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Risk perception, safe work behavior, and work-related musculoskeletal disorders among critical care nurses

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Risk Perception, Safe Work Behavior, and Work-Related Musculoskeletal Disorders Among Critical Care Nurses

by

Soo-Jeong Lee

DISSERTATION

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DEDICATION

This dissertation is dedicated to my parents,

Seung-Hyun Lee and Oak-Reum Seo,

who are the foundation of my life

and have always provided the support necessary for my journey in life.

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For a chrysanthemum to bloom
the scope owl must have been singing ever since springtime.
For a chrysanthemum to bloom
the thunder must have roared and rumbled in the inky clouds.
- Seo, Jeong-Ju –

For my chrysanthemum to bloom, the scope owl has sung now for five springs. These five years at UCSF have been the most challenging, meaningful, and colorful time in my life. In addition to my intellectual growth as a nurse scientist, I have gotten to know great faculty, mentors, and colleagues through my doctoral study at UCSF, and I have expanded my small world with valuable learning experiences. At this moment when I see my chrysanthemum come into the world, I am filled with appreciation for those wonderful people who have helped me grow during the last five years. With their support, guidance, and encouragement, I have been able to overcome challenges in my academic studies and dissertation research and enjoy my journey at UCSF.

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RISK PERCEPTION, SAFE WORK BEHAVIOR, AND WORK-RELATED MUSCULOSKELETAL DISORDERS AMONG CRITICAL CARE NURSES

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ABSTRACT

BACKGROUND: Work-related musculoskeletal disorders (WRMSDs) are a major occupational health problem among nurses. Existing interventions have not totally eliminated the risk for WRMSDs. Safe work behavior and risk perception may play an important role in modifying this risk.

OBJECTIVES: The aims of the study were to identify factors influencing safe work behaviors related to patient handling and risk perceptions about risk of musculoskeletal injury among critical care nurses; and examine the relationship between safe work behavior and risk perception.

METHODS: A cross-sectional national survey was conducted using a random sample of 1000 members of the American Association of Critical Care Nurses. A total of 412 registered nurses participated in the study, and 361 subjects served as the sample for the data analysis. Nurses reported on the physical, psychosocial, and organizational characteristics of their jobs and on their work behaviors, musculoskeletal symptoms, risk perception, and demographics using a mailed questionnaire.

FINDINGS: Multiple linear regressions revealed that significant predictors for safer work behavior included better safety climate, higher effort-reward imbalance, less overcommitment, greater social support, and day shifts (versus rotating shifts). These five predictors explained 20% of the variance in safe work behavior. Significant predictors for greater risk perception of musculoskeletal injury included greater job strain, higher physical workload index, more frequent patient handling, higher musculoskeletal symptom index, and lack of lifting devices or lifting teams. These five predictors explained 23% of the variance in risk perception of musculoskeletal injury. Nurses' perceived risk of musculoskeletal injury showed a weak inverse association with safe work behavior that was statistically significant in bivariate analysis ($r=-.13$, $p=.01$), but not in the multivariate model ($\beta=-.02$, $p=.75$).

CONCLUSION: Safe work behaviors and risk perception are best understood as socio-cultural phenomena influenced by organizational, psychosocial, and physical job characteristics. Management efforts to enhance the organizational safety climate and improve stressful job conditions could prove to be crucial in promoting nurses' safe work behavior. Further research is needed to determine the role of safe work behavior and risk perception in nurses' safety and health. The unexpected positive association of effort-reward imbalance with safer behavior should also be further investigated.

Julia Faucett, RN, PhD, FAAN

Dissertation Committee Chair

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Chapter 1. The Study Problem

Study Problem

Work-related musculoskeletal disorders (WRMSDs) have been a major occupational health problem in nursing. The annual prevalence of low back problems in nursing personnel is reported to be between 26-75% internationally (Alexopoulos, Burdorf, & Kalokerinou, 2006; Josephson, Lagerstrom, Hagberg, & Hjelm, 1997; Nahit et al., 2003; Smedley, Egger, Cooper, & Coggon, 1995; Smith et al, 2005; Trinkoff, Lipscomb, Geiger-Brown, & Brady, 2002). Registered nurses have ranked among the top 10 occupations with the highest risk for WRMSDs; and more than 10,000 U.S. registered nurses suffer annually from WRMSDs leading to lost work days (Bureau of Labor Statistics [BLS], 2002, 2005). In a survey conducted by the American Nurses Association (ANA, 2001), nurses identified back injury as their second most important health and safety concern. In the ANA survey, 83% of nurses reported that they continued working with back pain, and 59.4% of nurses reported that they fear they will sustain a severe back injury.

WRMSDs can lead to persistent medical problems, disability, productivity losses, and job changes (Baldwin, 2004; Larsson & Bjornstig, 1995). Studies report that among workers with back injuries, 57% had lost work days totaling 1 week or more (Pransky et al., 2002) and 20% developed long-term disability lasting 4 months or more (Williams, Feuerstein, Durbin, & Pezzullo, 1998). According to a study by Pransky et al. (2000), workers with a low back or upper extremity injury reported a 17% rate of job loss and a 34% job turnover rate one year after the injury. Even among those who returned to work, 76.2% of workers with low back injuries and 28.3% of workers with upper extremity injuries suffered from residual pain. In addition to personal suffering, WRMSDs are quite costly. In the United States, the direct cost of work-related back pain is estimated at $14 billion annually (Mont, Burton, Reno, & Thompson, 2001). Total costs, including direct and indirect costs, are estimated to be as high as $49 billion annually (Leigh, Markowitz, Fahs, Shin, & Landrigan, 1997).

Considerable research has been conducted to identify risk factors for WRMSDs. Among nurses, patient handling tasks, such as lifting, transferring, and repositioning, have been identified as major contributors to WRMSDs (Fragala & Bailey, 2003). Patient handling frequently involves forceful exertion and awkward postures such as bending and twisting, which are well-known risk factors for WRMSDs (Owen, Keene, & Olson, 2002). Psychosocial work factors, such as high job demands, low decision latitude, low social support, and job dissatisfaction, have also been associated with WRMSDs (Eriksen, Bruusgaard, & Knardahl, 2004; Josephson, Lagerstrom, Hagberg, & Wigaeus Hjelm, 1997; Lagerstrom, Wenemark, Hagberg, & Hjelm, 1995; Nahit et al., 2003).

Many intervention programs have been developed to reduce the risk of WRMSDs. Traditional approaches to preventing WRMSDs have been education and training programs on biomechanics and lifting techniques. However, research shows that these programs are largely unsuccessful in reducing musculoskeletal injuries (Fragala & Bailey, 2003; Owen & Fragala, 1999; Trinkoff, Brady, & Nielsen, 2003). Engineering and administrative controls, such as lifting devices, job task redesign, and lifting teams, have been shown to reduce the risk of WRMSDs (Charney, 1997; Haiduven, 2003; Owen & Fragala, 1999; Trinkoff et al., 2003; Yassi et al., 2001). Nonetheless, occupational injury statistics show that WRMSDs continue to be a significant problem among nursing personnel. These results suggest that other approaches might help identify further contributing factors to WRMSDs and perhaps improve the effectiveness of current intervention programs.

Nurses work in a dynamic environment. They need to determine the most appropriate methods for performing patient care tasks, taking into consideration task and patient characteristics while reducing WRMSDs (Nelson, 2001). Nurses must often respond to urgent or diverse patient needs, and urgent or unplanned situations in patient care may cause nurses to take greater ergonomic risks. Considering that individual workers have the final choice of making a decision before acting in each dynamic work situation, an approach that explores WRMSD occurrence at the individual level may be useful.

In addition to safety measures instituted by employers to ensure worker protection, individual workers need to take voluntary action to adequately deal with particular hazards in their work setting (Baker, 1990). Perception of risk has been proposed as a determinant for preventive health behaviors by a number of behavioral theories such as the health belief model and protection motivation theory (Janz & Becker, 1984; Rogers, 1975). Adequate perception of occupational risks can be expected to function as a motivator for adopting safe work behaviors and consequently contribute to occupational injury prevention. However, little research exists about the relationship between risk perception and safe work behavior among nurses. Furthermore, little is known about determinants for WRMSD risk perception among nurses.

Among WRMSD interventions, the use of lifting devices has been identified as contributing to WRMSD reduction. However, studies show that the actual use of lifting devices among nurses is quite limited. Trinkoff et al. (2003) reported that only 6% of nurses always used mechanical lifting devices and 57% sometimes used them, despite having mechanical lifting devices available. Byrns, Reeder, Jin, and Pachis (2004) found that only 11.3% of nurses routinely used lifting devices. The primary reasons for not using the devices were lack of equipment availability and insufficient time to use the lift. Furthermore, an ANA survey (2001) revealed that 53.9% of the nursing facilities did not have lifting and transfer devices readily available for moving patients. Therefore, manual patient handling is still an integral part of nursing tasks for many nurses, requiring special precaution to protect their safety, such as the use of good body mechanics. However, Karahan and Bayraktar (2004) reported that body mechanics were used incorrectly among many nurses while lifting (57.1%), sitting (53.6%), and moving patients to the side of the bed (52.4%). These findings imply that aggressive organizational efforts are needed to provide lift equipment. Organizations must also reinforce safe work behaviors. To facilitate appropriate organizational interventions, research is needed to clarify what factors affect safe work behavior among nurses and determine the role of work behaviors as a contributing factor to WRMSD.

Research on risk perception and safe work behavior may help to explore gaps in the understanding of the occurrence of WRMSDs in nursing personnel, and eventually lead to more effective prevention programs. The purposes of the study are a) to understand how nurses perceive their risk of musculoskeletal injury and how they behave in performing patient handling tasks; b) to examine the relationship between their risk perception and safe work behavior; and c) to identify factors that influence their risk perception and safe work behavior.

Chapter 2. Literature Review and Conceptual Framework

LITERATURE REVIEW

The theoretical purpose of this study was to incorporate the concepts of risk perception and safe work behavior into the understanding of WRMSDs development. Therefore, a comprehensive literature review regarding theoretical models and risk factors for WRMSDs, risk perception, and safe work behavior was undertaken. The literature review begins with theoretical models widely used to study WRMSDs and then proceeds to discuss research on the physical, psychosocial, organizational, and individual risk factors for WRMSDs in nursing personnel. Common methodological issues across these studies and gaps in the research on WRMSDs in nurses are also discussed. Finally, the limited literature on risk perception and work behaviors of nurses is reviewed. The literature presented in this chapter illustrates that current models have not sufficiently captured the role of the individual worker in safe work. Research on the key elements of the proposed conceptual framework is also discussed.

Theoretical Models for WRMSDs

A range of theoretical models regarding the development of WRMSDs has emerged from biomechanical, biobehavioral, and psychosocial perspectives. The occurrence of WRMSDs involves a range of complex links between physical and mental loads and biomechanical, physiological, neuroendocrine, neuromuscular, behavioral, and cognitive responses. Biomechanical theories provide basic hypotheses on the etiology of WRMSDs. Musculoskeletal injury, or tissue failure, occurs when the applied mechanical load exceeds the failure tolerance or strength of the tissue (McGill, 1997). Injury etiology is postulated via two biomechanical mechanisms. First, injury can occur from a one-time high load that exceeds the safety threshold of the tissue. Acute injury, such as fracture and sprain, can be explained by this mechanism. Second, injury can result from accumulated micro-trauma produced by either the repeated application of a relatively low load or the application of sustained load for a long duration. Repeated or sustained loads cause a slow degradation of the failure tolerance, thus making the tissue more vulnerable to injury. This mechanism is relevant in explaining cumulative trauma disorders.

Hypotheses regarding pathomechanisms help to explain the etiology of WRMSDs at the tissue or cellular levels. Major pathomechanisms proposed include the following hypotheses: posturally induced muscular imbalance, neural pathomechanisms, and the Cinderella hypothesis (Forde, Punnett, & Wegman, 2002). First, muscular imbalances can result from the maintenance of abnormal static postures, where some muscles are underused and become weakened while other muscles are overused and undergo hypertrophy. Muscles in either a shortened or elongated position are at a mechanical disadvantage which leads to weakening of muscles. Short and tight muscles may be painful when stretched. Weakened muscles may be vulnerable to injury (Higgs & Mackinnon, 1995; Novak & Mackinnon, 2002). Next, a primary neural pathomechanism, involving changes in the somatosensory cortex, can be caused by exposure to highly repetitive jobs. In a study of owl monkeys, Byl et al. (1997) found that repetitive, highly articulated hand-squeezing movement was associated with motor deterioration and a degradation of the hand representation on the somatosensory cortex. In addition, neural mechanisms can be impaired secondarily by compressive forces during awkward or prolonged static postures. Increased pressure around or stretching of peripheral nerves due to such postures increases tension within the nerve and results in chronic nerve compression. Inflammatory responses and impaired microcirculation further lead to nerve fiber dysfunction and fibrosis (Higgs & Mackinnon, 1995). Lastly, the 'Cinderella hypothesis' proposed by Hagg refers to the preferential recruitment of low-threshold small motor units (Type I motor units) for isometric muscle contraction. Given sustained contractions, metabolic overload on the Cinderella unit makes its muscle fibers lose calcium homeostasis and become vulnerable to muscle fatigue and musculoskeletal disorders (Forde, Punnett, & Wegman, 2002).

Beyond biomechanics and pathomechanisms, work-related psychosocial factors have been incorporated into the understanding of WRMSDs etiology. The term "psychosocial factors" has been applied to a wide range of work-related psychological or organizational factors. In general, "psychosocial factors" refer to nonphysical variables of the job/work environment, including organizational climate or culture, work organization components such as task complexity, and psychological attributes such as job satisfaction and personality traits (Sauter & Swanson, 1996). More recently, the term "work organization" is increasingly used to represent a subset of work-related psychosocial factors. "Work organization" refers to work process and organizational practices that influence job design. This concept also includes legal, economic, and technological factors that influence new organizational practices (National Institute for Occupational Safety Health [NIOSH], 2002).

There are several hypotheses that explain the role of psychosocial work factors in WRMSDs (Melin & Lundberg, 1997; National Research Council & Institute of Medicine [NRC & IOM], 2001; Theorell, 1996). The stress response induced by exposure to psychosocial risk factors leads to activation of sympathetic systems and release of catecholamines and cortisol. This biochemical change increases neuromuscular activity and tension. The increased muscular tension may alter internal load. Raised cortisol levels may affect recovery from micro-trauma. Moreover, stress may influence pain sensitivity and appraisal of symptoms.

The concept of occupational stress stands at the center of psychosocial approaches. Occupational stress theories propose ways in which work-related factors trigger job stress or strain. Among these theoretical models are the job strain model, the NIOSH job stress model, the person-environment fit model, the effort-reward imbalance model, and the balance theory.

Stress theories formulate hypotheses regarding the imbalance between environmental demands and individual response capabilities (Baker, 1985). In an attempt to understand the etiologic dynamics of job stress, some theories, such as the job strain model, focus on the role of the work environment as the key variable. Other theories, such as the person-environment fit model, focus more on the interaction of work environmental stressors and individual capabilities (Huang, Feuerstein, & Sauter, 2002).

Responses to stress are mediated by an individual's perception. The consequences of stress include physiological, psychological, and behavioral responses (Baker, 1985). These stress responses, especially if persistent or recurrent, can contribute to the development of health problems. Generic occupational stress theories provide simple conceptual frameworks that present causal connections among key elements in the etiology of stress. Within these general frameworks on job stress, WRMSDs are considered one potential outcome among a variety of stress-induced health problems. Accordingly, these generic occupational stress theories are considered limited models in understanding the multifactorial etiology of WRMSDs.

A number of psychosocial models based on the stress concept and focusing specifically on WRMSDs have also evolved. These models provide more comprehensive frameworks connecting multidimensional factors in the development of WRMSDs. In an early attempt based on epidemiological research findings, Bongers, de Winter, Kompier, and Hildebrandt (1993) developed a theoretical model that incorporated the role of psychosocial factors and the subsequent stress-induced physiological and behavioral responses as links between mechanical load and musculoskeletal symptoms. The ecological model by Sauter and Swanson (1996) was specifically developed to explain the development of WRMSDs in office workers. This model also incorporates the role of biomechanical, psychosocial, and cognitive factors in musculoskeletal outcomes. A distinguishing aspect of this model is the special attention given to cognitive processes of symptom detection and attribution that mediate the effect of biomechanical strain on musculoskeletal disorders.

A model proposed by the NRC and IOM (2001) formulates complex links between workplace factors (external load, organizational factors, and social context) and processes within the person (biomechanical loading, internal tolerances, and outcomes) in the development of musculoskeletal disorders. The integrated model proposed by Faucett (2005) constructs management systems as the primary driver of work environment factors and incorporates work barriers and worker perceptions as mediating factors for strain and WRMSDs outcomes. Moreover, the integrated model presents worker performance and productivity as the final outcome. The biopsychosocial model developed by Melin and Lundberg (1997) focuses on physiological responses to occupational stressors. This model further incorporates the role of additional loads after work, which can induce sustained stress responses leading to the development of WRMSDs. In this model, mental and physical job stressors trigger biochemical and neuromuscular stress responses, and domestic workloads after work slow the physiological unwinding of stress responses.

Whereas the majority of psychosocial models focus more on occupational factors in explaining WRMSDs, the workstyle model developed by Feuerstein (1996) uniquely targets the question of individual differences in musculoskeletal outcomes among workers with similar biomechanical exposures. The model proposes the concept of workstyle that is created through a combination of behavioral, cognitive, and physiological response patterns that can lead to the development of WRMSDs.

As reviewed in the above, a number of biomechanical, biological, and psychosocial theories provide a comprehensive view of how WRMSDs develop through interactive roles among multi-etiological factors. However, few existing theories of WRMSDs incorporate individual worker factors influencing WRMSDs, such as risk perception and behavior. Factors such as workstyle, for example, may play an important role in protecting workers from injury. Subsequently, little research has examined the contributing role of workers' risk perception or behavior in work-related musculoskeletal disorders. In practice, many intervention strategies for WRMSDs target individual workers' behaviors or work practices. In addition, secondary and tertiary interventions are also important for workers with WRMSDs. Therefore, a theoretical model incorporating the role of individual worker factors would provide a more comprehensive framework for WRMSDs and encourage workplace interventions developed with multifactorial strategies from various perspectives.

