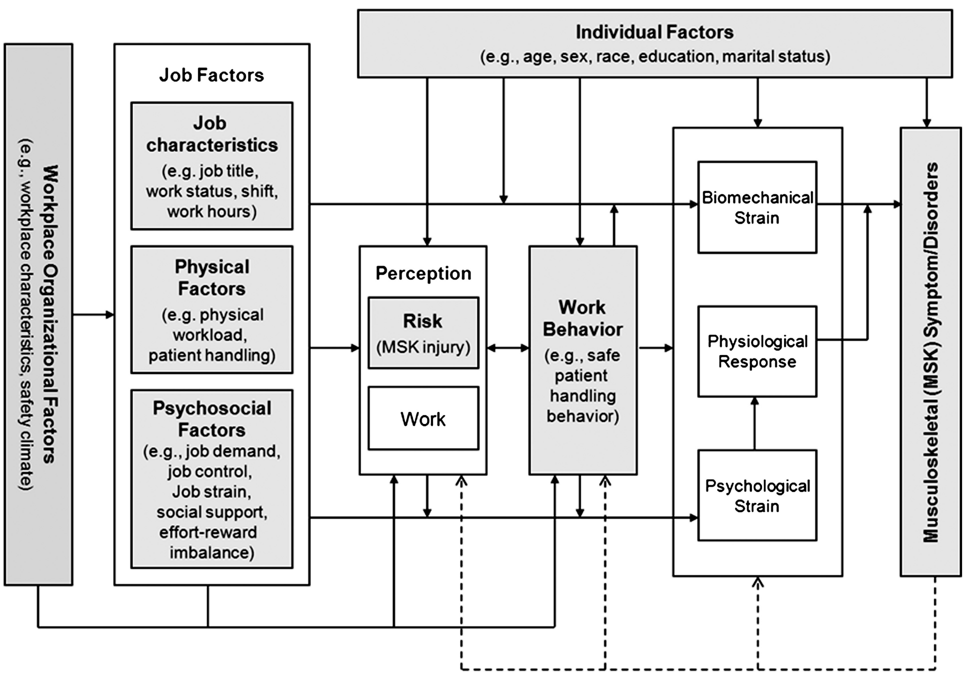

FIGURE 1. A conceptual framework for work-related musculoskeletal disorders.

Methods

Sample

The study population consisted of 1,000 critical care nurses randomly selected from a 2005 American Association of Critical Care Nurses (AACN) membership list. Eligibility was restricted to staff or charge nurses who were employed currently in hospitals and who performed patient-handling tasks, excluding those in nonhospital settings and in practice areas where nurses are unlikely to engage in complex patient-handling tasks (e.g., outpatient clinics, cardiac rehabilitation, and hemodialysis). A total of 412 nurses returned completed questionnaires (response rate = 41.5%, excluding eight for whom mailing addresses were incorrect). Of these, 47 nurses who did not meet the inclusion criteria were excluded: not currently employed (n = 5); not employed in a hospital (n = 1); not employed in critical care (n = 8); not a staff or charge nurse (n = 28); or not perform patient-handling tasks (n = 5). In addition, four nurses employed in a neonatal ICU were excluded because of the different nature of their physical workload.

The final sample for data analysis comprised 361 critical care nurses; the mean age of the respondents was 47.3 years (*SD* = 8.8), and the mean job tenure in nursing was 22.5 years (*SD* = 9.3). Of the sample, 93% were women, 83% were White, 74% were married, and 58% had a bachelor's degree. Among the respondents, 74% were staff nurses, 75% worked full time, 59% worked on the day shift, 55% worked for nonprofit community hospitals, 88% worked in urban or suburban areas, 81% worked in ICUs, and 19% worked in non-ICU units (e.g., emergency room, progressive care unit, postanesthesia care unit, and telemetry). Seven percent of the sample worked in a hospital where a lift team was available, and 47% worked on a unit where a lift device was available.

Data Collection

The study was approved by the Committee on Human Research at the University of California, San Francisco. The mail survey was conducted between January and July 2006. The mailed survey packet contained an information letter, a study questionnaire, and a refusal postcard. The mailing was conducted in two waves. The Wave 1 mailing (n = 320) was conducted to evaluate the reliability and validity of measures developed by the researchers and also to estimate a response rate among the study population. In Wave 2, 680 new subjects were invited. Postal reminders were sent in 2-week intervals up to five times. Early respondents received a small-denomination gift card.

Variables and Instruments

The study questionnaire included items on demographics (age, gender, race, weight, height, and education), job characteristics (current status of employment, job title, years worked in nursing, types of units, work status, work schedule, hours worked per shift, hours worked per 2-week pay period, and breaks per shift), and workplace characteristics (hospital type, hospital setting, and availability of lift devices or a lift team). The questionnaire also included measures for risk perception, safety climate (organizational factor), physical and psychosocial work factors, safe work behavior, and MSK symptoms.

Risk perception was assessed using the Risk Perception of MSK Injury (RPMI) measure, an instrument developed for this study (Lee et al., 2010). Using a 6-point Likert-type scale (1 = *extremely unlikely* to 6 = *extremely likely*), the respondents were asked to estimate the likelihood of experiencing an MSK injury within a year related to the following four categories: (a) nursing work in general, (b) work tasks not related to patient handling, (c) patient-handling tasks performed manually, and (d) patient-handling tasks performed using a mechanical lifting device. Respondents were asked to estimate the risk to self (RPMI-S) and other nurses in their unit (RPMI-O) separately. The RPMI score was calculated as the mean of the eight items, and the subscale scores of RPMI-S and RPMI-O were obtained. For those nurses who did not have a lifting device on their unit, the scale scores were calculated excluding the two items about risk from patient-handling tasks performed using a mechanical lifting device. Higher scores indicate greater perceived risk of MSK injury. Reliability of the RPMI measure was found to be acceptable in two pilot evaluations. Cronbach's alpha coefficients were .85–.87 for RPMI, .73–.77 for RPMI-S, and .69–.70 for RPMI-O. Two-week test–retest correlation coefficients were .71–.74 for RPMI, .71–.72 for RPMI-S, and .66–.73 for RPMI-O. Construct validity for the RPMI measure was considered acceptable by evaluation of convergent and discriminant validity: The RPMI scale and subscales showed higher correlations with perceived risks from patient handling (r = .42–.69) compared with correlations with perceived risks from sharps, biological, chemical, and radiation (r = .19–.51) and other behavior measures (r = .01–.20) such as compliance with universal precautions (Gershon et al., 2000), health and safety risk-taking behaviors (Weber, Blais, & Betz, 2002), and safe patient-handling behavior (SPHB; Lee et al., 2010).

Safety climate was measured using the 11-item Safety Climate Questionnaire developed by Felknor et al. (2000). Safety climate is used to measure how employees perceive workplace safety; key aspects include management's commitment to safety, communication and feedback, and safety programs, policy, and practices. A 5-point Likert-type scale (1 = *never* to 5 = *always*) is used. A higher score indicates perception of a safer work environment. The reliability of the 11-item measure was not provided by Felknor et al. (2000), but a 13-item measure previously developed by Gershon et al. (2000) showed good reliability (Cronbach's alpha coefficient = .88). Cronbach's alpha coefficient of the 11-item safety climate measure was .92 in this study sample.

Physical work factors were measured by the frequency of patient handling and the Physical Workload Index Questionnaire (PWIQ; Hollmann, Klimmer, Schmidt, & Kylian, 1999). The frequency of patient handling was calculated as the sum of *lifts and transfers* and *repositioning* performed during usual shifts. The 19-item PWIQ was used to determine how often the respondent worked in specific body postures (trunk, arms, and legs) and handling weights (lifting, pulling, pushing, or carrying) using a 5-point Likert-type scale (0 = *never* to 4 = *very often*). The index of physical workload was computed as a summation of items, of which scores are weighted according to the difference in the compressive force on the spine. The physical workload index represents the cumulative compressive force on the spine over a workday.

Hollmann et al. (1999) reported satisfactory convergent and discriminant validity of the PWIQ and acceptable test–retest reliability (*r* = .65). Cronbach's alpha coefficient of PWIQ was .82 in this study sample.

Psychosocial work factors were measured using the Job Content Questionnaire (JCQ ; Karasek et al., 1998) and the Effort–Reward Imbalance Questionnaire (ERIQ; Siegrist et al., 2004), of which validity and reliability have been tested extensively and established in diverse populations. The 22-item JCQ was used to measure job strain and support at work and included the following subscales: psychological demand, skill discretion, decision authority, supervisor support, and coworker support. All JCQ items were answered with a 4-point Likert scale (1 = *strongly disagree* to 4 = *strongly agree*). The sum of skill discretion and decision authority composed decision latitude, which reflects the worker's control over job performance. Job strain, which is triggered when high job demand is combined with low job control, was calculated by dividing the score of psychological demand by the score of decision latitude (Schnall, Landsbergis, & Baker, 1994). The sum of supervisor support and coworker support composed social support. Cronbach's alpha coefficients of JCQ scales in previous studies were in ranges of .51–.75 for psychological demand, .59–.80 for skill discretion, .61–.72 for decision authority, .80–.89 for supervisor support, and .69–.82 for coworker support (Karasek et al., 1998); in this study, alphas were .76 for psychological demand, .51 for skill discretion, .67 for decision authority, .92 for supervisor support, and .82 for coworker support. The 23-item ERIQ included subscales of effort, reward (financial and status reward, esteem reward, and job security reward), and overcommitment at work. Each effort and reward scale item was scored on a 5-point scale, and overcommitment was answered using a 4-point Likert scale (1 = *strongly disagree* to 4 = *strongly agree*). The lack of reciprocity between effort and reward, *effort–reward imbalance*, causes job stress; the effort–reward imbalance ratio was computed by dividing the effort score by the reward score with multiplication by a correction factor (0.5455) to account for the difference in the numbers of items on the two scales (Siegrist et al., 2004). Cronbach's alpha coefficients of ERIQ scales in previous studies were in ranges of .61–.78 for effort, .70–.88 for reward, and .64–.82 for overcommitment (Siegrist et al., 2004); in this study, alphas were .80 for effort, 82 for reward, and .78 for overcommitment.