Risk Factors for WRMSDs

Physical Work Factors

Physical risk factors for WRMSDs include force, repetition, vibration, and awkward postures. Patient handling tasks have been documented as major contributing factors for WRMSDs among nursing staff. Patient handling tasks such as lifting, transferring, and repositioning involve forceful exertion and awkward postures. Furthermore, the patient's physical and mental conditions, such as contractures or combativeness, can impose an additional load when performing a task (Garg & Owen, 1992).

The risks from patient handling tasks have been well identified by studies investigating injury reports. Engkvist, Hagberg, Hjelm, Menckel, and Ekenvall (1998) performed an accident analysis using 130 overexertion back injuries occurring during one year among 24,500 hospital nursing personnel in one Swedish county. The study found that injuries occurred most frequently during patient transfer to/from or in the bed, when transfer devices were not used, and when the nurse moved suddenly to compensate for a patient's resistance or loss of balance. In the U.S., Fragala and Bailey (2003) investigated injury reports submitted to a workers' compensation carrier from seven hospitals during a 24-month period and found that 69% of all occupational strains and sprains among hospital workers were related to patient handling activities. Repositioning patients in bed caused the most strains and sprains, accounting for 18% of all injuries, followed by lifting objects, lifting patients, transferring patients between beds and chairs, and transporting patients.

Goldman, Jarrard, Kim, Loomis, and Atkins (2000) also found that patient handling was the major cause of back injury among 8,000 employees in a large teaching hospital in the U.S. during a 2-year period. The study reported that nursing personnel were at higher risk of back injury than other hospital workers, and that patient handling accounted for over 80% of the accidents in all nursing areas except the operating room. The average injury rate in all nursing areas was 9.8/100 FTE, which was more than two times greater than the hospital-wide injury rate of 4.6/100 FTE. Of significance for the population selected for the current study, the intensive care unit (ICU) was shown to have the highest injury rate, 14.2/100 FTE.

Epidemiological studies have provided evidence of an association between WRMSDs and physical exposure at work in nursing. In the U.S., Byrns et al. (2004) conducted a cross-sectional study in a random sample of 128 registered nurses from two hospitals. Physical workload was assessed as self-reported frequencies of patient and material handling tasks during a typical day. Work-related low back pain (WRLBP) was defined as any self-reported symptoms in the lower back that limited movement or interfered with work at home or on the job. The annual prevalence of WRLBP was 69.5% and the strongest risk factor for WRLBP was combined lifting defined as total frequency of all manipulations and lifting of patients or objects ($\beta = 0.03$, $p = .003$). Lee and Chiou (1994) conducted a large cross-sectional study among 3,159 female nursing personnel in Taiwan. The study found an annual prevalence for any LBP of 69.7%, and that lifting heavy objects at work was significantly associated with LBP, after controlling for age, work experience, and habits of posture when sitting (OR = 2.8, 95% CI 1.9-4.2). In Sweden, Engkvist, Hjelm, Hagberg, Menckel, and Ekenvall (2000) conducted a case-control study in a source population of 24,500 hospital nursing personnel in one county.

The study identified 240 back injury cases using work injury insurance claim data for a 32-month period and obtained 614 referents matched by sex and age. The study found that nurses who transferred patients once or more per shift had a 2.7 times higher risk for back injury compared to nurses who transferred patients at irregular intervals (RR = 2.7, 95% CI 1.6-4.5).

Prospective studies have provided better evidence for the causal relationship between patient handling tasks and WRMSDs. Compared to the risk estimates from the above cross-sectional or case-control studies, which ranged between 2.7 and 2.8, the following prospective studies report lower risk estimates ranging between 1.6 and 2.1. Smedley, Egger, Cooper, and Coggon (1997) conducted a prospective study among nurses employed by a university hospital trust in the United Kingdom. The study defined LBP as pain lasting for longer than a day and followed 961 female nurses who had been free from LBP for at least one month every three months over a two-year period. Among 843 nurses who completed at least one follow-up survey, 38% developed LBP and 11% developed LBP leading to absence from work. The risk of LBP was significantly increased by 1.6-2.1 times from the following patient handling tasks: lifting patients in or out of the bath with a hoist (OR = 2.1, 95% CI 1.2-3.6); manually repositioning patients in bed (OR = 1.7, 95% CI 1.1-2.5); and manually transferring patients between bed and chair (OR = 1.6, 95% CI 1.1-2.3). The risk estimates were adjusted for age, height, history of LBP, and symptoms other than back at baseline. Smedley et al. (2003) conducted another prospective study of neck/shoulder pain, following 903 female nurses over two years. Among 587 nurses who completed at least one follow-up survey, 34% reported at least one episode of neck/shoulder pain. Patient handling tasks such as washing/dressing a patient on a chair/commode, moving a patient around in a wheelchair or bed, or assisting a patient to mobilize using assistive devices were found to significantly increase the risk of neck/shoulder pain by 1.6-1.7 times.

In a large prospective study, Eriksen et al. (2004) investigated predictors of intense LBP and LBP-related sick leave in a random sample of 4266 nurses' aides in Norway. The sample included those who were not bothered or only a little bothered by LBP during three months. Follow-up rates were 86-89% at 3 months and 15 months. At the 3-month follow-up, the incidence of intense LBP (defined as rather or very intensely bothered by LBP) and sick leave was 14.1% and 4.0%, respectively. At the 15-month follow-up, the incidence of the sick leave lasting longer than two weeks and eight weeks was 6.3% and 3.3%, respectively. The study found that positioning patients in the bed 5-9 times per shift increased the risk of intense LBP during the next three months by 1.6 times (OR = 1.6, 95% CI 1.1-2.3), controlling for eight other significant predictors (e.g., previous LBP, number of preschool children, fatigue/fitness, etc). For sick leave lasting longer than eight weeks, lifting, carrying, and pushing heavy objects 5-9 times per shift was a significant predictor of LBP (OR = 2.2, 95% CI 1.2-4.2).

In a cross-sectional study by Alexopoulos, Burdorf, and Kalokerinou (2003), work postures were shown to be associated with WRMSDs. The study investigated risk factors for musculoskeletal pain among 351 nursing personnel in six Greek hospitals using self-administered questionnaires. The annual prevalence of musculoskeletal pain continuing for at least a few hours was 75% for back, 47% for neck, and 37% for shoulders. Frequent awkward back posture (bending and twisting) was significantly associated with LBP (OR = 1.85, 95% CI 1.02-3.35) and neck pain (OR = 1.88, 95% CI

1.17-3.02), controlling for age and perceived general health. Frequent exposure to strenuous shoulder movement was significantly associated with shoulder pain, controlling for age, perceived general health, and manual materials handling (OR = 1.87, 95% CI 1.06-3.30).

As reviewed in the above, studies have shown the high prevalence of WRMSDs in nurses and the increased risk of WRMSDs, up to three times, from various tasks of patient handling, frequent or heavy lifting, and awkward postures. Although each study has its own limitations (discussed later), the cumulative evidence from studies with better designs such as a prospective design and large random samples is considered to be sufficient to understand the risk from physical work for nurses.

As the biomechanical risk from patient handling tasks has been identified, engineering solutions, including lifting equipment, have been employed to reduce the risk of WRMSDs in nursing personnel. The use of lifting equipment has significantly contributed to the reduction of WRMSDs and has been recognized as an effective strategy for WRMSDs prevention (Evanoff, Wolf, Aton, Canos, & Collins, 2003; Owen et al., 2002; Trinkoff et al., 2003). However, occupational health statistics, such as BLS, still show high incidence of WRMSDs among health care workers. This suggests that the increasing use of lift equipment has not been sufficient. These continued high incidence rate may also be due to lack of availability of lifting equipment. In addition, interventions targeted only at physical work factors may not address all of the relevant risk factors. It is likely that personal and psychosocial work factors also play important roles. A comprehensive understanding of WRMSDs is therefore needed to find a better solution. For example, none of the above studies considered the potential effect of risk perception or safety behavior in examining the association between physical work factors and WRMSDs. Research addressing this gap would provide a better understanding of risk from physical work, which may be modifiable by the individual nurse's play.

Psychosocial Work Factors

In the literature, the term "psychosocial factors" has been used to refer to a wide range of nonphysical work-related variables. These include job-level factors such as job demand and decision latitude, workplace-level factors such as organizational climate and culture, and psychological attributes such as job satisfaction and personality traits (Sauter & Swanson, 1996). In this section, psychosocial work factors refer to psychosocial variables more directly related to jobs, not the organizational environment as a whole. Workplace organizational factors and individual psychological factors are reviewed in the following sections.

Psychosocial factors have been examined for their relationships with WRMSDs in many studies conducted in diverse occupational settings (Bernard, 1997; Davis & Heaney, 2000; Hartvigsen, Lings, Leboeuf-Yde, & Bakketeig, 2004). Existing literature shows inconsistent results across studies, but considerable evidence of significant associations between psychosocial factors and WRMSDs has nonetheless accumulated. A review study by the NRC and IOM (2001) reported strong evidence of an association of back pain with low job satisfaction, monotonous work, poor social support, high perceived stress, and high perceived job demands.

Studies of nurses have also suggested that psychosocial work factors independently contribute to the development of WRMSDs. In a cross-sectional study of 688 Swedish female nurses, Lagerstrom et al. (1995) found significant associations between psychosocial factors and WRMSDs. The prevalence of ongoing symptoms was 56% for low back, 53% for shoulders, and 48% for neck. In their study, significant psychosocial factors included low supervisor support for low back and neck symptoms and low work control for shoulder symptoms (OR ranging from 1.7 to 2.0). In addition, neck symptoms were found to be associated with low work commitment (OR = 1.7, 95% CI 1.1-2.5), but this unexpected relationship has not been replicated by other studies. This study also investigated significant factors for severe symptoms, defined as symptom rating of six or greater in a 0-9 scale. High work demands were significantly associated with severe neck symptoms (OR = 1.8, 95% CI 1.1-2.9) and severe shoulder symptoms (OR = 1.7, 95% CI 1.1-2.6). However, for physical work variables, this study used qualitative measures of the type of ward and job titles, less precise than quantitative measures, such as frequency of patient handlings. The study therefore may not control sufficiently for physical work factors in the association between psychosocial factors and WRMSDs.

Another Swedish study investigated the impact of job strain, which was defined as high job demand and low decision latitude, on WRMSDs in female hospital nursing personnel (Josephson et al., 1997). The researchers conducted four annual cross-sectional surveys (n ~ 419 - 565) and followed the baseline cohort over three years (completed follow-up rate of 50.4%). The prevalence of any musculoskeletal symptoms in neck, shoulder, or back was 84% in the baseline survey. By restricting symptom cases to those with ongoing symptom scores greater than six (range 0-9), the prevalence of cases ranged between 33-36% in the cross-sectional surveys and 34-35% in the prospective cohort portions. In the four serial cross-sectional surveys, job strain was significantly associated with musculoskeletal symptoms in two surveys (OR = 1.5, 95% CI 1.1-2.1), and not in the other two surveys (OR = 1.1, 95% CI 0.8-1.6), after controlling for age, occupation, and physical exertion. In the prospective cohort data, however, job strain was not significantly associated with musculoskeletal symptoms. This latter prospective finding provides more confirmative evidence than the cross-sectional findings, but the smaller sample size of 172, the high rate of lost-to-follow up, and the absence of information regarding changes in exposure over follow-up periods limits the strength of these findings. Since the composite variable of job strain has been rarely examined in studies of nurses, the significant finding in the cross-sectional data, although problematic, provides useful information for future research.

Significant associations were found between psychosocial factors and WRMSDs in a prospective study by Nahit et al. (2003). The study was conducted in 1,081 newly employed workers from 12 diverse occupational groups including 87 nurses. After one year, 77% of the sample remained in the study. The study defined the outcome as pain occurring in the past month and lasting for longer than 24 hours in low back, shoulders, knees, or forearms. Significant predictors of musculoskeletal pain included monotonous work, stressful work, hectic work, and dissatisfaction with support from colleagues. The risk estimates ranged between 1.6 and 1.7, adjusted for age, sex, and region of pain. However, the study did not control for physical work factors. In addition, given that the nurse group accounted for less than 10% of the sample, the study findings may not be generalizable to the general nurse population.

Eriksen et al. (2004) provided supporting evidence regarding the effect of psychosocial factors on WRMSDs in health care workers. In their prospective study of

4,266 Norwegian nurses' aides, the risk of intense LBP at the 3-month follow-up point was significantly reduced by support from their immediate supervisor (OR = 0.6, 95% CI 0.4-0.9) and the risk of LBP-related sick leave longer than three days was significantly increased by work demands (OR = 2.3, 95% CI 1.3-3.9). These analyses of psychosocial factors controlled for the frequency of positioning patients, an indicator of physical workload, and thus this study provides strong evidence.

The reviewed studies suggest a meaningful contribution of psychosocial factors to WRMSDs in nursing personnel even after physcial workload is taken into account. Important psychosocial work factors that should be considered in the intervention for WRMSDs include support from supervisor or coworkers, psychological work demands, job control, and potentially job strain.

Workplace Organizational Factors

Compared to physical and psychosocial work factors, there has been little research on the effect of workplace organizational factors on WRMSDs. The role of workplace organizational factors has been investigated primarily in research on generic occupational injuries. According to a review by the NRC and IOM (2001), characteristics of workplaces with a lower rate of lost-time injuries or fewer lost workdays include commitment to worker health and safety, involvement of the workers in decision making, and availability of modified work.

Stone and Gershon (2006) examined the relationship between organizational climate and work-related injuries among ICU nurses. The researchers obtained incident reports from 39 ICUs across the U.S. and cross-sectional survey data from 837 nurses. Organizational climate was measured using the perceived nurse work environment scale.

ICUs with more positive organizational climates were found to have significantly lower rates of musculoskeletal injury and any injury whereas blood and body fluid exposures were not associated with organizational climate. The study provided evidence supporting the role of organizational climate in preventing occupational injuries. However, the study did not control for any confounding factors in their analysis.

Piirainen, Rasanen, and Kivimaki (2003) found a significant association between organizational climate and work-related symptoms after controlling for age, sex, and physical and psychological variables. The researchers conducted a population-based cross-sectional survey in a random sample of 4,209 currently employed Finnish workers, including health care workers. Work-related symptoms were defined as persistent or recurring symptoms in the past six months that were caused or made worse by work. They found that work-related musculoskeletal symptoms were significantly associated with a charged and tense organizational climate (OR = 1.5, 95% CI 1.2-1.8) and with an outmoded and prejudicial organizational climate (OR = 1.3, 95% CI 1.1-1.6).

Eriksen et al. (2004) provided further supporting evidence of a protective role of organizational culture in their prospective study of 4,266 Norwegian nurses' aides. The study found that intense LBP at the 3-month follow-up was significantly fewer among those who reported a relaxing and pleasant culture in the work unit (OR = 0.5, 95% CI 0.2-0.9). LBP-related sick leave longer than three days was also significantly less common among those who reported a supportive and encouraging culture in the work unit (OR = 0.4, 95% CI 0.2-0.8). These significant associations were found after controlling for physical and psychosocial work factors.

Safety climate, which has emerged as an important organizational concept in occupational safety over the past two decades, has been examined in a number of studies of health care workers. In general, safety climate is defined as shared perceptions by the employees about the safety of their work environment (Gershon et al., 1995; Zohar, 1980). Felknor, Aday, Burau, Delclos, and Kapadia (2000) conducted a cross-sectional study in a random sample of 878 hospital workers in ten Costa Rican hospitals selected by stratified cluster sampling. The study found that better safety climate was significantly associated with better safe work practice as well as with fewer work-related injuries including back injuries ($p = .00001$). However, potential confounders were not controlled for in their analyses. After three years, the researchers conducted another cross-sectional survey using the same source population. The final sample included 475 hospital workers. After controlling for occupational and organizational variables (occupational hazards, safety training, safety practices, etc.), better safety climate was found to be associated with lower rates of work-related injuries (RR = 1.51, 95% CI 1.06-2.15).

Gershon et al. (2000) also found significant associations between safety climate and safe work practices as well as blood and body fluid exposure incidents in a cross-sectional study of 789 U.S. hospital workers. In their study, three safety climate subfactors were found to be associated with safe work practices compliance: cleanliness of work area (OR = 3.3, 95% CI 2.2-4.9), managerial support (OR = 2.3, 95% CI 1.5-3.4), and absence of job hindrances (OR = 1.5, 95% CI 1.0-2.3). Fewer exposure incidents were associated with strong managerial support (OR = 0.6, 95% CI 0.4-0.8) and frequent feedback and training (OR = 0.4, 95% CI 0.2-0.8). Demographic factors were controlled for in those analyses.

The impact of organizational or safety climate on safe work practices or occupational health problems in health care workers has been well identified by the reviewed studies. Stone and Gershon's study identified its significant impact at the level of work units whereas the other studies found that it operated at the individual level. The significant role of organizational or safety climate would be better supported by combining these two different approaches with regard to the unit of analysis.

Individual Factors

A worker's ability to respond to work factors may be modified by personal characteristics (Bernard, 1997). The literature was reviewed to understand the effect of individual factors on WRMSDs. Individual factors reviewed include previous symptoms, age, gender, anthropometry, general health and psychological well being, and non-occupational physical activities.

Previous Symptoms

A previous history of symptoms, in particular a recent and prolonged occurrence, has been identified as a strong predictor of WRMSDs in many studies. In prospective studies by Smedley et al. (1997, 2003), previous history of a symptom was found to be the strongest risk factor for back, neck, and shoulder pain. LBP risk increased with a longer duration and shorter intervals of previous pain. For nurses who had pain for 1-6 days within one year, the risk of new LBP was three times greater than for nurses who had no previous pain (OR = 3.4, 95% CI 2.0-5.8). For pain that lasted over one month in total within one year, the risk of LBP increased by six times (OR = 6.1, 95% CI 4.1-9.1). The risk of neck and shoulder pain was highest among nurses with previous pain that lasted over 4 weeks in total within the past year (Hazard ratio [HR] = 3.3, 95% CI 1.9-

5.8). These estimates were obtained with adjustment for age, height, BMI, and mood.