Safe work behavior was assessed using the 15-item SPHB measure (Lee et al., 2010). Using a 6-point Likert-type scale (1 = *never* to 6 = *all of the time*), the SPHB measure asked how often the nurse engaged in safe work practices (e.g., assess patient and physical conditions, take corrective actions, use a lifting assistive device, and ask for assistance) while performing a patient-handling task. A higher score indicates safer work behaviors. The Cronbach's alpha coefficient of the SPHB was .80 in this study sample.

Musculoskeletal symptoms were assessed via questions used in a study by Lipscomb, Trinkoff, Geiger-Brown, and Brady (2002), with minor wording modifications. Respondents were asked whether or not they had experienced symptoms including pain, aching, stiffness, burning, numbness, or tingling in the low back, neck, or shoulders in the previous 12 months. Low back pain included sciatica. Follow-up questions for those reporting symptoms included frequency, duration, and severity of symptoms. The MSK symptom index was created as a composite score for symptoms in the back, neck, and shoulders. One point was assigned for each of the following criteria: (a) the intensity of symptoms was at least moderate, (b) the duration was at least 1 week, and (c) the frequency was at least monthly. The MSK symptom index was the sum of points for all three body regions, ranging from 0 to 9.

Data Analysis

Data analyses were conducted using SPSS version 14.0. Descriptive statistics were computed to characterize all variables. For multi-item measures, scores were obtained by substituting the case mean for missing data if 80% of total items, in general, were answered. The case mean substitution approach has been documented as a robust method for handling missing data in multi-item measures (Roth, Switzer, & Switzer, 1999). Two-tailed tests and 95% significance levels were used to test statistical significance. Bivariate associations between study variables were examined using *t* tests, analysis of variance, or Pearson correlations. Multiple linear regression analyses were performed to identify significant factors for risk perception, controlling for covariates. Multivariable models included independent variables that indicated $p < .20$ in the bivariate association with any of the three risk perception variables. Multicollinearity in multivariable analyses was evaluated using the criteria of correlation coefficient > .80 and the variance inflation factor > 4 (Glantz & Slinker, 2001).

Results

Risk Perception of MSK Injury

The mean score of overall risk perception (RPMI) was 4.04 of 6, and the mean risk perception to self was significantly lower than the mean risk perception to others RPMI-S 3.82 vs. RPMI-O 4.27; $p < .001$; Table 1). By item, critical care nurses perceived the highest risk from manual patient handling. RPMI, RPMI-S, and RPMI-O scores were all significantly higher among nurses who did not have lifts than nurses who had them ($p < .01$). Of the participants, 83% perceived that an MSK injury was more likely than not to occur to themselves or coworkers within a year (RPMI > 3.0).

Risk Perception by Individual, Job, and Workplace Characteristics

No demographic variables were associated with risk perception (Table 2). Nurses with higher education tended to report lower risk perception scores, but the differences were not statistically significant. Among job and workplace characteristics, risk perception was associated significantly with only the type of unit ($p < .05$). The ICU nurses reported significantly lower overall risk perception and perception of risk to others than non-ICU nurses. Perception of risk to self was also lower among ICU nurses, but not significant ($p = .13$).

Risk Perception, MSK Symptoms, and Safe Work Behavior

MSK symptoms were correlated significantly with all of the three risk-perception variables. A higher MSK symptom index score was correlated with higher overall risk perception ($r = .275$, $p < .001$), risk perception to self ($r = .332$, $p < .001$), and risk perception to others ($r = .179$, $p = .001$). Safe work behavior had significant inverse correlations with all three risk perception variables. A higher safe work behavior score was correlated with lower levels of overall risk perception ($r = -.132$, $p = .012$), risk perception to self ($r = -.140$, $p = .008$), and risk perception to others ($r = -.108$, $p = .041$).

Particularly, critical care nurses were well aware of risks from manual patient handling, and they felt safer when performing tasks using a lifting device.

Factor Associated With Risk Perception of MSK Injury

The multivariable models (Table 3) included 15 variables that indicated $p < .20$ with any of the three risk perception variables in bivariate analyses. Among the psychosocial factors, job strain and effort–reward imbalance were selected instead of their subscale variables for the parsimony of the model and to be consistent with these theories. In these analyses, no variables exhibited multicollinearity.

For overall risk perception, significant predictors of higher risk perception included lack of availability of lift devices or lift teams, more frequent patient handling, higher physical workload index, greater job strain, and higher MSK symptom index. Of these five predictors, the strongest predictor for overall risk perception was job strain. The multivariable model including the 15 variables explained 26% of the variability in RPMI ($R^2 = .258$, $p < .001$). For risk perception to self, four variables were found significant: lack of availability of lift devices or lift teams, physical workload index, job strain, and MSK symptom index. Of these, the physical workload index was the strongest predictor. The multivariable model explained 29% of the variability in RPMI-S ($R^2 = .286$, $p < .001$). For risk perception to others, three variables were significant predictors: lack of availability of lift devices or lift teams, frequency of patient handling, and job strain. Of these, job strain was the strongest predictor. The multivariable model explained 21% of the variability in RPMI-O ($R^2 = .205$, $p < .001$).

Risk perception was shown to be significantly lower among ICU nurses than non-ICU nurses in bivariate analyses, but the significance did not remain in multivariable models. Also, significant associations between safe work behavior and risk perception did not remain in multivariable models.

Discussion

Critical care nurses, overall, were concerned about ergonomic risks in their work environments. Eighty-three percent of study participants reported that they were more likely than not to experience an MSK injury within 1 year—a relatively short time frame. Particularly, critical care nurses were well aware of risks from manual patient handling, and they felt safer when performing tasks using a lifting device. However, more than half of the participants did not have lifting devices on their units, indicating that protective programs do not exist in many hospitals and underscoring the need to improve worker safety interventions. Similar findings were shown in a survey by ANA (2001), where 59% of respondents reported fear of developing a severe back injury and 54% reported not having lifting and transfer devices readily available. In the absence of workplace preventive measures against injury, on-the-job safety inevitably relies on individual nurses' perceptions and behaviors in protecting their safety. The perception that their work is not safe may influence nurses both negatively (e.g.,

TABLE 1 Item and Scale Scores for Risk Perception of Musculoskeletal Injury Among Critical Care Nurses

Scale/Item[a]	Total (N = 361) Mean (SD)	Nurses with lifts (n = 168) Mean (SD)	Nurses without lifts (n = 193) Mean (SD)	t	p
Overall risk perception (RPMI)	4.04 (1.00)	3.85 (0.96)	4.20 (1.01)	−3.364	<.01
Risk perception to self (RPMI-S)	3.82 (1.10)	3.64 (1.07)	3.97 (1.11)	−2.786	<.01
Nursing work in general	4.23 (1.41)	4.15 (1.40)	4.29 (1.42)		
Patient-handling tasks performed manually	4.69 (1.27)	4.60 (1.29)	4.76 (1.25)		
Patient-handling tasks performed with a lift	3.20 (1.37)	3.20 (1.36)	N/A		
Work tasks not related to patient handling	2.74 (1.35)	2.61 (1.27)	2.85 (1.42)		
Risk perception to others (RPMI-O)	4.27 (1.02)	4.06 (0.96)	4.45 (1.03)	−3.597	<.001
Nursing work in general	4.75 (1.25)	4.64 (1.24)	4.84 (1.26)		
Patient-handling tasks performed manually	5.07 (1.06)	4.93 (1.11)	5.19 (1.00)		
Patient-handling tasks performed with a lift	3.49 (1.37)	3.49 (1.36)	N/A		
Work tasks not related to patient handling	3.25 (1.46)	3.18 (1.37)	3.31 (1.53)		

Note. N/A = not applicable; RPMI = Risk Perception of Musculoskeletal Injury.
[a]Each item and scale score ranges from 1 to 6.

TABLE 2 Risk Perception of Musculoskeletal Injury by Individual, Job, and Workplace Characteristics (*N* = 361)