A study by Feyer et al. (2000) provides more evidence on a previous symptom as a strong predictor of LBP. They followed 694 Australian nursing students during their three-year training and one year after training. Among the students, 7% developed one episode of LBP and 36% developed multiple episodes of LBP. Nursing students who had a history of back pain within one year at the baseline had a three times higher risk of developing LBP during training than those who did not (OR = 3.1, 95% CI 2.3-4.1). For students with recurrent LBP during training, the risk of LBP while working as a nurse increased by six times (OR = 6.4, 95% CI 3.2-12.7). The odds ratios were obtained with adjustment for general health, job dissatisfaction, life events, working part time, or working as nurse.

Risk estimates obtained in the above two studies are much greater than those from physical or psychosocial work factors. Since important physical and psychosocial work factors, such as those reviewed in the previous sections, were not included for adjustment, the studies might overestimate the risk from previous symptoms. However, such overestimation would not discolor the significant effect of previous symptoms on the development of future musculoskeletal symptoms.

Age

Age may contribute to the development of WRMSDs. Musculoskeletal function may be decreased due to the development of age-related degenerative disorders, while the probability or severity of soft tissue damage from a given insult may be increased due to the loss of tissue strength with age (Bernard, 1997). Overall, studies report inconsistent findings about the association between age and WRMSDs.

In a Swedish case-control study by Engkvist et al. (2000), the risk of back injury by patient transfer was higher among nurses older than 40 years (RR = 3.7, 95% CI 1.8-7.6) compared with nurses 40 or less than 40 years (RR = 3.1, 95% CI 1.9-4.7). When they dichotomized age at 50, the risk increased greatly for nurses older than 50 years (RR = 6.3, 95% CI 1.8-22.9) compared with younger nurses (RR = 2.9, 95% CI 1.9-4.7). In a cross-sectional study conducted in Greece by Alexopoulos et al. (2003), age was significantly associated with shoulder pain, controlled for physical work factors and perceived general health. Nurses over 40 years old reported shoulder pain approximately four times more than nurses less than 35 years old (OR = 3.6, 95% CI 1.9-6.9). However, there was no association between age and low back or neck pain. In a cross-sectional study in Italy, Violante et al. (2004) found that the risk of lumbar disc herniation increased by 8% for a 1-year increase in age among female nursing personnel (OR = 1.08, 95% CI 1.04-1.13). However, age was not associated with acute or chronic LBP. In contrast, in a U.S. prospective study by Myers, Silverstein, and Nelson (2002), a protective effect of age was found on back and shoulder injuries, giving a 5% reduction in the risk of back and shoulder injuries for a 1-year increase in age (OR = 0.95, 95% CI 0.92-0.98). Three differences might contribute to the contrary finding of this study. The setting for this study was a nursing home and the study sample was nursing assistants only, whereas the other international studies were conducted in hospitals and their study samples included registered nurses and other staff. In addition, the median age of this study sample was only 27 years (mean was not provided), whereas the mean age of the study samples was 34- 37 years in the other international studies.

Overall, the effect of age on WRMSDs is still inconclusive. However, studies generally consider age a potential confounder and adjust for its effect in examining the association between WRMSDs and risk factors.

Gender

Gender differences are a common research interest. Studies on WRMSDs also have investigated gender difference. However, because the nursing occupation consists mostly of women, women comprise the majority of study populations in research on nursing personnel. Accordingly, even though a study may include male nurses, data analysis is often restricted to female nurses.

Studies in other occupational settings provide knowledge about gender differences in WRMSDs. According to a NIOSH review (Bernard, 1997), some studies report higher prevalence of MSDs in women, but in general, study findings are inconsistent. Gender differences observed in some studies may be due to physiological differences or exposure differences. Women may be more likely to report pain (Barsky, Peekna, & Borus, 2001; Wijnhoven, de Vet, & Picavet, 2007), and this reporting bias can contribute to the observed gender difference. Thus, the role of gender in WRMSDs remains unclear.

Anthropometry

Personal physical factors including anthropometry are frequently included in the investigation of risk factors for WRMSDs. Many studies report that WRMSDs are not associated with either weight or body mass index (Ando et al., 2000; Engkvist et al., 2000; Yip, 2001). On the other hand, height, in particular tall height, has been shown to be a risk factor for WRMSDs in some studies (Adams, Mannion, & Dolan, 1999; Botha & Bridger, 1998; Smedley et al., 1997).

Botha and Bridger (1998) measured anthropometric data on 27 body dimensions in a volunteer study population of 100 South African female nurses, and examined the association between anthropometric data and musculoskeletal pain. LBP was significantly associated with stature and abdominal depth, and the most vulnerable group was nurses in the 4^{th} quartile of these dimensions. Neck/shoulder pain or shoulder/arm pain were significantly associated with stature, standing shoulder height, or grip reach, and the most vulnerable group was nurses in the 1^{st} quartile of each dimension.

In a prospective study, Adams et al. (1999) examined the effect of physical factors on LBP in 403 Swiss health care workers. Study participants underwent a functional assessment for anthropometry, muscle strength, endurance, mobility, and posture and were followed every 6 months for three years. Significant physical predictors of serious LBP, which was defined as LBP requiring medical attention or time off from work, were a long back, reduced lumbar lordosis, and reduced range of lumbar lateral bending. At the 24-month follow-up, relative risks of serious LBP were 1.9 (95% CI 1.1-3.3) for trunk length, 1.8 (95% CI 1.0-3.2) for reduced lumbar lordosis, and 2.5 (95% CI 1.4-4.5) for reduced range of lumbar lateral bending. Stronger associations were found in a subgroup of student nurses (n=125). A long back and reduced lumbar lordosis increased the risk of serious LBP among these student nurses by 4.7 times (95% CI 1.7-13.1) and 6.5 times (95% CI 2.0-20.8), respectively.

Although physical or psychosocial work factors were not controlled for in the associations of anthropometic factors with WRMSDs, the reviewed studies suggest that tall nurses are at higher risk for LBP and short nurses are at higher risk for shoulder problems. Therefore, the anthropometric factor, particularly height, should be considered in the design of equipment and workstation for nurses to reduce musculoskeletal stress and prevent WRMSDs. Moreover, precautions for musculoskeletal safety should be emphasized for those at higher risk.

General Health and Psychological Distress

General health and psychological distress also have shown an association with WRMSDs. In a cross-sectional study by Alexopoulos et al. (2003), perceived general health status was significantly associated with LBP (OR = 4.4, 95% CI 2.3-8.1), shoulder pain (OR = 2.9, 95% CI 1.7-4.9), and neck pain (OR = 2.8, 95% CI 1.7-4.4), controlling for age and physical work factors.

Psychological factors were shown to be significantly associated with WRMSDs in a number of prospective studies. Nahit et al. (2003) measured psychological distress with the 12-item General Health Questionnaire (GHQ-12), which assesses current psychological symptoms of anxiety and depression. For workers who reported a GHQ-12 score greater than zero out of 12, the risk of pain in the low back, shoulders, knees, or forearms increased by two times (OR ranging from 2.1 to 2.3), with adjustment for age and sex. However, using a GHQ-12 score of zero as a cut-off point is questionable in differentiating psychological distress. Feyer et al. (2000) examined the association between psychological distress and LBP using the 28-item of GHQ (GHQ-28) in their study of nursing students. Psychological distress was defined as a GHQ-28 score greater than 5. The study also found significant associations of psychological distress with LBP during training (OR=1.4, 95% CI 1.1-1.7) and LBP at one year after finishing training (OR=2.7, 95% CI 1.4-5.1). These findings were obtained with adjustment for previous LBP, job dissatisfaction, life event, or job status. Additionally, in a study by Smedley et al (1997), frequent low mood was associated with absence from work for back pain (OR=3.4, 95% CI 1.4-8.2), controlling for age and BMI.

Compared with risk estimates for psychosocial work factors in this review (OR 1.5-2.0), personal psychological factors are shown to have a somewhat greater impact on WRMSDs (OR 1.4-3.4). However, psychological distress may ensue from psychosocial work factors, especially job stress. Thus, combining work and individual factors, psychosocial factors are understood as to make an important contribution to WRMSDs.

Non-occupational Physical Activities

Physical activities of all kinds can cause MSDs. However, of greater interest in research about WRMSDs is a protective role of physical exercise in MSDs. Many intervention programs have used regular exercise. Physical activity, in particular regular exercise, enhances the strength and endurance of musculoskeletal systems and consequently, may reduce susceptibility to musculoskeletal injury and reduce the risk of WRMSDs. In a study by Byrns et al. (2004), a significant association between exercise and LBP was found in bivariate analysis, but their association was not maintained after controlling for physical and psychosocial factors. Likewise, other studies have not found a significant association between physical activity and WRMSDs (Eriksen et al., 2004; Feyer et al., 2000; Smedley et al., 1995; Violante et al., 2004). Therefore, the protective role of physical activity in WRMSDs today has not been supported by scientific evidence.

Work At Home

In research on work-related disorders, one challenge is to separate the effect of exposure related to paid work from the exposure related to non-occupational work activity such as chores at home. In particular, since the majority of nursing personnel are female workers, work at home that is frequently performed by women homemakers can be a potential confounder in the association between occupational risk factors and WRMSDs. To measure the exposure of work at home, many studies have used the proxy variable of the number of children. In a study by Violante et al. (2004), motherhood was associated with chronic LBP in bivariate analysis, but not in the multivariate analysis. Most studies did not find significant associations between the number of children and WRMSDs (Ahlberg-Hulten, Theorell, & Sigala, 1995; Ando et al., 2000; Smedley et al., 1995; Yip, 2001). This suggests that the effect of work at home on MSDs may be insignificant or minimal.

Among the individual factors reviewed, the effects of previous symptoms and psychological distress on WRMSDs are relatively well supported by literature. This highlights the importance of primary prevention of WRMSDs to prevent future problems and the significant contribution of psychological components to WRMSDs.

Common Methodological Issues in Studies of WRMSDs

Reviewing literature on WRMSDs uncovers common methodological issues that should be considered in interpreting study findings and in designing future research. Those methodological issues include causality, selection bias, measurement issues, and confounding.

Causality

Study design imposes a major limitation on the causal inference of the observed associations between risk factors and WRMSDs. The majority of studies reviewed used a cross-sectional design. This cross-sectional design does not establish the temporal sequence between exposure and outcome, and thus, the causality is usually questionable except with unchangeable variables such as age and gender. For example, work-related risk factors may change for workers with back pain who move to less stressful or less physically demanding jobs because of their injuries, leading to an underestimation of the association between exposure and outcome (Davis & Heaney, 2000).

On the other hand, a prospective study design may allow us to establish causality since the exposure precedes the outcome. Accordingly, evidence provided from cross-sectional studies has been reinforced or weakened by prospective studies. For example, social support or work demand was found to be significantly associated with musculoskeletal symptoms both in a cross-sectional study by Lagerstrom et al. (1995) and in a prospective study by Erikson et al. (2004). The same finding obtained by the prospective study made the evidence stronger. On the contrary, in a study by Josephson et al. (1997), the association between job strain and musculoskeletal symptoms was found to be significant with cross-sectional data, but not with prospective data, leading to loss of strength of evidence.

The literature review reveals that case-control studies have rarely been conducted to study WRMSDs in nursing personnel and only one case-control study was included in this review of risk factors. A case-control design is commonly used in occupational epidemiology due to its time and cost effectiveness. However, in case-control studies, selection of appropriate controls is a critical key to obtain valid findings and the vulnerability to recall bias compromises the establishment of a causal relationship.

Selection Bias

Selection bias can mislead the study findings. In a cross-sectional study, self-selection bias or survivor bias may result in overestimation or underestimation of the prevalence of WRMSDs. For example, workers with current or past symptoms or injury experience may be more likely to participate in studies, inflating the prevalence of WRMSDs. Therefore, the participation rate in a study is an important concern. In this review, participation rates range between 45-99%. Lower response rates limit the representativeness of the target population as well as risk introducing inaccuracy in study estimates. If possible, comparison of characteristics between respondents and non-respondents should be performed to check if there is any significant difference between them. On the other hand, healthy survivor effect may affect study findings. For example, those who have severe symptoms or injuries may leave work temporarily or permanently due to disability, and accordingly, the study population may not include these severe cases. The consequence of this exclusion may deflate the prevalence of WRMSDs or distort the true relationship between exposure and outcome.

In a prospective study, lost-to-follow up can be a source of selection bias. The reason for dropout can be related to the outcome in either direction. Severe cases may leave work and result in lost-to-follow up as mentioned above, or those who have no symptoms may drop out of the study due to less motivation. In this review, drop-out rates range between 10-50%. Rigorous effort should be made to minimize attrition or to track the reason of lost-to-follow up. Smedley et al.'s study (1997) shows a good example of this tracking effort. At the end of the study period, they sent the final questionnaire to those who dropped out. Although information was not available from all of the drop-outs, a study could document the strength of the results by citing similar incidence rates between them and those who completed the follow-ups.

Measurement Issues

Information bias is a major issue that can threaten the internal validity of the study. In the review of previous studies on WRMSDs, measurement issues including information bias are raised in several ways.

First, the lack of a standardized measure of the outcome is a challenge for research on WRMSDs. The definition of WRMSDs varies across studies, and this interferes with comparison of study findings. The majority of studies have assessed self-reported symptoms for outcome, and WRMSDs have been defined with the following bases: frequency of symptoms, duration of symptoms, or severity of symptoms. In addition, the period of measuring WRMSDs varies between the present, in the last month, and in the last year. Consequently, the prevalence of WRMSDs or their association with exposure can be influenced by these differences in the case definition. For example, a prospective study by Josephson et al. (1997) used a case definition of ongoing and severe symptoms, and did not find an association with job strain. Employing a more restricted case definition may lead to an underestimation of the association between risk factors and WRMSDs.

Another problem in the outcome measure is that most WRMSDs are symptoms rather than diseases (Byrns, Bierma, Agnew, & Curbow, 2002). Studies on LBP, the most frequently studied area, show that most cases are idiopathic. A study reported that 75% of LBP cases were classified into non-specific etiologies and only 3% had a specific medical diagnosis (Krause, Dasinger, Deegan, Rudolph, & Brand, 2001). This non-specific nature of musculoskeletal outcomes brings about a challenge in validating the outcome of WRMSDs. The determination of outcome work-relatedness is another major challenge. In order to assess "work-related" symptoms or injuries, studies have mostly excluded symptoms or injuries that were definitely caused by non-occupational activities or medical conditions such as pregnancy.

Next, the measure of exposure also varies across studies of WRMSDs. A number of different measures have been used to assess physical or psychosocial exposure at work (although this variety may reflect research efforts to identify risk factors more comprehensively). Regarding psychosocial factors, the job strain model has been used predominantly for measurement, and the Job Content Questionnaire has established psychometric properties for validity and reliability (Karasek et al., 1998; Seago & Faucett, 1997). However, a wide variety of psychosocial variables and instruments exist in the literature, and the validity and reliability of some measures have not been well documented. For physical exposure, the use of different measures or cut-off points makes direct comparison of findings across studies difficult. For example, measures for physical workload used in studies of nursing personnel have included from the job category or work units to the frequency of patient handling, the frequency of manual material handling, physical exertion, or work postures (Alexopoulos et al., 2003; Josephson et al., 1997; Lagestron et al., 1995; Smedley et al., 2003). Examples of cut-off points used for the frequency of patient handling tasks include none versus one or more (Engkvist et al., 2000) and tertile points (Yip, 2001). Misclassification resulting from imprecise measurements can bias the association between risk factors and WRMSDs.

Lastly, the majority of WRMSDs studies have largely relied on self-reported data and this raises a well known concern about reporting bias. In some studies, injury report data such as injury records (e.g., the OSHA log) and workers' compensation data were used for outcome measures. These data sources may underestimate the problem due to underreporting. According to a survey by ANA (2001), 75% of nurses did not report injuries, and 40% did not report injuries that occurred on the job. Therefore, active survey data may be a better data source to capture the actual magnitude of the problem than passive data sources such as injury records. However, survey data are usually self-report measures, thus including potential reporting bias or recall bias. The perception or reporting of occupational stressors may be influenced by affective and attitudinal reactions to the job or personality traits such as negative affectivity (Greiner, Ragland, Krause, Syme, & Fisher, 1997). Nurses who have symptoms or an injury experience, for example, may overreport physical or psychosocial work factors, because of their discomfort or heightened sense of vulnerability. Some studies show that self-report may overestimate exposure to physical risk factors, compared to observation or direct measurement (Spielholz, Silverstein, Morgan, Checkoway, & Kaufman, 2001). Other studies, however, suggest that workers can make good estimations of their exposure to ergonomics hazards (Faucett & Rempel, 1996). In addition, social desirability and common method bias are concerns in using self-reported measures. Social desirability refers to a tendency to behave or report in a socially acceptable or desirable way rather than reflect one's true feelings or states. Using the same method of self-report in measuring both stressors and health outcomes, the shared response sets may cause a common method variance bias, which means a tendency to complain of both work conditions and health conditions could lead to spurious associations (Greiner et al., 1997). For physical exposures at work, the quality of self-reported data may be questionable in terms of reliability or accuracy.

As such, due to this subjectivity and potential reporting bias, studies based on self-report have limited the strength of evidence on the observed association between risk factors and WRMSDs. Accordingly, the use of self-report for outcome and exposure measures requires more rigorous consideration if the self-report measures achieve relevant validity and reliability. Regarding the reliability of self-reported symptoms, some studies have documented good reliability (Eriksen et al., 2004). Walsh and Coggon (1991) reported good agreement on self-reported LBP between two measures at an interval of 12 months ($k = 0.82$). For physical exposure, a review by Davis and Heaney (2000) notes limited accuracy of self-reports of biomechanical work demands and moderate correlation between self-reports and expert observations. For example, the duration of lifting and trunk flexion, in general, have been overestimated by self-reports as compared with direct observations. Davis and Heaney further report that LBP studies that use more reliable and valid measures of biomechanical factors show more consistent and stronger relationships with biomechanical factors, but less consistent relationships with psychosocial factors.

Confounding

Confounding is an important consideration especially in observational epidemiological studies. The multifactorial origin of WRMSDs raises a more complicated requirement to control for confounding factors to determine the relationship between the suggested risk factor and WRMSDs. Each risk factor of physical, psychosocial, and individual origin can act as a potential confounder for the other risk factors. Lack of control for potential confounders may distort the association between risk factors and WRMSDs, and thus weaken the strength of evidence regarding the observed association between the risk factor and WRMSDs.

According to Davis and Heaney's (2000) review of studies on psychosocial factors and LBP, in general there were only minor differences in the results between unadjusted models and adjusted models for demographic variables. This indicates that demographic variables have at most a minimal confounding effect on the association between psychosocial factors and LBP, for example. On the other hand, they found that the inclusion of biomechanical factors in the model resulted in a 20% increase in null study findings. This suggests that the effect of psychosocial factors on WRMSDs cannot be determined more accurately without adequate control for biomechanical factors.

Gaps in Previous Research on WRMSDs

As reviewed here, considerable research effort has been made to identify risk factors for WRMSDs in nursing personnel. Nonetheless, relatively little attention has been paid to the intervening role of individual workers through perception or behaviors. The aim of the majority of WRMSDs research has been to identify job-level risk factors for WRMSDs and determine their relationship. In the link between job risk factors and WRMSDs, workers' perception of risk or work behavior may act as preventive or another risk factor and moderate their relationships. Workers who are well aware of risk from work may behave more safely and follow safety rules more strictly while performing job tasks, leading to better protect themselves from work-related injury or health problems. However, the moderating roles by individual workers' risk perception or safe work behavior have not been well explored in research on WRMSDs in nurses.

Existing interventions have not totally eliminated the risk for WRMSDs, and many of these, such as lift equipment, require safe work behavior to appropriately implement. Furthermore, workplace-level interventions, in reality, are not easily implemented and immediately available in many work settings. Therefore, worker-level interventions may also be a crucial part in preventing WRMSDs. Research on the roles of risk perception or safe work behavior in WRMSDs may provide helpful information for designing more effective worker-level interventions.

In addition, there is little research exploring organization-level factors. For example, organizational safety climate, which has been studied extensively in occupational safety research and also in research on health care workers, has been identified as a significant factor affecting needlestick injury rates and compliance with safe work practices (Felknor et al., 2000; Gershon et al, 2000). However, safety climate has not been well investigated for its contributions to WRMSDs. Research on safety climate may help understanding the role of organizational-level factors in preventing WRMSDs.

The constructs of risk perception and safe work behavior were explored as outcome variables in the present study, and safety climate was also included as an independent variable. In the following two sections, literature about risk perception and safe work behavior are reviewed. Since there is a paucity of research on risk perception and safe work behavior related to WRMSDs in nurses, the literature review includes studies of other populations or occupations.

Risk Perception

Risk perception is a central concept in health behavior theories such as the Health Belief Model and the Protection Motivation Theory (Janz & Becker, 1984; Rogers, 1975). In such theories, risk perception is a key motivator of personal behavior change.

According to the theories, risk is perceived in terms of the *likelihood* of an undesirable event and the *severity* of negative consequences; *likelihood* is also referred to as *susceptibility* or *vulnerability*. In the research literature to date, risk perception has been associated with undertaking various health behaviors such as cancer screening, exercise, smoking cessation, vaccination, or adherence to treatment. However, meta-analytic studies report that the relationships between risk perception and these health behaviors are weak, with effect sizes obtained with using Pearson correlation *r* ranging from .08 to .26 (Brewer et al., 2007; Floyd, Prentice-Dunn, & Rogers, 2000; Harrison, Mullen, & Green, 1992). Therefore, although risk perception is understood as an important determinant for health behaviors, human health behavior is a complex phenomenon involving multiple factors and the role of risk perception takes only a small part in explaining health behavior.

Influenced by these theories, occupational health studies have also examined the relationship between risk perception and safe work behavior or occupational health outcomes, and studies provide inconsistent findings. Tomas, Melia, and Oliver (1999) conducted a cross-validation study to test a model of occupational accidents in three Spanish workers samples (n ~ 123 – 182). The study hypothesized that the actual level of risk is determined by the combination of hazards and safety behavior of the workers. Using structural equation modeling (SEM), the study found significant inverse associations between safety behavior and perceived risk in all of the three samples. In addition, perceived risk was shown to predict accidents in all three samples. In a study of Australian dentists and dental hygienists (n = 758), Waddell (1997) found that higher risk perception was associated with more conservative and cautious approach to HIV infection. However, the study did not control for any confounders in the analysis. Arezes and Miguel (2006) also reported a significant association between risk perception and the use of hearing protection devices in a 434 Portuguese industrial workers. However, in that study, risk perception referred to knowledge about potential risk sources, and thus this definition is different from the theoretical concept of perceived susceptibility or likelihood used in other studies reviewed.

The lack of relationship between risk perception and safety behavior, on the other hand, was shown in a number of studies. Rickett, Orbell, and Sheeran (2006) investigated predictors for the use of hoist in a prospective study of 379 U.K. health care workers. Hoist usage was assessed 6 weeks later and 189 workers responded to this follow-up survey. Perceived susceptibility to back problems was shown to be significantly associated with the use of hoist in the bivariate analysis (r = -.21, p < .05), but not in the multivariate analysis, which controlled for hoist availability, injunctive norm, perceived behavioral control, response benefits, response costs, and social and physical costs of not using a hoist. In a study using SEM, Seo (2005) tested a model of unsafe work behavior in a sample of 722 U.S. grain industry workers and also found no direct relationship between risk perception and safety behavior. Using LISREL, Rundmo (1996) also failed to find a direct relationship between risk perception and risk behavior in a sample of 1,138 offshore oil installation workers in Norway.

The studies reviewed show inconsistent findings about the association between risk perception and safe work behavior, and the lack of their relationship may be better supported by the latter three studies with a prospective design, larger sample sizes, and controls for confounders or covariates. However, the reviewed studies were conducted with different types of worker populations in industry settings or health care settings as well as different measures of safety behaviors such as a specific behavior of hoist usage or a range of safe work behaviors. Therefore, more research is needed to reach a well grounded conclusion about the relationship between risk perception and safe work behavior.

Regarding the relationship of risk perception with occupational injury, Cordeiro (2002) conducted a case-control study in a sample of 465 Brazilian metallurgical factory workers. Controls were matched to injury cases on work sector and job occupied at the time of injury. The study defined risk perception as the capacity to identify and quantify an occupational risk present in work processes and the work environment. The study found that at the time of injury, injured workers perceived significantly greater risk than non-injured workers for not complying with safety instructions, but lower risks for working with machines with malfunctioning safety devices and for handling materials without proper care. Recall bias might contribute to the findings of this study. However, the study suggests that low risk perception may contribute to the occurrence of occupational injuries, and also indicates the necessity of understanding the role of risk perception in the design of injury prevention programs.

In literature on WRMSDs, only a little information exists about risk perception. Risk perception was included in two studies of nurses by Daraiseh et al. (2003) and Yeung, Genaidy, Deddens, and Sauter (2005). However, the two studies included risk perception as only one dimension of the variables of *work demand* or *workload exposure,* and did not examine the unique relationship between risk perception and WRMSDs. The variables including risk perception were found to be associated with musculoskeletal symptoms, but we cannot determine the unique role of risk perception.

A study by Landry (2006) provides information about predictors for perception of injury risk from occupational musculoskeletal exposures. Telephone interviews were conducted in a community based sample of 123 U.S. women workers. The study reported that predictors for risk perception of injury to self were current bodily pain scores, exposure to repeated strenuous physical activity, exposure to repetitive hand motion, perceived seriousness or low controllability of the risk, and perception of risk to other women. Risk perception of injury was not associated with work-related injury in this cross-sectional study. The study showed that risk perception was influenced by physical symptoms, physical work factors, and characteristics of risk. However, the study findings are limited by not including psychosocial work or organizational factors in this examination as well as by the small sample size and cross-sectional design.

In summary, the association between risk perception and safe work behavior is not yet clear, and the role of risk perception in WRMSDs has not been explored in the nurse population. Research is needed to determine the role of risk perception in WRMSDs in nurses and to better understand risk perception in a comprehensive context of work environment.

Safe Work Behavior

Safety behavior is emphasized in many workplaces where engineering has not totally controlled for occupational hazards. In these settings, individual workers need to take voluntary action to adequately deal with particular hazards (Baker, 1990). Safe work behavior, for example in using hoists, may modify the risk from occupational hazards and play some role in protecting workers' safety and health. However, relatively little evidence exists about the association between safe work behavior and occupational health outcomes in literature.

Safe Work Behavior and Injury

Oliver, Cheyne, Tomas, and Cox (2002) examined a model of occupational accidents constructed with organizational and individual factors in a sample of 525 Spanish industrial workers, using structural equation modeling (SEM). Occupational accidents ranged from near misses to severe accidents leading to absence of work. Safety behavior was assessed by items about using safety equipment, taking shortcuts, following safety rules, and the incompatibility of working safely and quickly. The study found that safe behavior was significantly associated with low rates of occupational accidents ($\beta = -0.332$, $p < .05$), and unsafe behavior was shown to be the strongest predictor for occupational accidents, among significant predictors of physical work environment, organizational involvement, and general health. In addition, safe behavior was found to be significantly associated with organizational involvement ($\beta = 0.7$, $p < .01$), but not with physical work environment.

Gimeno, Felknor, Burau, and Delclos (2005) also examined significant factors for work-related injuries in their cross-sectional study of 475 Costa Rican hospital workers. Work-related injuries included back injuries, needlesticks, skin rashes, and others. Safety practice was assessed by compliance with hospital safety practices. They also found that low levels of safety practices were associated with an increased risk of work-related injuries (OR = 1.3, 95% CI 1.1-1.5). Additionally, there was a significant interaction effect between safety practice and safety climate on work-related injuries, increasing the risk for low levels of both safety practices and safety climate (OR = 1.9, 95% CI 1.2-3.0).

In a study on WRMSDs in nurses, Kjellberg, Lagerstrom, and Hagberg (2003) examined an association between work technique and musculoskeletal symptoms. The study videorecorded patient transfer tasks of 102 Swedish volunteer nurses in laboratory settings. Volunteer nurses performed two types of patient transfer tasks, which were transfers from a supine position to higher up in bed and from a sitting position to a wheelchair. Two observers rated their work technique with a 24-item instrument about behaviors from the preparation phase (e.g., create space, use transfer aids, ask for assistance) and to the performance phases (e.g., use a starting signal, postures, motion). The study found that poor work technique was significantly associated with low back symptoms (OR 3.6-3.7). However, this cross-sectional study can not determine the causal relationship between poor technique and symptoms. Furthermore, volunteer nurses might behave differently in front of a camera, and the use of laboratory setting may not capture usual work technique given the more complicated aspects of real work situations.

The above three observational studies provide initial evidence of the association between safe work behavior and occupational health outcomes, especially in health care settings. This evidence supports the importance of organizational efforts in reinforcing safe work practices of individual workers. The significance of organizational involvement in supporting safe work behavior was shown by an Oliver et al.'s study (2002).

Availability of Lift Equipment and Its Use

In contrast, safe work behavior may also be limited by organizational factors. Although lifting equipment has been shown to significantly reduce WRMSDs (Evanoff, et al., 2003; Hignett, 2003; Trinkoff et al., 2003; Tveito, Hysing, & Eriksen, 2004), nurses may not always use them.

Byrns et al. (2004) found that only 11.3% of nurses routinely used mechanical lifting devices. The primary reasons given for not using the devices were that lift equipment was unavailable and that there was insufficient time to use the lifts. Furthuremore, according to an ANA survey (2001), 53.9% of the nursing facilities did not have lifting and transfer devices readily available for moving patients. In a study by Trinkoff et al. (2003), of nurses who had mechanical lifting devices available, only 6% reported that they always used it and 57% reported using it "sometimes." The study compared those who used lifting devices always or sometimes with those who did not use lifting devices and found that the ready availability of the devices was significantly different between them. The ease of use or adjustment and the maintenance level did not differ between the groups. *Readily availability* is a key factor in the use of lifting devices, and thus organizational efforts are needed to remove barriers to discourage the lift usage. Too few lift devices which are not readily available and also poor job design constitute organizational barriers to safe work practice.

Safe Work Behavior and the Use of Lift Equipment

Rickett, Orbell, and Sheeran (2006) examined determinants of the use of lifting devices in a sample of 379 U.K. health care workers. The study examined the behavior of hoist usage in the personal and organizational contexts and also included motivational factors drawn from two health behavior theories of the theory of planned behavior and the protection motivation theory. With personal, organizational, and motivational factors, the study explained 59% of the variability in intention to use a hoist and 41% of the variability in actual use of the hoist. Significant predictors for the intention to use a hoist were height, number of hoists available, coworker injunctive norm, perceived behavioral control, response cost, response benefit, and social and physical costs of not using the hoist. Among these factors, actual hoist usage after six weeks was significantly predicted by the number of hoists available and response costs. When intention was added to the model for behavior, intention uniquely accounted for 5% of the variability in actual use of a hoist. The study also reported that all of the key motivational determinants of behavior, including coworker injunctive norm, perceived control, susceptibility, response costs and benefits, and social and physical costs, were associated with the availability of hoists. The study suggests that intention to use hoists may well be influenced by characteristics of the job and organization, including their social characteristics, and also that organizational efforts to ensure the availability of hoists may play the key role in promoting actual use of hoists.

Finally, lifting devices do not totally remove the risk of WRMSDs and ergonomic risk factors still remain in patient handling tasks. The success of lift equipment in reducing WRMSDs among nurses is dependent upon nurses learning how to use the equipment correctly and then employing safe work practices along with lift use while being aware of the remaining ergonomic risks. Therefore, organizational efforts are crucial for ensuring this linkage between having proper equipment readily available and utilizing it appropriately and safely.

In the above two sections, literature was reviewed on risk perception and safe work behavior. Risk perception and safe work behavior are not still fully understood for their roles in linking between risk factors and WRMSDs. Furthermore, there is limited literature that explores the phenomena of risk perception and safe work behavior per se in nurses. Therefore, further studies are needed to understand risk perception and safe work behavior, and their ties to other key components of preventive intervention such as safety climate, safety education and training, and the appropriate utilization of safety equipment.

CONCEPTUAL FRAMEWORK FOR THE STUDY

A conceptual framework for WRMSDs is presented in Figure 1. The conceptual framework posits physical and psychosocial job factors at work as two major risk factors. Physical job factors refer to physical workload with ergonomic risk factors such as force, posture, and repetition. Psychosocial job factors refer to nonphysical work factors such as job demands and decision latitude. These job factors are influenced by macro-level workplace organizational factors, such as management style, staffing, and safety climate.

Physical job factors produce biomechanical strain that can lead to the development of WRMSDs. Depending on the worker's behavior, biomechanical load or strain resulting from physical factors may be modified. For example, the worker under time pressure may take few breaks, increasing the impact of sustained postures or shortening the time to recovery from effort. Additionally, the model posits that work behavior is influenced by the worker's perception of risk. Thus, if the perceived level of risk from work is high, the worker will behave in a more cautious way, and choose a safer way to perform the task (e.g., using good body mechanics or proper lifting equipment).

Responses to psychosocial in addition to physical factors may be moderated by an individual's perception and work behavior. Depending on how a worker perceives job factors and potential risk in performing job tasks, and how the worker deals with them at

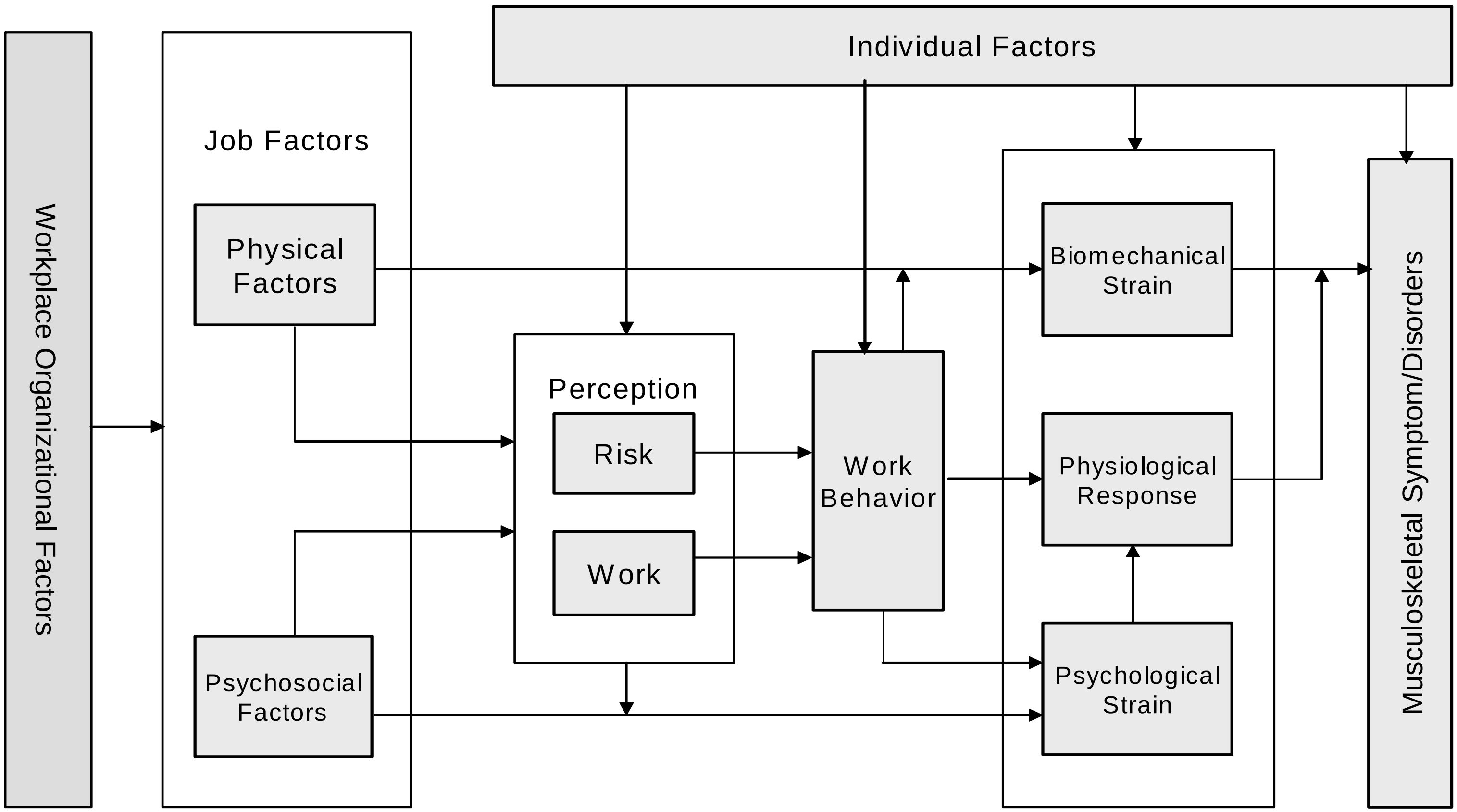


Figure 1. A conceptual framework for WRMSDs

the cognitive level, psychological strain may be produced. For example, if the worker perceives work as too demanding for his/her capacity in a given time or requiring extreme caution to avoid the risk of injury, the worker will experience higher psychological strain. Psychological strain, in turn, elicits physiological responses (e.g., increased muscle tension, corticosteroid and catecholamine release). Physiological responses may modify the effect of biomechanical strain on WRMSDs by reducing the worker's tolerance to the physical load and augmenting the effect of biomechanical strain.