Variable	Overall risk perception		Risk perception to self		Risk perception to others	
	Mean (*SD*)	*p*	Mean (*SD*)	*p*	Mean (*SD*)	*p*
Gender						
Female	4.06 (1.00)	.48	3.83 (1.11)	.42	4.28 (1.02)	.60
Male	3.91 (0.96)		3.65 (1.05)		4.17 (1.04)	
Age in years						
<30	4.15 (0.56)	.52	3.72 (0.73)	.68	4.58 (0.72)	.28
30–39	3.90 (0.97)		3.69 (1.01)		4.12 (1.08)	
40–49	4.15 (0.94)		3.91 (1.07)		4.39 (0.95)	
50–59	4.03 (1.04)		3.84 (1.15)		4.22 (1.03)	
≥60	3.88 (1.33)		3.65 (1.42)		4.12 (1.29)	
Race						
White	4.04 (0.96)	.86	3.81 (1.07)	.68	4.27 (0.98)	.98
Other	4.07 (1.20)		3.87 (1.28)		4.27 (1.19)	
Education						
Diploma	4.13 (1.07)	.43	3.95 (1.19)	.15	4.30 (1.04)	.89
Associate	4.11 (0.92)		3.92 (1.01)		4.31 (0.98)	
Bachelor	4.06 (0.97)		3.84 (1.07)		4.28 (0.99)	
Master or doctoral	3.83 (1.18)		3.50 (1.28)		4.17 (1.18)	
Body mass index						
Underweight or normal	4.03 (1.02)	.89	3.78 (1.13)	.55	4.29 (1.05)	.68
Overweight or obese	4.05 (0.99)		3.84 (1.08)		4.25 (0.99)	
Nursing position						
Staff nurse only	4.08 (1.01)	.57	3.85 (1.13)	.73	4.31 (1.01)	.45
Charge or multiple roles	3.95 (0.98)		3.74 (1.03)		4.16 (1.04)	
Work status						
Full time	4.03 (0.98)	.83	3.81 (1.06)	.88	4.26 (1.01)	.81
Other	4.06 (1.08)		3.83 (1.23)		4.29 (1.06)	
Work schedule						
Days	4.11 (0.98)	.41	3.93 (1.07)	.13	4.30 (1.00)	.87
Evenings	4.04 (0.90)		3.76 (0.90)		4.33 (1.03)	
Nights	3.93 (1.03)		3.66 (1.14)		4.19 (1.07)	
Rotating	3.93 (1.05)		3.60 (1.21)		4.25 (1.03)	
Type of unit						
ICU	3.99 (1.01)	<.05	3.78 (1.11)	.13	4.21 (1.02)	.03
Non-ICU[a]	4.26 (0.95)		4.00 (1.08)		4.52 (0.98)	
Type of hospital						
Nonprofit community	4.06 (1.01)	.26	3.83 (1.11)	.33	4.28 (1.03)	.29
University medical center	4.21 (0.86)		3.98 (1.06)		4.44 (0.77)	
Profit community	3.86 (0.94)		3.62 (1.01)		4.11 (1.02)	
Other	3.98 (1.22)		3.80 (1.26)		4.16 (1.29)	
Work setting						
Urban	4.13 (0.99)	.31	3.91 (1.07)	.32	4.35 (1.05)	.31
Suburban	3.96 (0.98)		3.72 (1.13)		4.21 (0.95)	
Rural	3.96 (1.08)		3.79 (1.13)		4.12 (1.10)	

Note. ICU = intensive care unit.
[a]Examples include emergency room, progressive care unit, postanesthesia care unit, and telemetry.

Nursing Research January/February 2013 Vol 62, No 1

TABLE 3 Multivariable Analyses of Risk Perception of Musculoskeletal Injury among Critical Care Nurses

Variable	Overall risk perception		Risk perception to self		Risk perception to others	
	Standardized β	*p*	Standardized β	*p*	Standardized β	*p*
Education (reference = bachelor)		.55		.16		.98
Diploma	.041	.46	.055	.32	.019	.74
Associate	−.003	.96	−.010	.86	.003	.95
MS/PhD	−.063	.26	−.102	.06	−.014	.80
Shift (reference = days)		.58		.68		.49
Evenings	.055	.32	.030	.57	.075	.19
Nights	.016	.79	.000	.99	.027	.66
Rotation	−.041	.47	−.051	.36	−.028	.64
Type of unit (ICUs)	.004	.95	−.012	.83	.018	.76
Direct patient care (% time)	.049	.37	.080	.13	.011	.84
Break (minutes)	.072	.19	.080	.14	.057	.32
Lift devices or lift teams (yes)	**−.174**	**<.01**	**−.120**	**.03**	**−.213**	**<.001**
Safety climate	.065	.42	.024	.76	.105	.21
Frequency of patient handling	**.119**	**.04**	.067	.23	**.160**	**<.01**
Physical workload index	**.174**	**<.01**	**.218**	**<.01**	.106	.08
Job strain	**.261**	**<.01**	**.203**	**<.01**	**.288**	**<.001**
Social support	.084	.25	.057	.43	.099	.19
Effort–reward imbalance ratio	.099	.18	.096	.18	.089	.25
Overcommitment	−.023	.72	.023	.72	−.069	.30
Safe work behavior	−.059	.34	−.019	.75	−.097	.13
Musculoskeletal symptom index	**.129**	**.03**	**.186**	**.001**	.050	.41
N^a	283		284		283	
R^2	.258		.286		.205	
F (df)	4.809 (19,263)		5.565 (19,264)		3.566 (19,263)	

Note. ICU = intensive care unit. Significant findings ($p <$. 05) are presented in bold.

[a]Among 361 cases, multivariable analyses included all cases that had complete information on the variables included in the models.

affecting job dissatisfaction or the intention to change jobs) and positively (e.g., requesting job safety improvements). Either way, organizational efforts must serve as the foundation for hospital safety improvements.

A discrepancy was discovered between perceptions of risk of MSK injury to self and to others among critical care nurse participants, which supports the optimistic bias theory as reported in the literature (Caponecchia & Sheils, 2011; Weinstein, 1987). On average, nurses rated the likelihood of having an MSK injury themselves lower than that likelihood to others. The difference in risk perceptions to self and to others, consequently, results in a discrepancy between overall risk perception and risk perception to self, which has an implication for measurement of risk perception. Among the three risk perception measures, risk perception to self (RPMI-S) had the strongest correlations with safe work behavior and MSK symptoms. Measuring perception of risk specifically to oneself could be a better measure.

This study identified five significant predictors of risk perception for MSK injury among critical care nurses. Higher overall risk perception was associated significantly with greater job strain, higher physical workload index, more frequent patient handling, lack of availability of lift devices or lift teams, and higher MSK symptom index. Of these five variables, job strain and availability of lift devices or lift teams were significant for both risk perception to self and risk perception to others. Interestingly, a physical work variable of the physical workload index was the strongest predictor of risk perception to self, whereas a psychosocial variable of job strain was the strongest predictor of risk perception to others and overall risk perception. This is understandable, because risk perception seems to be affected by both physical and psychological factors, but when an individual perceives occupational risk to oneself, perception appears to be affected more by personal experience of physical work factors.

The finding of increased perception of risk accompanying increased physical workload reflects appropriate assessment of risk of injury. Physical workload is well recognized as a major risk factor for MSK injury or symptoms (Bernard, 1997). Landry (2006) also found that risk perception of injury among female workers was associated significantly with exposures to strenuous physical activity and repetitive hand motion. Also found was that perception of one's own risk of injury was associated with the physical workload index, whereas perception of the risk to others was associated with the frequency of patient-handling tasks. The physical workload index appears to be a better measure of personal risk than the frequency of patient-handling tasks because it can be used to assess the individual's ergonomic workload more comprehensively by including work postures and loads.

Job strain was associated with all three risk perception variables among critical care nurses. Studies have found a significant association between job stress and MSK symptoms or injuries (Bernard, 1997; Gillen et al., 2007; Josephson et al., 1997), but the positive association with risk perception of injury has not been explored previously. Nurses with high job stress may feel more vulnerable regarding their health or be more aware of negative aspects of working conditions, leading to perceptions of heightened risk for MSK injury. An alternative interpretation is plausible: heightened awareness about risk from work might result in increased negative psychological loading and thus reports of higher stress in jobs. The direction of this relationship cannot be determined with a cross-sectional study design.

Availability of lift devices or lift teams was associated also with all three risk perception measures. Risk perception of MSK injury was lower among nurses who had a lift device or a lift team than those who had neither. Indeed, actual reduction of risk of MSK injury by the use of lift devices or lift teams has been shown in many studies (Charney, 1997; Hignett, 2003; Yassi et al., 2001). Provision of lift devices or a lift team reflects organizational injury prevention efforts. Although safety climate itself was not associated significantly with risk perception in this study, other researchers have found supportive evidence that positive organizational climate is associated with lower rates of work-related injury (Eriksen et al., 2004; Felknor et al., 2000; Stone & Gershon, 2006). In fact, a secondary analysis of data (not presented in this manuscript) revealed that safety climate was significantly more positive among nurses who had access to lift devices or lift teams compared with nurses who did not. Our study findings suggest that provision of prevention measures contributes to the creation of a strong safety climate and reduces the level of risk perceived by the workers, but safety climate does not affect risk perception directly.

The last significant factor for risk perception of MSK injury among critical care nurses was MSK symptom experience. The MSK symptom index was associated significantly with overall risk perception and risk perception to self, but not with the perception of risk to others. Nurses who perceived themselves to be less at risk of MSK injury reported less MSK symptoms. Landry (2006) reported a similar finding, where bodily pain reported among women workers was associated with perception of injury risk to self, but not risk to other women. Since the MSK symptom index reflects one's personal state and does not capture the experience of other workers, its value in predicting only risk to self is understandable. Although causal implications cannot be determined in this cross-sectional study, it is plausible to assume that symptoms cause nurses to have a heightened awareness of injury risks, thereby increasing their perception of risk. The finding of a significant association between symptom experience and risk perception is meaningful because the ultimate goal of the study is to prevent MSK injury. Determining how risk perception influences injury prevention should be of interest to occupational health researchers, and further research is needed.

In addition to the limitations noted above, the representativeness of the study sample across critical care nurses may have been limited by the response rate. Furthermore, findings about critical care nurses may not generalize to nurses in different clinical settings. Also, the use of a single survey method may introduce bias related to social desirability or negative affectivity.

Conclusions

In conclusion, critical care nurses' perceptions about risk from their work environment were elucidated and their greater perception of risk for MSK injury was found to be associated with greater job strain, greater physical workload, more frequent patient-handling tasks, the lack of lifting devices or a lifting team, and experience of more severe MSK symptoms. This study provides a framework to assist occupational health professionals and nurse managers to better understand nurses' perceptions about their personal risks. Physically demanding and psychosocially stressful working conditions are the most influential factors for risk perception, and organizational efforts are needed to improve working conditions and to ensure that nurses feel safe at work. Occupational health professionals, nurse managers, and nursing organizations should make concerted efforts to ensure the safety of nurses by providing effective preventive measures. Improving the physical and psychosocial work environment may make nursing jobs safer, reduce the risk of MSK injury, and improve nurses' perceptions of job safety. Ultimately, these efforts would contribute to enhancing safety in nursing settings and to maintaining a healthy nursing workforce. Future research is needed to determine the role of risk perception in preventing a MSK injury. ▼

Accepted for publication June 18, 2012.