Individual factors, such as age, gender, and physical and psychological health conditions, may moderate the effects of physical and psychosocial factors on biomechanical strain and also on physiological and psychological stress responses. Furthermore, individual factors may influence the occurrence of WRMSDs, for example, through the awareness and reporting of symptoms.

This conceptual framework is far too complex to be tested with a single study. The present study provides a preliminary test of a part of this framework. The study examines the associations of four categories of independent variables on risk perception and work behavior, and the mutual association between risk perception and work behavior. The four categories are individual, physical work, psychosocial work, and organizational factors. Prior or existing musculoskeletal symptom experience is regarded in this study as an individual factor, rather than as the final outcome. A modified framework for this study is presented in Figure 2.

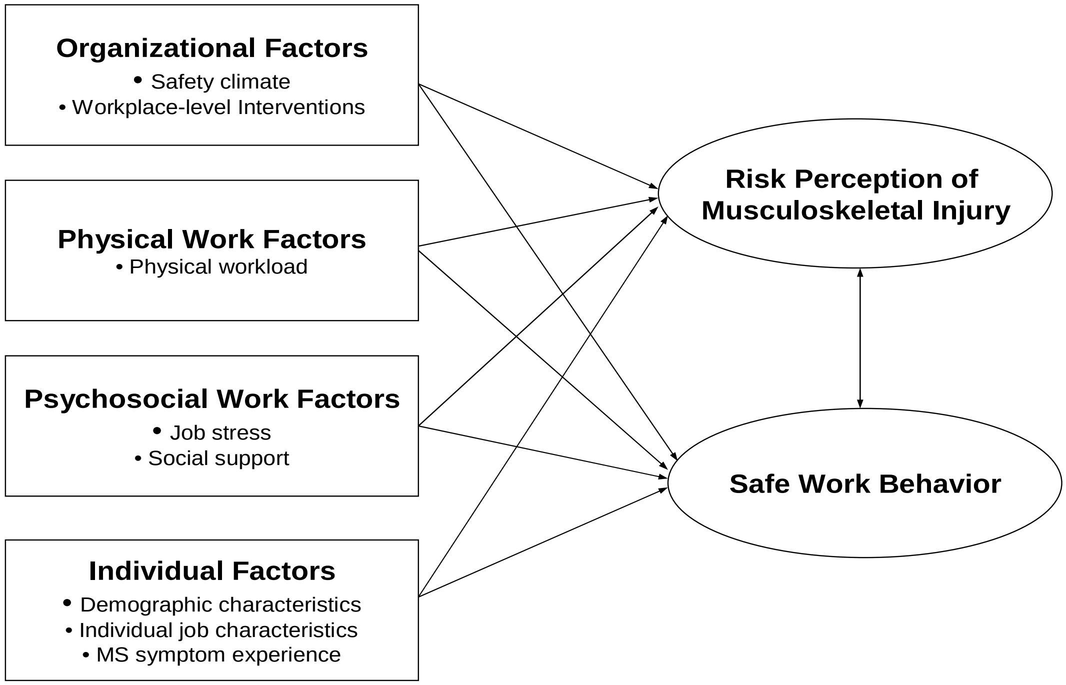


Figure 2. The conceptual framework for this study

ASSUMPTIONS FOR THE STUDY

The study assumes that risk perception and safety behavior are phenomena that can be understood in the context of work environment. The ultimate goal of the study assumes that the safety of the work environment may be improved by identifying protective or risk factors for occupational health problems and changing worker perceptions and behaviors within the work context. Therefore, rather than relying on theories for preventive health behaviors focusing only on personal determinants, the study attempted to understand risk perception of musculoskeletal injury and safe work behavior within the context of work environment and investigate occupational factors contributing to WRMSDs, guided by a model of WRMSDs. The study assumed that physical, psychosocial, and organizational factors do not only affect the development of

WRMSDs, but also the individual worker's perception and behavior. Therefore, the study set physical, psychosocial, and organizational factors as main independent variables.

RESEARCH QUESTIONS

Research questions guiding this study are as follows:

a) What is the perception of nurses about their risk of experiencing a musculoskeletal injury from their work?

b) How frequently do nurses engage in safe work behaviors related to patient handling tasks?

c) Is there a relationship between risk perceptions of musculoskeletal injury and safe work behavior related to patient handling tasks?

d) Among individual, physical work, psychosocial work factors, and organizational factors, which factors significantly affect nurses' perceptions about their risk of musculoskeletal injury?

e) Among individual, physical work, psychosocial work factors, and organizational factors, which factors significantly affect nurses' safe work behavior in performing patient handling tasks?

DEFINITION OF TERMS

In the present study, risk perception of musculoskeletal injury was defined as how a nurse perceives the likelihood of experiencing a musculoskeletal injury from work within a year. Work behavior in this study specifically refers to how a nurse performs patient handling tasks and patient handling tasks refer to work activities related to moving a patient to a different location or changing a patient's body position, such as lifting, transferring, and repositioning. Safe work behavior was defined as engagement in the risk-reducing actions before and during patient handling (e.g., adjusting the height of the bed, asking help from coworkers) and the use of good body mechanics in performing a patient handling task.

Musculoskeletal symptoms were defined as pain, aching, stiffness, burning, numbness, or tingling in back, neck, and shoulders. Physical work factors referred to job-level variables regarding physical workload imposed to nurses over the course of work day. Psychosocial work factors referred to non-physical job-related variables that reflect job stress, support at work, and work style. Organizational factors referred to workplace-level variables that reflect culture or environment of the workplace. Safety climate refers to the summary of perceptions that employees share about the safety of their work environment (Zohar, 1980).

Chapter 3. Methodology

Study Design

This study was a cross-sectional national survey of nurses randomly selected from the membership of the American Association of Critical Care Nurses (AACN). A postal survey method using a self-administered questionnaire was employed for data collection. Data collection began after the study was approved by the Committee on Human Research at the University of California, San Francisco.

Survey Sample

AACN is one of the largest specialty nursing organizations with over 60,000 critical care nurse members (AACN, personal communication, December 16, 2005). The term “critical care nurses” broadly refers to professional nurses who practice nursing care for very acutely and critically ill patients. According to the AACN website, critical care nurses are estimated to account for 31% of nurses working in the hospital setting. Critical care nurses work in diverse hospital areas such as progressive care units, telemetry units, step-down units, and emergency department,as well as in traditional ICUs and cardiac care units (AACN, n.d.).

A random sample of 1000 nurses was drawn from the AACN membership list. Random sampling was conducted within selected categories of the AACN membership to include nurses who were currently employed in hospitals and who performed patient handling tasks. Only nurses from staff or charge nurse categories were included in the potential pool. To prevent the sample from including ineligible subjects, random sampling also excluded: a) nurses employed in non-hospital settings (e.g., long term care, home care, corporate industry, etc.) and b) areas of practice where nurses are unlikely to engage in patient-handling tasks (e.g., subacute care, outpatient clinic, cardiac rehabilitation, hemodialysis unit, interventional cardiology, etc.).

Data Collection Procedures

The survey process and response pattern are presented in Figure 3. The survey mailing was conducted in two waves. The survey packet for the mailings in Wave 1 and 2 included a cover letter, an information letter, a survey questionnaire, and a refusal card (for those who wished no further contact about the study). Postal reminders were sent to study packet recipients within two-week intervals up to five times. Finally, thank-you postcards were mailed to those who returned the completed surveys. Early respondents (the first 80 in Wave 1 and the first 50 in Wave 2) received a $3 or $5 gift card, respectively.

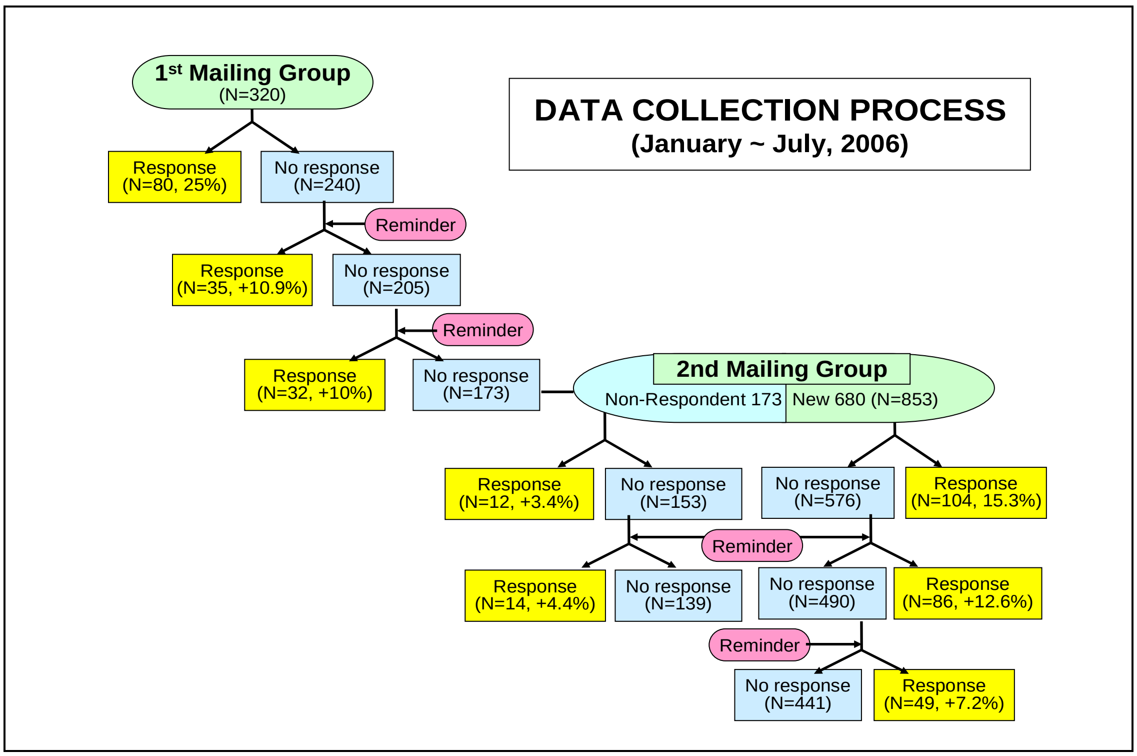


Figure 3. Data collection and subjects' responses

Wave 1

Data collection for the Wave 1 mailing was conducted between January 17 and

March 31, 2006. Surveys were sent to 320 nurses during Wave 1, and a total of 147 nurses returned the survey. This initial mailing wave served to identify the likely response rate among the AACN study population, allowed evaluation of the study questionnaire's usability, and allowed validation of measures developed by the researcher.

Wave 2

Data collection for the Wave 2 mailing was conducted between April 24 and July 31, 2006. Wave 2 included 853 nurses (680 new potential subjects and 173 non-respondents from the first wave). The Wave 2 mailing added a brief questionnaire about demographics and symptoms to obtain information about those who decided not to participate in the study. A total of 265 nurses returned completed surveys in Wave 2. Among these were 26 respondents from the 173 who had not responded in Wave 1. A total of 137 nurses returned the demographic questionnaire for non-participants, including eight non-participants from Wave 1.

Variables and Instruments

The final study questionnaire consisted of 192 items about demographics, job characteristics, musculoskeletal symptoms, physical work factors, psychosocial work factors, and organizational factors, risk perception of musculoskeletal injury, and safe work behavior. Measures included in the Wave 1 questionnaire which served only to validate researcher-developed measures were not included in the final version. It also included minor revisions from the Wave 1 questionnaire, such as modified wording, a change in item sequence, and the addition of two items about job characteristics. The two questionnaire versions are provided in Appendix A.

Dependent Variables

The dependent variables of the study were risk perception of musculoskeletal injury and safe work behavior related to patient handling. Each variable also served as an independent variable for the other in separate analyses.

Risk Perception of Musculoskeletal Injury

Risk perception of musculoskeletal injury was assessed by the Risk Perception of Musculoskeletal Injury (RPMI) measure developed by the researcher. The RPMI measure consists of two subscales of RPMI-S (risk perception of musculoskeletal injury to self) and RPMI-O (risk perception of musculoskeletal injury to coworkers). Each subscale is comprised of the same four items and asks "How likely it is that *you* (RPMI-S) [or *another nurse on your unit* (RPMI-O)] will experience a musculoskeletal injury within a year related to:" 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.

The RPMI measure uses a 6-point Likert scale, ranging from "1 = extremely unlikely" to "6 = extremely likely," and the scores of RPMI, RPMI-S, and RPMI-O were obtained as mean scores of items answered. For those who did not have a lifting device on their unit, the scale scores were obtained excluding the two items about risk from patient handling tasks performed using a mechanical lifting device. Since a mean score was used, scale scores were not affected if these items were excluded. The greater the RPMI score, the greater the perceived risk of musculoskeletal injury.

Preliminary testing of the instrument using a subgroup of this study sample (n = 141) demonstrated Cronbach's alpha coefficients of .85 for the RPMI, .73 for the RPMI-

S, and .69 for the RPMI-O. Test-retest correlation coefficients obtained within a 2-week interval were .71 for the RPMI, .71 for the RPMI-S, and .66 for the RPMI-O. Similarly, a test sample of graduate nursing students (n = 66) demonstrated Cronbach's alpha coefficients of .87 for the RPMI, .77 for the RPMI-S, and .70 for the RPMI-O; and test-retest coefficients of .74 for the RPMI, .72 for the RPMI-S, and .73 for the RPMI-O.

Face validity for the RPMI instrument was established by examination using a panel of four occupational health experts in musculoskeletal disorders. Furthermore, construct validity of the instrument was demonstrated with acceptable convergent and discriminant validity in the preliminary validation studies (See Appendix B). In the validation studies, RPMI subscales showed higher correlations with perceived risks from patient handling (r = .42 ~ .69) and in general (r = .43 ~ .55) than correlations with perceived risks from sharps, biological, chemical, and radiation (r = .19 ~ .51), as expected. In addition, these RPMI subscale correlations with perceived risks from nursing activity hazards items were higher overall than those with other measures (r = .01 ~ .24) such as safety climate (Felknor et al., 2000), compliance with Universal Precautions (Gershon et al., 2000), health/safety risk taking behaviors (Weber, Blais, & Betz, 2002), safe work behavior related to patient handling, and the musculoskeletal symptom index – again, as expected. (The latter two measures were developed by the researchers, and details were described in later sections.)

Safe Work Behavior

Safe work behavior was assessed by the Safe Work Behavior related to Patient Handling (SWB-PH) measure, which was developed by the researcher based on the literature (Feletto & Graze, 1997; Kjellberg et al., 2003).

The SWB-PH measure consists of 15 items which are divided into two sections: the preparation phase before performing a patient handling task, and the performance phase during a patient handling task. The preparation phase includes ten items regarding assessment (patient condition, height of the bed, and the space for performing a task), correction (inappropriate height and space), use of lifting assistive devices, and asking for assistance from patients and coworkers. The performance phase includes five items about the use of good body mechanics. Each item asks how often the nurse engages in the action in question, and is answered with a 6-point Likert scale ("1 = never" to "6 = all of the time"). Two items (manual handling and perform a task alone) were negatively worded, so they were coded in reverse for the total score calculation. The SWB-PH score was obtained as a mean score of items answered. For those who do not have height-adjustable beds in their unit, an item about adjusting the height of bed was not included in computing the SWB-PH score. A greater SWB-PH score indicates safer work behaviors.

For the reliability for the SWB-PH measure, Cronbach's alpha coefficient was .79 and the test-retest correlation coefficient was .76 in the preliminary examination with the critical care nurses' subsample (n = 141). Cronbach's alpha coefficient for the test sample of graduate nurses (n = 66) was .75 and the test-retest correlation coefficient was .68. Face validity for the SWB-PH measure was established by examination using a panel of four occupational health experts in musculoskeletal disorders. Construct validity of the SWB-PH measure was demonstrated with acceptable convergent and discriminant validity in the preliminary validation studies (See Appendix C). The SWB-PH measure showed higher correlations with other behavioral measures [Compliance with Universal Precautions (r = .43 ~ .44) and health/safety risk taking behaviors (r = -.36 ~ -.50)]; and lower correlations with risk perception measures ($|r|$ = .05 ~ .26) and the musculoskeletal symptom index (r = -.11). In addition, SWB-PH was positively correlated with Universal Precautions compliance and inversely correlated with health/safety risk taking; and these findings further support the validity of the SWB-PH instrument.