This paper was accepted under the editorship of Dr. Molly C. Dougherty.

We thank Steven Paul and Bruce Cooper for statistical consultation.

This research was supported by the grants from the American Association of Occupational Health Nurses Foundation, the Sigma Theta Tau International Alpha Eta Chapter, the University of California, San Francisco, Graduate Division, and the University of California, San Francisco, School of Nursing Century Club.

The authors have no conflicts of interest to disclose.

Corresponding author: Soo-Jeong Lee, PhD, RN, ANP, School of Nursing, University of California, San Francisco, San Francisco, CA 94143 (e-mail: soo-jeong.lee@nursing.ucsf.edu).

References

American Nurses Association. (2001). *Nursing world: Health and safety survey*. Retrieved from http://ana.nursingworld.org/MainMenuCategories/OccupationalandEnvironmental/occupationalhealth/HealthSafetySurvey.aspx

American Nurses Association. (2012). *Safe patient handling*. Retrieved from http://nursingworld.org/MainMenuCategories/WorkplaceSafety/SafePatient

Bernard, B. P. (Ed.). (1997). *Musculoskeletal disorders and workplace factors: A critical review of epidemiological evidence for work-related musculoskeletal disorders of the neck, upper extremity, and low back*. Cincinnati, OH: National Institute for Occupational Safety and Health.

Black, T. R., Shah, S. M., Busch, A. J., Metcalfe, J., & Lim, H. J. (2011). Effect of transfer, lifting, and repositioning (TLR) injury prevention program on musculoskeletal injury among direct care workers. *Journal of Occupational and Environmental Hygiene*, *8*, 226–235. doi: 934845381[pii]10.1080/15459624.2011.564110.

Buerhaus, P. I., Staiger, & D. O., Auerbach, D. I. (2000). Why are shortages of hospital RNs concentrated in specialty care units? *Nursing Economics*, *18*, 111–116.

Bureau of Labor Statistics. (2011). *Nonfatal occupational injuries and illnesses requiring days away from work, 2010*. Retrieved from http://www.bls.gov/news.release/osh2.nr0.htm

Caponecchia, C., & Sheils, I. (2011). Perceptions of personal vulnerability to workplace hazards in the Australian construction industry. *Journal of Safety Research*, *42*, 253–258. doi: S0022-4375(11)00076-4[pii].

Carayon, P., Alvarado, C. J., & Systems Engineering Initiative for Patient Safety. (2007). Workload and patient safety among critical care nurses. Critical Care Nursing Clinics of North America, *19*, 121–129. doi: 10.1016/j.ccell.2007.02.001.

Charney, W. (1997). The lift team method for reducing back injuries. A 10 hospital study. *AAOHN Journal*, *45*, 300–304.

Collins, J. W., Wolf, L., Bell, J., & Evanoff, B. (2004). An evaluation of a "best practices" musculoskeletal injury prevention program in nursing homes. *Injury Prevention*, *10*, 206–211. doi: 10.1136/ip.2004.005595.

Eriksen, W., Bruusgaard, D., & Knardahl, S. (2004). Work factors as predictors of intense or disabling low back pain; a prospective study of nurses' aides. *Occupational and Environmental Medicine*, *61*, 398–404. doi: 10.1136/oem.2003.008482.

Felknor, S. A., Aday, L. A., Burau, K. D., Delclos, G. L., & Kapadia, A. S. (2000). Safety climate and its association with injuries and safety practices in public hospitals in Costa Rica. *International Journal of Occupational and Environmental Health*, *6*, 18–25.

Gershon, R. R., Karkashian, C. D., Grosch, J. W., Murphy, L. R., Escamilla-Cejudo, A., Flanagan, P. A., … Martin, L. (2000). Hospital safety climate and its relationship with safe work practices and workplace exposure incidents. *American Journal of Infection Control*, *28*, 211–221.

Gillen, M., Yen, I. H., Trupin, L., Swig, L., Rugulies, R., Mullen, K., … Blanc, P. (2007). The association of socioeconomic status and psychosocial and physical workplace factors with musculoskeletal injury in hospital workers. *American Journal of Industrial Medicine*, *50*, 245–260. doi: 10.1002/ajim.20429.

Glantz, S. A., & Slinker, B. K. (2001). *Primer of applied regression and analysis of variance* (2nd ed.). New York, NY: McGraw-Hill.

Goldman, R. H., Jarrard, M. R., Kim, R., Loomis, S., & Atkins, E. H. (2000). Prioritizing back injury risk in hospital employees: Application and comparison of different injury rates. *Journal of Occupational and Environmental Medicine*, *42*, 645–652. doi: 10.1097/00043764-200006000-00016.

Hignett, S. (2003). Intervention strategies to reduce musculoskeletal injuries associated with handling patients: A systematic review. *Occupational and Environmental Medicine*, *60*, E6.

Hollmann, S., Klimmer, F., Schmidt, K. H., & Kylian, H. (1999). Validation of a questionnaire for assessing physical work load. *Scandinavian Journal of Work, Environment and Health*, *25*, 105–114. doi: 10.5271/sjweh.412.