Independent Variables

The independent variables of the study consisted of demographics, individual job characteristics, musculoskeletal symptoms, physical work factors, psychosocial work factors, and organizational factors.

Demographics and Job Characteristics

Demographic variables included age, gender, race, weight, height, education, and marital status. Job characteristics of these critical care nurses were assessed by questions about current status of employment, job title, years worked in nursing, types of units, hospital type, hospital setting, the number of hospital beds (this question was included only in the second wave), work status, work schedule, hours worked per shift, hours worked per two-week pay period, breaks of 10 minutes or more (numbers and minutes), and availability of lift devices, a lift team, and height-adjustable beds.

Musculoskeletal Symptoms

Musculoskeletal symptoms were assessed by modifying the questionnaire used in the Nurses' Work Life and Health study (Lipscomb, Trinkoff, Geiger-Brown, & Brady, 2002). The questionnaire adopted the Nordic Musculoskeletal Questionnaire's definition of musculoskeletal symptoms, which is pain, aching, stiffness, burning, numbness, or tingling in the body region. Modifications included minor changes in wording of questions or choice of answers and the addition of a question about the symptom's work-relatedness: “Do you think that this low back (or neck or shoulder) problem was a) Made worse by working? b) Caused by working?”

This study assessed musculoskeletal symptoms in the low back, neck, and shoulders, and low back pain, including sciatica. Respondents were asked about whether or not they have experienced musculoskeletal symptoms in their lifetime and in the previous 12 months for each of the three body regions. Those who experienced symptoms during the previous 12 months were asked subsequent questions about frequency, duration, severity, work-relatedness of symptoms, impact on work and non-work activities, health care seeking, and missing work. In addition, a question about whether the respondent has ever changed jobs because of musculoskeletal symptoms was included.

In addition to assessing the presence of symptoms during one’s lifetime and in the previous 12 months, the study assessed three additional parameters of musculoskeletal symptoms in the previous 12 months: work-related symptoms, major symptoms, and a musculoskeletal (MS) symptom index. *Work-related symptoms* were defined as symptoms caused or worsened by work. *Major symptoms* were defined as symptoms experienced either at least monthly or lasting at least one week; with at least moderate intensity. This definition follows the case definition used in a study by Lipscomb et al. (2002). *The MS symptom index* was created as a composite score for major symptoms in the back, neck, and shoulders. One point was assigned for each of the following criteria met: 1) the intensity of symptoms is at least moderate; 2) the duration is at least one week; and 3) the frequency is at least monthly. By including all three types of symptom locations, the MS symptom index ranged from 0 to 9.

Physical Work Factors

Physical workload was assessed by two measures: a) a 7-item instrument about the frequency of patient handling tasks used by Menzel, Lilley, and Robinson (2006) and b) the Physical Workload Index Questionnaire (PWIQ) developed by Hollmann, Klimmer, Schmidt, and Kylian (1999) and modified by Janowitz et al. (2006).

Frequency of patient handling. Regarding frequency of patient handling tasks, respondents were asked about the average numbers of "lifts and transfers" and "repositioning" that they performed during normal shifts, both alone and with the help of another person. Respondents were also asked about the number of lifts and transfers performed manually, with mechanical assistance, and with other transfer aides (e.g., friction-reducing devices).

Physical Workload Index Questionnaire. The PWIQ consisted of 19 items using pictograms. It assessed the average frequency of body postures and the lifting of loads during ordinary daily work. Five items describe trunk postures (e.g., upright, bent, twisted), three items describe arm positions (above or below shoulder height), and five items describe leg postures (e.g., standing, squatting). Six items describe both the weight of a lifted load (light, medium, and heavy) and the trunk posture (upright and inclined). All items are answered using a 5-point Likert scale (0 = never, 1 = seldom, 2 = somewhat, 3 = often, 4 = very often). Four of the 19 items are regarded as standard positions (trunk upright, two arms below the shoulder, standing without lifting weights, and sitting without lifting weights). The index of physical workload is calculated via a weighted summation of the scores of the remaining 15 items. Each item is weighted according to the difference in the compressive force on the spine (L5/S1) between that item posture and standard positions. The physical workload index therefore represents the compressive force on the spine generated by the body postures and the lifting of weights. A higher index indicates higher physical workload. Hollmann et al. (1999) reported that the test-retest reliability ranged from .63 to .74, and the convergent and discriminant validity was satisfactory.

Psychosocial Work Factors

Psychosocial work factors were assessed using the Job Content Questionnaire (JCQ) developed by Karasek and the Effort-Reward Imbalance Questionnaire (ERIQ) developed by Siegrist. Both measures are commonly used to assess job stress and have demonstrated their validity and reliability in the literature (Karasek et al., 1998; Siegrist et al., 2004).

Job Content Questionnaire. Using the 22-item JCQ, psychological demands (five items), skill discretion (six items), decision authority (three items), supervisor support (four items), and coworker support (four items) were measured, employing a 4-point Likert scale ranging from "1 = strongly agree" to "4 = strongly disagree."

The score for decision latitude was obtained by adding the subscale scores of skill discretion and decision authority. The social support score was obtained by adding the scores of supervisor support and coworker support. The job strain score was derived by dividing the score of psychological demands by the score of decision latitude. The Cronbach's alpha coefficient has been reported to range from .61 to .72 for the psychological demands subscale, from .73 to .81 for the decision latitude subscale, and .80 for the social support subscale (Karasek et al., 1998).

Effort-Reward Imbalance Questionnaire. The ERIQ consists of three scales measuring effort (six items), reward (11 items), and overcommitment (six items). The effort scale asks about demanding aspects of the work environment such as time pressure, work interruptions, inconsistency of demands, and work problems. The reward scale consists of three subscales measuring rewards from work in terms of money, esteem, and career opportunities. The overcommitment scale measures the personal style of coping with work, which reflects intrinsic effort. Overcommitment is defined as a set of attitudes, behaviors, and emotions that reflect excessive endeavor combined with a strong desire for approval and esteem (Peter & Siegrist, 2000).

The effort and reward scales ask first about exposure to each item using a dichotomous response of "agree" or "disagree." Then, for those whose response indicates a stressful experience, the degree of distress is indicated using the four response categories of "not at all distressed," "somewhat distressed," "moderately distressed," and "very distressed." Each item is scored on a 5-point scale. Effort-reward imbalance (ERI) is obtained by computing the ratio between the effort score (E) and the reward score (R). The ER ratio is $E / (R \times c)$, where "c" is a correction factor obtained by dividing the number of effort items by the number of reward items. An ER ratio greater than 1.0 indicates high effort and low reward, or effort-reward imbalance (Bakker, Killmer, Siegrist, & Schaufeli, 2000). The overcommitment scale is scored on a 4-point Likert scale ranging from "1 = strongly agree" to "4 = strongly disagree." Cronbach's alpha coefficients have been reported from .61 to .78 for the effort scale; from .70 to .88 for the reward scale; and from .64 to .81 for the overcommitment scale (Siegrist et al., 2004).

Organizational Factors

The variable of safety climate was used as an organizational factor. Safety climate was assessed using the Safety Climate Measure developed by Felknor et al. (2000). The Safety Climate Measure consisted of 11 items answered with a 5-point Likert scale ("1 = never" to "5 = always"). The score of safety climate is obtained by the sum of scale items. A higher safety climate score indicates a safer work environment as perceived by the employee. A Cronbach's alpha coefficient of 0.81 was reported in a study on public hospital employees (Gimeno et al., 2005).

Data Analysis

Data analyses were conducted using SPSS 14.0 program. Visual screening was performed to check for data entry errors. Data were also checked for range, logical consistency, and outliers. Extreme data values treated as erroneous or suspect and data values showing logical inconsistency were reclassified as missing data if two researchers agreed. Examples of these problematic data included responses indicating greater than 18 hours worked per shift and 160 hours worked per two-week period. For extreme data values that were not obviously erroneous and for which the cut-off point for outliers was unclear, the author performed correlation analysis between the variable and dependent variables twice, both including and excluding the problematic data. If the correlation did not change much, the data were retained in the analysis. Examples of this case included reports of lifting and transferring a patient 80 times per shift, or repositioning a patient 80 times per shift. The study also conducted a residual analysis to examine the influence of those extreme values on the data. Since no cases showed Cooks' distance greater than 1.0, the study retained the extreme values in the dataset for analysis.

For missing data in multi-item measures, mean substitution was used at the item level based on the available items of the case when the subject answered at least the required number of items for each measure listed in Table 1.

Table 1

A Priori Criteria for the Substitution of Missing Data with Case Means for the Measures

Measures	# total items	Minimum # items required	%
RPMI	8	6	75
RPMI-S	4	3	75
RPMI-S	4	3	75
SWBPH	15	12	80
Safety climate	11	9	82
Psychological demand	5	4	80
Skill discretion	6	5	83
Decision authority	3	2	67
Decision latitude	9	7	78
Supervisor support	4	3	75
Coworker support	4	3	75
Social support	8	6	75
Effort	6	5	83
Financial Reward	4	3	75
Esteem Reward	5	4	80
Job security Reward	2	2	100
Reward	11	9	82
Overcommitment	6	5	83
Physical workload Index	19	19	100

The case mean substitution approach was recommended as a robust method for handling missing data in multi-item measures by Roth, Switzer, and Switzer (1999). In general, the study used an 80% rule to determine the required number for each measure. A 100% rule was used for the job security scale and the physical workload index because the former consisted of only two items, and the latter was obtained by using a formula which required complete items.

The study sample and study variables were characterized using descriptive statistics such as frequency, percentage, mean, median, range, and standard deviation.

Statistical analyses were conducted using two-tailed tests and 95% significance levels. Bivariate analysis was performed using t-tests, analysis of variance (ANOVA), or Pearson correlations to examine associations between study variables. Multivariate analysis was conducted using multiple linear regressions and included variables for which $p < .20$ in bivariate analyses. For psychosocial factors containing subscale variables and combined variables (e.g., job strain and ER ratio), combined variables were included in multivariate analyses by following theoretical guidance as well as for parsimony of the model.

Two models for each dependent variable were constructed. The first was a comprehensive model which included all selected variables based on the findings of bivariate analysis. The second was a reduced model that included only variables that demonstrated significance ($p < .05$) in the initial comprehensive model. Since this study is a preliminary investigation about risk perception and safe work behavior, the author did not choose the path analysis method for data analysis. Path analysis may be a better method after obtaining a clearer understanding of each phenomenon and establishing a more solid conceptual framework for the study.

To examine multicollinearity in multivariate analysis, the author reviewed correlation coefficients between variables as well as the variance inflation factors (VIF) in the multivariate model. In general, a correlation greater than .80 indicates a possible multicollinearity, and a correlation greater than .95 indicates a serious problem. A variance inflation factor exceeding 4 warrants investigation for multicollinearity, and the variance inflation factor exceeding 10 indicates serious multicollinearity (Glantz & Slinker, 2001).

Chapter 4. Results

Study Sample

Response Rates and Eligible Sample Selection

Of the 1000 AACN members who were mailed questionnaires, a total of 412 participated in the study. Excluding eight undeliverable questionnaires, the response rate was 41.5 % (412 out of 992). Among the 412 respondents, 48 subjects were excluded from data analysis for the following reasons: a) not currently employed as nurses (n = 5); b) not employed in hospital settings (n = 1); c) not employed in critical care settings (n = 8); d) not employed as staff or charge nurses (n = 28); and e) did not perform patient handling tasks (n = 5). Additionally, the study excluded three participants who were employed in neonatal intensive care units because patient handling of newborns differs from other patient handling. Data from 13 subjects who were currently absent from work for maternity, illness, or disability were included in the analysis. A total of 361 subjects therefore constituted the study sample on which the data analysis was based. The response rate counting only these 361 participants and based on a pool of 992 subjects was calculated as 36.4%.

Comparison of Participants and Non-participants

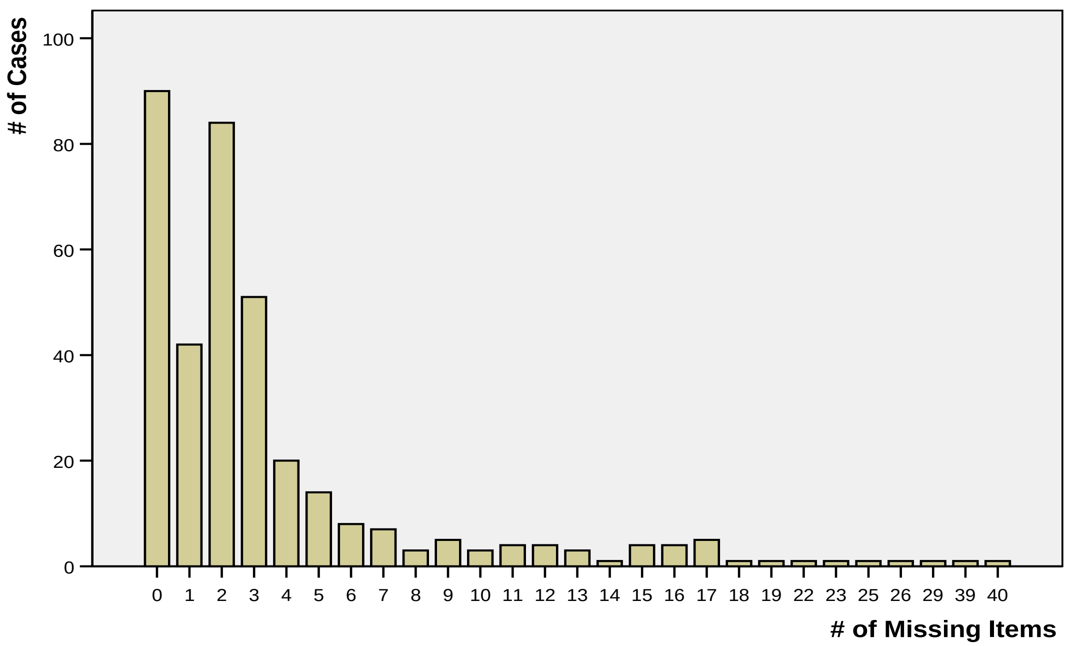
To evaluate selection bias of the sample, the study compared demographic and symptom experience between participants (n = 412) and those who only returned a demographic and symptom questionnaire (n = 137) (See page 56 of Methodology). The latter group, referred to as non-participants in this section, actually only represented 23.6% of all non-participants. Non-participants were more likely to not be currently employed as nurses ($p < .001$), and less likely to have any experience of musculoskeletal symptoms in their lifetimes or within the past year compared to participants ($p < .001$).

There were no differences in gender, age, and duration of employment between participants and non-participants who returned the demographics and symptom questionnaire ($p > .05$).

Missing Data

The original dataset comprised of 361 cases contained a total of 1304 missing data items, or 1.9% out of 69312 possible data items (= 361 cases × 192 variables). Figure 4 presents the distribution of the number of cases by the number of missing items.

Figure 4. Distribution of Cases with Missing Data



The missing data for multi-item measures was handled with case mean substitution (See page 65 of Methodology). Table 2 presents valid sample sizes for each variable before and after substitution. The risk perception and safe work behavior variables resulted in a large number of missing data and the reason was because those measures included an item about the use of lifting devices, and more than half of subjects did not have access to lifting devices in their unit. This was accounted for in the scale scoring (See page 57 of Methodology).

Table 2

Complete Cases for Multi-Item Measures Before and After the Substitution of Missing Data with Case Means

Variables	Before substitution		After substitution	
	N[a]	% [b]	N[a]	% [b]
Risk perception (RPMI)	163	54.8	359	0.6
Risk perception to self (RPMI-S)	163	54.8	360	0.3
Risk perception to others (RPMI-O)	163	54.8	359	0.6
Safe work behavior (SWBPH)	236	34.6	361	0.0
Safety climate	352	2.5	360	0.3
Psychological demand	357	1.1	358	0.8
Skill discretion	357	1.1	360	0.3
Decision authority	357	1.1	359	0.6
Decision latitude	354	1.9	360	0.3
Supervisor support	352	2.5	358	0.8
Coworker support	354	1.9	358	0.8
Social support	346	4.2	358	0.8
Effort	331	8.3	341	5.5
Financial Reward	337	6.6	356	1.4
Esteem Reward	342	5.3	356	1.4
Job security Reward	346	4.2	346	4.2
Reward	325	10.0	351	2.8
Overcommitment	354	1.9	358	0.8
Physical workload Index	341	5.5	345	4.4

a. Complete cases

b. Missing data

Reliability of Measures

The reliability for study measures was evaluated with Cronbach’s alpha coefficient in the study sample and presented in Table 3.

Table 3

Cronbach's Alpha Coefficients for Study Measures

Measures	# of items	N	Alpha
RPMI	8	279	.857
RPMI-S	4	281	.759
RPMI-O	4	282	.715
SWBPH	15	241	.804
Safety climate	11	352	.915
Psychological demand	5	357	.758
Skill discretion	6	357	.513
Decision authority	3	357	.671
Decision latitude	9	354	.696
Supervisor support	4	352	.916
Coworker support	4	354	.820
Social support	8	346	.851
Effort	6	331	.804
Financial and status reward	4	337	.695
Esteem reward	5	342	.761
Job security reward	2	346	.521
Reward	11	325	.813
Overcommitment	6	354	.777
Physical Workload Index	19	341	.819

Results

Demographic Characteristics

Demographics of the study sample (n = 361) are presented in Table 4. The majority of study participants were female (92.8%), white (82.7%), 40-59 years of age (81.0%), married (74.4%), and had a bachelors degree (58.4%). The mean age of the sample was 47.3 years (SD = 8.8) and their mean scores of height and BMI were 165.4 cm (SD = 7.6) and 26.4 (SD = 5.7), respectively. The study sample resembled the 2005 AACN membership, which was 80% female, 82% white, and 56% educated at the bachelors level. With regard to age, however, the study sample included a greater proportion of nurses 50 years or older (45.1%), compared to the AACN population (36%).