Josephson, M., Lagerström, M., Hagberg, M., & Wigaeus Hjelm, E. (1997). Musculoskeletal symptoms and job strain among nursing personnel: A study over a three-year period. *Occupational and Environmental Medicine*, *54*, 681–685.

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.

Koh, Y., Hegney, D., & Drury, V. (2012). Nurses' perceptions of risk from emerging respiratory infectious diseases: A Singapore study. *International Journal of Nursing Practice*, *18*, 195–204. doi: 10.1111/j.1440-172X.2012.02018.x.

Landry, L. G. (2006). Preventing occupational injuries: Women's perception of risk from musculoskeletal exposures. *AAOHN Journal*, *54*, 75–83.

Lee, S. J. (2007). *Risk perception, safe work behavior, and work-related musculoskeletal disorders among critical care nurses* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses database (UMI No. 3286660).

Lee, S. J., Faucett, J., Gillen, M., Krause N., & Landry, L. (2010). Factors associated with safe patient handling behaviors among critical care nurses. *American Journal of Industrial Medicine*, *53*, 886–897. doi: 10.1002/ajim.20843.

Leppin, A., & Aro, A. R. (2009). Risk perceptions related to SARS and avian influenza: Theoretical foundations of current empirical research. *International Journal of Behavioral Medicine*, *16*, 7–29. doi: 10.1007/s12529-008-9002-8.

Lipscomb, J. A., Trinkoff, A. M., Geiger-Brown, J., & Brady, B. (2002). Work-schedule characteristics and reported musculoskeletal disorders of registered nurses. *Scandinavian Journal of Work, Environment and Health*, *28*, 394–401.

Listyowardojo, T. A., Nap, R. E., & Johnson, A. (2010). Perceptions of personal health risks by medical and non-medical workers in a university medical center: A survey study. *BMC Public Health*, *10*, 681. doi: 1471-2458-10-681[pii].

Nelson, A., Matz, M., Chen, F., Siddharthan, K., Lloyd, J. & Fragala, G. (2006). Development and evaluation of a multifaceted ergonomics program to prevent injuries associated with patient handling tasks. *International Journal of Nursing Studies*, *43*, 717–733. doi: S0020-7489(05)00169-0 [pii]10.1016/j.ijnurstu.2005.09.004.

Rickett, B., Orbell, S., & Sheeran, P. (2006). Social-cognitive determinants of hoist usage among health care workers. *Journal of Occupational Health Psychology*, *11*, 182–196.

Rogers, R. W. (1975). A protection motivation theory of fear appeals and attitude change. *Journal of Psychology*, *91*, 93–114.

Rosenstock, I. M., Strecher, V. J., & Becker, M. H. (1988). Social learning theory and the health belief model. *Health Education Quarterly*, *15*, 175–183.

Roth, P. L., Switzer, F. S. III, & Switzer, D. M. (1999). Missing data in multiple item scales: A Monte Carlo analysis of missing data techniques. *Organizational Research Methods*, *2*, 211–232.

Rundmo, T. (1996). Associations between risk perception and safety. *Safety Science*, *24*, 197–209.

Schnall, P. L., Landsbergis, P. A., & Baker, D. (1994). Job strain and cardiovascular disease. *Annual Review of Public Health*, *15*, 381–411. doi: 10.1146/annurev.pu.15.050194.002121.

Seo, D. C. (2005). An explicative model of unsafe work behavior. *Safety Science*, *43*, 187–211.

Siegrist, J., Starke, D., Chandola, T., Godin, I., Marmot, M., Niedhammer, I., & Peter, R. (2004). The measurement of effort–reward imbalance at work: European comparisons. *Social Science and Medicine*, *58*, 1483–1499. doi: 10.1016/S0277-9536(03)00351-4.

Stone, P. W., & Gershon, R. R. (2006). Nurse work environments and occupational safety in intensive care units. *Policy, Politics, Nursing Practice*, *7*, 240–247.

Stone, P. W., Larson, E. L., Mooney-Kane, C., Smolowitz, J., Lin, S. X., & Dick, A. W. (2006). Organizational climate and intensive care unit nurses' intention to leave. *Critical Care Medicine*, *34*, 1907–1912. doi: 10.1177/1527154406297896.

Weber, E. U., Blais, A., & Betz, N. E. (2002). A domain-specific risk-attitude scale: Measuring risk perceptions and risk behaviors. *Journal of Behavioral Decision Making*, *15*, 263–290.

Weinstein, N. D. (1987). Unrealistic optimism about susceptibility to health problems: Conclusions from a community-wide sample. *Journal of Behavioral Medicine*, *10*, 481–500.

Yassi, A., Cooper, J. E., Tate, R. B., Gerlach, S., Muir, M., Trottier, J., & Massey, K. (2001). A randomized controlled trial to prevent patient lift and transfer injuries of health care workers. *Spine*, *26*, 1739–1746.