Table 4

Demographic Characteristics

Variables	N	Mean	Median	S.D.	Range
Age (years)	357	47.3	48.0	8.8	24 – 68
Height (cm)	359	165.4	165.1	7.6	149 – 196
BMI (kg/m^2)	358	26.4	25.0	5.7	18 – 53

		Study Sample		2005 AACN
Variables		%	(N)	%
Sex (n = 359)	Female	92.8	(333)	90
	Male	7.2	(26)	10
Age, years (n = 357)	<30	4.2	(15)	6
	30-39	14.8	(53)	21
	40-49	35.9	(128)	39
	50-59	38.7	(138)	31
	≥60	6.4	(23)	5
Race (n = 359)	White	82.7	(297)	82
	Asian/Pacific Islander	9.7	(35)	10
	African-American	4.7	(17)	4
	Others	2.9	(10)	3
Education (n = 361)	Diploma	8.9	(32)	-
	Associate	18.8	(68)	26
	Bachelor	58.4	(211)	56
	Master/Doctoral	13.9	(50)	17
Marital Status (n = 360)	Married	74.4	(268)	-
	Separated/Divorced/Widowed	12.5	(45)	-
	Never been married	10.8	(39)	-
	Others	2.3	(8)	-
Height, cm (n = 359)	<160	20.6	(74)	-
	160-164.9	24.0	(86)	-
	165-169.9	25.6	(92)	-
	170-174.9	19.2	(69)	-
	≥175	10.6	(38)	-
BMI, kg/m^2 (n = 358)	Underweight (<18.5)	1.4	(5)	-
	Normal (18.5-24.9)	47.8	(171)	-
	Overweight (25-29.9)	28.5	(102)	-
	Obese (≥30)	22.3	(80)	-

Note: Sample sizes for variables vary due to missing data.

Job Characteristics

Individual job characteristics of the study sample are shown in Table 5. Among the study participants, 55% worked for non-profit community hospitals and 48% worked in urban areas. Information regarding the size of hospital was obtained only from Wave 2 participants, of whom 46.0% worked for hospitals with fewer than 500 beds, and 15.8% worked for hospitals with 500 beds or more. ICU was defined as ICU, specialty ICU units, and coronary care units. The majority of the sample worked in ICUs (81.4%), and 18.6% worked in non-ICUs (e.g., PACU, telemetry, ER, progressive care unit, etc.). The mean number of years employed in nursing was 22.5 years (SD = 9.3), and 3.6% of the sample were on leave (sick, maternity, or disability) at the time of the survey. Additionally, 74.2% of the sample worked as staff nurses, 12.2% were charge nurses, and 13.6% were staff nurse and also occupied charge or other nursing roles, such as educator or wound care nurse. The mean percentage of time devoted to direct patient care was 78.7% (SD = 22.6). Most participants worked full-time (75.2%) and worked the day shift (58.9%). The mean number of hours worked including overtime was 11.6 (SD = 1.6) hours per shift and 69.7 (SD = 16.7) hours per two week period. On average, participants reported 1.4 (SD = 0.9) breaks of 10 or more minutes duration and a total of 30.3 (SD = 17.8) minutes for breaks per shift, with 9.5% reporting fewer than one break (≥ 10 minutes) per shift.

Table 6 shows the availability of lifting devices, a lifting team, and height-adjustable beds. Only 46.5% of participants had lifting devices on their unit. Among them, 13.7% responded that lifting devices were rarely or never available. Twenty-six participants (7.2%) had a lifting team in their hospital but 34.6% of them reported that a lifting team was rarely or never available. Ninety-eight percent of participants answered that their units were equipped with height-adjustable beds.

Table 5 *Job Characteristics*

Variables	N	Mean	Median	S.D.	Range
Years worked in nursing	360	22.5	23.3	9.3	1.3-44
Hours worked per shift[a]	345	11.6	12.0	1.6	6-14.5
Hours worked per 2 weeks[a]	358	69.7	72.0	18.7	8-144
Direct patient care, % time	358	78.7	85.0	22.6	3-100
Breaks of ≥10 minutes	359	1.4	1.0	0.9	0-5
Total number of minutes for breaks	355	30.3	30.0	17.8	0-90

Variables		N	%
Current nursing position (n = 361)	Staff nurse	268	74.2
	Charge nurse	44	12.2
	Both Staff & Charge/other roles	49	13.6
Years worked in nursing (n = 360)	<10	36	10.0
	10-19	95	26.4
	20-29	144	40.0
	≥30	85	23.6
Work status (n = 359)	Full-time	270	75.2
	Part-time	69	19.2
	Per-diem	16	4.5
	Other (contingent)	4	1.1
Work schedule (n = 360)	Days	212	58.9
	Evenings	16	4.4
	Nights	92	25.6
	Rotating	40	11.1
Type of unit (n = 361)	ICUs	294	81.4
	Non-ICUs (ER, PACU, etc)	67	18.6
Type of hospital (n = 359)	Community hospital (non-profit)	197	54.9
	Community hospital (profit)	57	15.9
	University medical center	66	18.4
	Other (military/government, etc)	39	10.8
Type of work setting (n = 352)	Urban	169	48.0
	Suburban	139	39.5
	Rural	44	12.5
Breaks of ≥10 minutes (n = 358)	<1	34	9.5
	1	181	50.6
	>1	143	39.9
Number of beds in hospital[b] (n = 223)	<100	21	9.4
	100-299	64	28.7
	300-499	81	36.3
	500-799	44	19.8
	≥800	13	5.8

a. The work hours included overtime.
b. The item was added in Wave 2.

Table 6 *Availability of Lifting Devices, A Lifting Team, and Height-Adjustable Beds*

Variables		N	%
Lifting devices on the unit and lifting team (n = 361)	Both	16	4.4
	Either	162	44.9
	Neither	183	50.7
Lifting devices on the unit (n = 361)	Yes	168	46.5
	No	188	52.1
	Don't know	5	1.4
Availability of lifting devices (n = 168)	Always	33	19.6
	Most of the time	67	39.9
	Often	19	11.3
	Occasionally	23	13.7
	Rarely	21	12.5
	Never	2	1.2
	Missing	3	1.8
Lifting team (n = 361)	Yes	26	7.2
	No	334	92.5
	Don't know	1	0.3
Availability of a lifting team (n = 26)	Always	1	3.8
	Most of the time	8	30.8
	Often	3	11.5
	Occasionally	5	19.2
	Rarely	5	19.2
	Never	4	15.4
Height-adjustable beds on the unit (n = 356)	Yes	348	97.8
	No	8	2.2

Musculoskeletal Symptoms

The prevalence of musculoskeletal symptoms is presented in Table 7. The lifetime prevalence was 91.9% for low back pain, 71.4% for neck pain, and 58.9% for shoulder pain. Among those who have experienced musculoskeletal symptoms in their lifetime, 6.6% reported changing jobs because of low back pain; 2.0%, because of neck pain; and 3.4% because of shoulder pain. The 12-month prevalence was 75.8% for low back pain, 63.0% for neck pain, and 46.9% for shoulder pain. Ninety percent of the sample reported suffering from symptoms in one or more of these regions in the previous 12 months, and 21.5% had symptoms in one location, 37.9% in two locations, and 30.6%

in three locations.

Symptom experiences in the previous 12 months were further evaluated for work-related symptoms and major symptoms; frequency, duration, and intensity; and by using a MS symptom index (see Tables 7-9). Among those reporting symptoms in the previous 12 months by body region, 81.6% reported low back pain caused or worsened by work. Corresponding numbers for shoulder and neck pain were 67.9% and 62.9% respectively. Major symptoms (defined as a symptom with at least moderate intensity and either at least weekly duration or at least monthly frequency) were reported by 35.7% of those with low back pain, 45.2% of those with neck pain, and 40.0% of those with shoulder pain. The mean and median MS symptom index scores were 2.7 (SD = 2.28) and 2.0 out of 9, respectively. Thirty-three percent of participants were shown to have a MS symptom index score greater than 3.

Table 10 shows the impact of musculoskeletal symptoms in the previous 12 months. Among those who experienced low back pain, 15.8% reported that they missed work due to pain; 30.8% sought health care; 59.5% changed the way they perform work activities; 64.8% changed the way they perform non-work activities such as housework; and 69.4% reported changes in exercise or leisure activities. Likewise, neck pain caused 12.5% to miss work; 38.4% to seek health care; 52.7% to change the way they perform work activities; 56.2% to change the way they perform non-work activities; and 62.1% to make changes in exercise or leisure activities. Of those with shoulder pain, 9.3% missed work; 32.3% sought health care; 55.8% changed the way they perform work activities; 57.7% changed the way they perform non-work activities; and 69.1% made changes in exercise or leisure activities.

Table 7 *Musculoskeletal Symptoms (N = 361)*

Variables	Low back N (%)	Neck N (%)	Shoulders N (%)
Symptoms during lifetime	331 (91.9)	250 (71.4)	208 (58.9)
Job change due to pain in lifetime	22 (6.6)	5 (2.0)	7 (3.4)
Symptoms in the past 12 months	272 (75.8)	221 (63.0)	165 (46.9)
Caused or worsened by work	222 (81.6)	139 (62.9)	112 (67.9)
Major symptoms*	97 (35.7)	100 (45.2)	66 (40.0)

Note: Sample sizes vary due to missing data.
* A major symptom was defined as a symptom with at least moderate intensity and either a duration of at least one week or a frequency of at least monthly. This definition was adopted following the case definition of musculoskeletal disorders used in a study by Lipscomb, Trinkoff, Geiger-Brown, and Brady (2002).

Table 8 *Musculoskeletal Symptoms in the Past 12 Months*

Variables		Low Back (n = 272) N (%)	Neck (n = 221) N (%)	Shoulders (n = 165) N (%)
Frequency	Daily	22 (8.1)	26 (11.9)	25 (15.2)
	Almost daily	47 (17.3)	45 (20.6)	26 (15.8)
	Weekly	56 (20.6)	49 (22.5)	32 (19.4)
	Monthly	32 (11.8)	22 (10.1)	19 (11.5)
	Every 2-3 months	52 (19.1)	32 (14.7)	28 (17.0)
	Every 4-6 months	42 (15.4)	26 (11.9)	22 (13.0)
	One time only	21 (7.7)	18 (8.3)	13 (7.9)
Duration	< 1 day	98 (36.0)	53 (24.4)	40 (24.2)
	< 1 week (1-6 days)	118 (43.4)	92 (42.4)	58 (35.2)
	1 week to 3 months	23 (8.5)	37 (17.1)	42 (25.5)
	> 3 months	33 (12.1)	35 (16.1)	25 (15.2)
Intensity	None	2 (0.7)	-	2 (1.2)
	Mild/Minimal	140 (51.7)	98 (45.0)	80 (48.8)
	Moderate	116 (42.8)	106 (48.6)	70 (42.7)
	Severe	13 (4.8)	14 (6.4)	12 (7.3)
	Worst ever in life	-	2 (0.9)	-

Note: Sample sizes vary due to missing data.

Table 9 *MS Symptom Index (N = 333)*

Variable		N	%
MS symptom index	0	70	21.0
	1-3	153	46.0
	4-6	90	27.0
	7-9	20	6.0

Table 10 *Impact of Musculoskeletal Symptoms in the Past 12 Months*

Variables		Low Back Pain Total (n = 272) N (%)	WRLBP (n = 222) N (%)	NWRLBP (n = 50) N (%)
Missing work	Yes	42 (15.8)	37 (17.1)	5 (10.6)
	No	223 (84.2)	180 (82.9)	42 (89.4)
Seeking out health care	Yes	82 (30.8)	70 (32.1)	12 (25.5)
	No	184 (69.2)	148 (67.9)	35 (74.5)
Changes in the way work is performed	Yes	160 (59.5)	136 (61.8)	23 (47.9)
	No	109 (40.5)	84 (38.2)	25 (52.1)
Changes in the way non-work activities (e.g. housework) are performed	Yes	175 (64.8)	146 (66.4)	28 (57.1)
	No	95 (35.2)	74 (33.6)	21 (42.9)
Changing exercise/leisure activities	Yes	188 (69.4)	155 (70.1)	32 (65.3)
	No	83 (30.6)	66 (29.9)	17 (34.7)

Variables		Neck Pain Total (n = 221) N (%)	WRNP (n = 139) N (%)	NWRNP (n = 82) N (%)
Missing work	Yes	27 (12.5)	26 (19.4)	0 (0.0)
	No	189 (87.5)	108 (80.6)	79 (100)
Seeking out health care	Yes	84 (38.4)	61 (44.5)	22 (27.8)
	No	135 (61.6)	76 (55.5)	57 (72.2)
Changes in the way work is performed	Yes	116 (52.7)	95 (68.8)	20 (25.3)
	No	104 (47.3)	43 (31.2)	59 (74.7)
Changes in the way non-work activities (e.g. housework) are performed	Yes	123 (56.2)	96 (70.1)	26 (32.9)
	No	96 (43.8)	41 (29.9)	53 (67.1)
Changing exercise/leisure activities	Yes	136 (62.1)	105 (76.6)	30 (38.0)
	No	83 (37.9)	32 (23.4)	49 (62.0)

Variables		Shoulder Pain Total (n = 165) N (%)	WRSP (n = 112) N (%)	NWRSP (n = 53) N (%)
Missing work	Yes	15 (9.3)	15 (13.6)	0 (0.0)
	No	146 (90.7)	95 (86.4)	50 (100)
Seeking out health care	Yes	53 (32.3)	42 (37.8)	11 (21.2)
	No	111 (67.7)	69 (62.2)	41 (78.8)
Changes in the way work is performed	Yes	91 (55.8)	75 (67.0)	15 (30.0)
	No	72 (44.2)	37 (33.0)	35 (70.0)
Changes in the way non-work activities (e.g. housework) are performed	Yes	94 (57.7)	73 (65.2)	20 (40.0)
	No	69 (42.3)	39 (34.8)	30 (60.0)
Changing exercise/leisure activities	Yes	112 (69.1)	83 (74.8)	28 (56.0)
	No	50 (30.9)	28 (25.2)	22 (44.0)

Note: Sample sizes vary due to missing data.
WRLBP: work-related LBP, WRNP: work-related neck pain, WRSP: work-related shoulder pain
NWRLBP: not work-related LBP, NWRNP: not work-related neck pain, NWRSP: not work-related shoulder pain

Physical and Psychosocial Work Factors and Safety Climate

Descriptive statistics for physical and psychosocial work factors and organizational factors are presented in Table 11. Physical work factors were measured with frequency of patient handling tasks performed per shift and the physical workload index. The mean total number of patient handling tasks performed per shift was 17.9 (SD = 13.7). More specifically, the mean numbers of lifting/transferring and repositioning tasks per shift were 6.8 (SD = 7.3) and 11.0 (SD = 8.0), respectively. Among lifting/transferring tasks, the mean number of tasks performed manually was 6.1 (SD = 7.1) per shift. Over three quarters (76.8%) of participants reported that all of the lifting/transferring tasks were performed manually and only 3% reported that they were not engaged in manual patient lift and transfer tasks any of the time. The mean physical workload index was 30.7 (SD = 11.0).

Psychosocial work factors were measured using the JCQ (psychological demand, decision latitude, and social support) and the ERIQ (effort, reward, and overcommitment) scales. Mean scores for the JCQ scales were 37.2 (SD = 5.8) for psychological demand, 73.5 (SD = 8.8) for decision latitude, and 23.7 (SD = 3.7) for social support. The mean job strain, the ratio of psychological demand to decision latitude, was 0.51 (SD = 0.1). The mean ERIQ scale scores were 15.7 (SD = 4.9) for effort, 48.4 (SD = 7.3) for reward, and 13.0 (SD = 3.1) for overcommitment. The mean ER ratio was 0.63 (SD = 0.33), and 9.6 % of respondents showed an ER ratio greater than 1.0, indicating an effort-reward imbalance. Safety climate was the measure for work organizational factors. The mean safety climate score was 38.1 (SD = 7.9).

Table11

Physical and Psychosocial Work Factors and Safety Climate

Variables	N	Mean	Median	SD	Min	Max
Physical work factors						
Frequency of patient handling per shift	351	17.9	15.0	13.7	3.5	160
Lifting and transferring per shift	358	6.8	4.5	7.3	0	80
Manually	353	6.1	4	7.1	0	80
With help	352	5.3	4	5.3	0	40
With a lift	353	0.4	0	2.3	0	40
With transfer aids	351	1.3	0	4.0	0	60
Repositioning per shift	353	11.0	10	8.0	0	80
With help	353	8.5	6	6.1	0	40
Physical workload Index (0-56.17)	345	30.7	30.8	11.0	2.9	56.17
Psychosocial work factors						
JCQ						
Psychological demand (12-48)	358	37.2	36.5	5.8	22	48
Decision latitude (24-96)	360	73.5	72	8.7	44	94
Skill discretion (12-48)	360	38.0	38	3.8	28	46
Decision authority (12-48)	359	35.5	36	6.2	12	48
Social support (8-32)	358	23.7	24	3.7	13	32
Supervisor support (4-16)	358	11.0	12	2.8	4	16
Coworker support (4-16)	358	12.6	12	1.7	6	16
Job strain (0.125-2.0)	358	0.51	0.50	0.10	0.28	1.02
ERIQ						
Effort (6-30)	341	15.7	15	4.8	6	30
Reward (11-55)	351	48.4	51	7.3	17	55
Financial and status (4-20)	356	17.3	18	3.2	4	20
Esteem (5-25)	356	22.3	24	3.8	7	25
Job security reward (2-10)	346	8.8	10	2.0	2	10
Effort-reward ratio (0.2-5.0)	337	0.63	0.55	0.33	0.20	2.91
Overcommitment (6-24)	358	13.0	13.0	3.1	6	23
Organizational factors						
Safety climate (11-55)	360	38.1	39	7.9	17	55

Note: ( ) indicates the full possible range of the scale score.

Risk Perception of Musculoskeletal Injury

Perceived risk of musculoskeletal injury from work among critical care nurses is presented in Table 12. The mean RPMI score was 4.04 (SD = 1.0) out of 6. The mean scores of RPMI-S and RPMI-O were 3.82 (SD = 1.10) and 4.27 (SD = 1.02), respectively, indicating that, on average, nurses perceived the risk of experiencing a musculoskeletal injury as lower to themselves than to other coworkers.

Risk perception scores were compared by dividing the study sample into nurses with lifts and nurses without lifts. Comparisons were conducted this way because the risk perception scale scores for the latter group were obtained by excluding the item about the risk from patient handling tasks performed with a lifting device. Nurses who did not have a lifting device on their unit reported significantly higher risk perception scores for each item than those with a lifting device ($p < .01$), resulting in significantly higher scores for RPMI ($t = -3.364$, $p = .001$), RPMI-S ($t = -2.786$, $p = .006$), and RPMI-O ($t = -3.597$, $p = .000$) among those without lifts.

Among the four nursing tasks listed in Table 12, risk from manual patient handling was perceived as highest, and risk from nursing activities not related to patient handling was perceived as lowest. Nurses perceived that the risk when they perform patient handling tasks using a lift device was lower than the risk from manual patient handling.

Additionally, the discrepancy in risk perception to self and to coworkers was examined using proportions (see Table 13). Almost half of the sample (48.7%) perceived the general risk to self as lower than the risk to coworkers. However, when looking at discrepancy by item, more than half of the sample perceived the risk to self as the same

Table 12

Risk Perception of Musculoskeletal Injury

	Total			With lifts			Without lifts				
Scales/Items	N	Mean	SD	N	Mean	SD	N	Mean	SD	t	*p*
RPMI	359	4.04	1.00	168	3.85	0.96	190	4.20	1.01	-3.364	.001
RPMI-S	360	3.82	1.10	168	3.64	1.07	191	3.97	1.11	-2.786	.006
Nursing work in general	360	4.23	1.41	168	4.15	1.40	191	4.29	1.42		
Patient handling tasks performed manually	360	4.69	1.27	162	4.60	1.29	191	4.76	1.25		
Patient handling tasks performed with a lift	163	3.21	1.37	162	3.20	1.36	-	-	-		
Work tasks not related to patient handling	360	2.74	1.35	168	2.61	1.27	191	2.85	1.42		
RPMI-O	359	4.27	1.02	168	4.06	0.96	190	4.45	1.03	-3.597	.000
Nursing work in general	359	4.75	1.25	168	4.64	1.24	190	4.84	1.26		
Patient handling tasks performed manually	359	5.07	1.06	162	4.93	1.11	190	5.19	1.00		
Patient handling tasks performed with a lift	163	3.50	1.37	162	3.49	1.36	-	-	-		
Work tasks not related to patient handling	359	3.25	1.46	168	3.18	1.37	190	3.31	1.53		

RPMI: Risk perception of musculoskeletal injury, RPMI-S: Risk perception of musculoskeletal injury to self, RPMI-O: Risk perception of musculoskeletal injury to coworkers
Note: Each item and scale score ranges from 1 to 6.

Table 13

Comparison of Risk Perception Between Self and Coworkers

	Lower risk to self	Equal risk	Higher risk to self
Items/Scales	N (%)	N (%)	N (%)
Nursing work in general	133 (37.0)	215 (59.9)	11 (3.1)
Patient handling tasks performed manually	106 (29.5)	235 (65.5)	18 (5.0)
Patient handling tasks performed with a lifting device	41 (25.2)	112 (68.7)	10 (6.1)
Work tasks not related to patient handling	120 (36.2)	214 (59.6)	15 (4.2)
RPMI-S versus RPMI-O	175 (48.7)	157 (43.7)	27 (7.5)

RPMI-S: Risk perception of musculoskeletal injury to self, RPMI-O: Risk perception of musculoskeletal injury to coworkers as the risk to coworkers with the proportion of those subjects ranging from 59.6% to 68.7%. Those perceiving the risk to self as lower than the risk to coworkers ranged from 25.2% to 37.0%, and those perceiving the risk to self as higher than the risk to coworkers ranged from 3.1% to 6.1% for the four items.

Safe Work Behavior

Table 14 shows how frequently nurses engage in safe work practices when they perform patient handling tasks. The mean safe work behavior score was 4.85 (SD = 0.53) out of 6. All but three items were shown to have scores above the mean safe work behavior score. The three items with the lowest scores, indicating less frequent engagement in safe behaviors, were “If a lifting device is not readily available, I perform the task manually” (reversed mean 2.58, SD 1.52), “If no coworker is readily available, I perform the task by myself” (reversed mean 3.80, SD 1.21), and “If the patient is physically dependent, I use a lifting device or transfer aid” (mean 3.06, SD 1.60). The item referring to assessing a patient’s condition before performing a task reflected the highest scores (mean 5.73, SD 0.53). Four items about assessing and correcting bed height and the space required for the task scored greater than 5 (range 5.08 – 5.48), which indicates that the nurse engaged in safer behavior more frequently than *most of the time.* The item referring to asking help from coworkers also scored greater than 5 (mean 5.34, SD 0.8). The mean scores of items about body mechanics during patient handling tasks (e.g., face the patient, keep my back straight) ranged between 4.88 and 5.35.

Table 14

Safe Work Behavior Related To Patient Handling

Scale/Items	N	Mean	SD
Safe work behavior related to patient handling (SWB-PH)	361	4.85	0.53
I assess the condition of the patient.	361	5.73	0.53
I assess the height of bed to see if it is at the proper height (at waist level).	361	5.08	1.06
I adjust the height of bed when it is not appropriate for my height.	352	5.14	1.01
I assess whether the space is too crowded to perform the task.	360	5.39	0.97
I clear space to make enough room for the task if needed.	360	5.48	0.82
If the patient is physically dependent, I use a lifting device or transfer aid.	259	3.06	1.60
If a lifting device is not readily available, I perform the task manually.[a]	303	2.58	1.52
I ask help from coworkers if needed.	361	5.34	0.84
If no coworker is readily available, I perform the task by myself.[a]	361	3.80	1.21
I encourage the patient to assist if possible.	361	4.86	1.01
I face the patient.	360	5.33	0.83
I keep my feet apart (shoulder width).	361	5.35	0.77
I keep my back straight.	360	4.91	0.93
I bend my knees, not my back.	361	4.98	0.98
I turn my whole body towards the patient, and do not twist my back.	360	4.88	0.93

Note: Each item and scale score ranges from 1 to 6. A higher score indicates a safer behavior, which is defined as more frequent engagement in safe work practices.
a. Items were coded reversely.

Bivariate Analysis: Risk Perception and Independent Variables

Bivariate analyses were conducted to examine significant ($p < .05$) associations among three risk perception variables and independent variables, and the findings are presented in Tables 15-18.

Overall risk perception as measured by RPMI was significantly associated with a total of 18 variables. None of demographic characteristics was found to be significant. Nurses with higher education tended to report lower risk perception scores, but the trend was not significant. Among job characteristics, overall risk perception was significantly higher in non-ICU nurses than ICU nurses (t = -1.980, p = .048) and in nurses who had neither lifting devices nor a lift team compared with nurses who had either or both of them (t = -3.287, p = .001). Nurses who worked in university medical centers tended to report greater risk perception than nurses who worked in for profit community hospitals, and a relatively large mean difference of 0.35 was found between their risk perceptions; but the difference was not significant. Regarding the size of hospital, nurses who worked in medium-sized hospitals with 300-499 beds tended to report lower risk perception than nurses who worked in larger or smaller size hospitals, but their mean differences were not significant.

Regarding symptom variables, overall risk perception was significantly higher among nurses who experienced major musculoskeletal symptoms in the previous 12 months than among nurses who did not (t =4.582, $p < .001$). Higher risk perception was associated with a higher MS symptom index (r = .275, $p < .001$). Regarding physical work variables, higher overall risk perception was associated with more frequent patient handling (r = .106, $p < .047$) and greater physical workload index (r = .331, $p < .001$).

Regarding psychosocial work variables, higher overall risk perception was associated with higher levels of psychological demand, job strain, effort, ER ratio, and overcommitment, as well as lower levels of decision authority, supervisor support, reward, financial and status reward, esteem reward, and job security reward ($p < .05$). Lastly, higher overall risk perception was associated with lower safety climate scores ($r = -.230$, $p < .001$). Overall risk perception was not associated with any demographic variables.

Risk perception to self as measured by RPMI-S was significantly associated with all of the above variables, except for the type of hospital unit and frequency of patient handling. These associations, in general, were slightly stronger than those between overall risk perception and the same variables. In addition, two more variables were found to be associated with risk perception to self: any MS symptoms in the past 12 months and decision latitude. Risk perception to self was significantly higher in nurses who experienced any MS symptoms in the previous 12 months compared with nurses who did not ($t = 2.655$, $p = .008$). Higher risk perception was also associated with lower decision latitude ($r = -.127$, $p = .016$). Regarding work shift, day shift nurses tended to perceive greater risk to self than nurses working evening, night, or rotating shifts, but the differences were not significant.

Unlike findings on risk perception to self, risk perception to coworkers as measured by RPMI-O was significantly associated with the type of unit ($t = -2.238$, $p = .026$) and frequency of patient handling ($r = .118$, $p = .027$), but not with experience of MS symptoms in the previous 12 months, decision latitude, decision authority, and supervisor support ($p > .05$). Furthermore, associations between risk perception to coworkers and the remaining 14 variables were slightly weaker in general compared with associations for risk perception to self.

Bivariate Analysis: Safe Work Behavior and Independent Variables

Sixteen significant ($p < .05$) variables for safe work behavior were identified via bivariate analysis (see Tables 19-22). Among demographic characteristics, safe work behavior was significantly associated only with race. Compared with white nurses, minority nurses (including Asian/Pacific Islander, African-American, and Hispanic) reported higher safe work behavior scores (t = -2.240, p = .026). None of job characteristics was significantly associated with safe work behavior. Nurses working rotating shifts tended to report lower safe work behavior scores than any other shift nurses, but the differences were not significant (F = 2.597, p = .052). The safe work behavior score tended to be higher in night-shift nurses and lower in rotating-shift nurses compared with day-shift or evening-shift nurses, but the differences were not significant (t = 2.597, p = .052). Among musculoskeletal symptom parameters, safer work behavior was significantly associated with experiencing major symptoms and the MS symptom index. Nurses with major symptoms had lower safe work behavior scores than nurses without major symptoms (t = -2.117, p = .035). Safer work behavior was associated with lower MS symptom index (r = -.137, p = .012).

Among physical work variables, safer work behavior was significantly correlated with lower physical workload index (r = -139, p = .010). Among psychosocial work variables, safer work behavior was associated with higher levels of decision latitude, skill discretion, decision authority, social support, supervisor support, coworker support, reward, esteem reward, and job security reward ($p < .05$); and lower levels of job strain and overcommitment ($p < .01$). Lastly, safer work behavior was associated with higher safety climate ($r = .366$, $p = .000$).

Bivariate Analysis: Risk Perception and Safe Work Behavior

Significant ($p < .05$) correlations were found between safe work behavior and all three risk perception variables in bivariate analysis (see Table 23). Safer work behavior correlated weakly with lower levels of overall risk perception ($r = -.132$, $p = .012$), risk perception to self ($r = -.140$, $p = .008$), and risk perception to coworkers ($r = -.108$, $p = .041$). Among the three risk perception variables, risk perception to self was shown to have the strongest correlation with safe work behavior.

Table 15

Risk Perception of Musculoskeletal Injury by Demographic Characteristics

Variables	RPMI			RPMI-S			RPMI-O		
	N	*r*	*p*	N	*r*	*p*	N	*r*	*p*
Age	355	-.019	.722	356	.015	.780	355	-.053	.321
Height	357	-.016	.762	358	-.009	.863	357	-.023	.662

Variables	RPMI					RPMI-S					RPMI-O				
	N	Mean	SD	t or F	*p*	N	Mean	SD	t or F	*p*	N	Mean	SD	t or F	*p*
Gender															
Female	331	4.06	1.00	0.714	.475	332	3.83	1.11	0.816	.415	331	4.28	1.02	0.525	.600
Male	26	3.91	0.96			26	3.65	1.05			26	4.17	1.04		
Race															
White	297	4.04	0.96	-0.180	.858	297	3.81	1.07	-0.412	.681	297	4.27	0.98	-0.020	.984
Others	60	4.07	1.20			61	3.87	1.28			60	4.27	1.19		
Education															
Diploma	31	4.13	1.07	0.933	.425	31	3.95	1.19	1.781	.150*	31	4.30	1.04	0.210	.889
Associate	68	4.11	0.92			68	3.92	1.01			68	4.31	0.98		
Bachelor	210	4.06	0.97			211	3.84	1.07			210	4.28	0.99		
Master/Doctoral	50	3.83	1.18			50	3.50	1.28			50	4.17	1.18		
Marital status															
Married	266	4.03	1.00	-0.432	.666	267	3.81	1.10	-0.311	.756	266	4.26	1.00	-0.495	.621
Others	92	4.08	1.02			92	3.85	1.12			92	4.32	1.08		
BMI															
Underweight/Normal	174	4.03	1.02	-0.133	.894	175	3.78	1.13	-0.593	.554	174	4.29	1.05	0.410	.682
Overweight/Obese	182	4.05	0.99			182	3.84	1.08			182	4.25	0.99		

RPMI: Risk perception of musculoskeletal injury, RPMI-S: Risk perception of musculoskeletal injury to self, RPMI-O: Risk perception of musculoskeletal injury to coworkers
* $p < .20$

Table 16

Risk Perception of Musculoskeletal Injury by Job Characteristics

Variables	RPMI N	RPMI *r*	RPMI *p*	RPMI-S N	RPMI-S *r*	RPMI-S *p*	RPMI-O N	RPMI-O *r*	RPMI-O *p*
Total duration of employment	358	.020	.703	359	.044	.410	358	-.007	.898
Direct patient care (% time)	356	.056	.292	357	.074	.161*	356	.030	.574
Hours worked per 2 wks	356	.033	.539	357	.030	.569	356	.033	.533
Break (minutes)	353	.055	.304	354	.028	.600	353	.079	.140*

Variables	RPMI N	RPMI Mean	RPMI SD	RPMI t or F	RPMI *p*	RPMI-S N	RPMI-S Mean	RPMI-S SD	RPMI-S t or F	RPMI-S *p*	RPMI-O N	RPMI-O Mean	RPMI-O SD	RPMI-O t or F	RPMI-O *p*
Nursing position															
Staff nurse	266	4.08	1.01	0.557	.574	267	3.85	1.13	0.310	.734	266	4.31	1.01	0.792	.454
Charge nurse	44	3.96	0.94			44	3.73	0.98			44	4.19	1.02		
Both staff & other roles	49	3.94	1.03			49	3.75	1.08			49	4.13	1.07		
Work status															
Full time	268	4.03	0.98	-0.217	.829	269	3.81	1.06	-.0157	.875	268	4.26	1.01	-0.240	.811
Others	88	4.06	1.08			88	3.83	1.23			88	4.29	1.06		
Work schedule															
Days	211	4.11	0.98	0.955	.414	212	3.93	1.07	1.925	.125*	211	4.30	1.00	0.245	.865
Evenings	16	4.04	0.90			16	3.76	0.90			16	4.33	1.03		
Nights	90	3.93	1.03			90	3.66	1.14			90	4.19	1.07		
Rotating	40	3.93	1.05			40	3.60	1.21			40	4.25	1.03		
Type of unit															
ICU	292	3.99	1.01	-1.980	.048*	293	3.78	1.11	-1.509	.132*	292	4.21	1.02	-2.238	.026*
Non-ICU	67	4.26	0.95			67	4.00	1.08			67	4.52	0.98		
Type of hospital															
Non-profit community	197	4.06	1.01	1.352	.257	197	3.83	1.11	1.138	.334	197	4.28	1.03	1.265	.286
Profit community	56	3.86	0.94			57	3.62	1.01			56	4.11	1.02		
University medical center	66	4.21	0.86			66	3.98	1.06			66	4.44	0.77		
Others	39	3.98	1.22			39	3.80	1.26			39	4.16	1.29		

RPMI: Risk perception of musculoskeletal injury, RPMI-S: Risk perception of musculoskeletal injury to self, RPMI-O: Risk perception of musculoskeletal injury to coworkers

* $p < .20$

Table 16

Risk Perception of Musculoskeletal Injury by Job Characteristics (cont.)

	RPMI					RPMI-S					RPMI-O				
Variables	N	Mean	SD	t or F	*p*	N	Mean	SD	t or F	*p*	N	Mean	SD	t or F	*p*
Work setting															
Urban	168	4.13	0.99	1.175	.310	169	3.91	1.07	1.152	.317	168	4.35	1.05	1.164	.313
Suburban	138	3.96	0.98			138	3.72	1.13			138	4.21	0.95		
Rural	44	3.96	1.08			44	3.79	1.13			44	4.12	1.10		
Size of hospital (beds)															
<100	21	4.05	0.85	1.928	.107*	21	3.85	0.92	1.601	.175*	21	4.26	0.90	2.179	.072*
100-299	64	4.10	1.04			64	3.95	1.11			64	4.26	1.04		
300-499	80	3.81	0.96			81	3.57	1.10			80	4.07	1.00		
500-799	44	4.30	1.02			44	3.98	1.17			44	4.63	0.98		
800+	13	4.01	0.86			13	3.66	0.81			13	4.35	1.11		
Number of break ≥ 10 min															
<1	34	3.96	1.04	0.720	.488	34	3.83	1.16	0.252	.777	34	4.09	1.04	1.599	.204
1	180	3.99	1.00			180	3.77	1.10			180	4.21	1.02		
>1	142	4.12	0.99			143	3.86	1.10			142	4.37	1.01		
Lift device or lift team															
Yes	178	3.87	0.97	-3.287	.001*	178	3.65	1.08	-2.835	.005*	178	4.09	0.98	-3.395	.001*
No	181	4.21	1.01			182	3.98	1.10			181	4.45	1.03		

RPMI: Risk perception of musculoskeletal injury, RPMI-S: Risk perception of musculoskeletal injury to self, RPMI-O: Risk perception of musculoskeletal injury to coworkers

* $p < .20$

Table 17

Risk Perception of Musculoskeletal Injury by MS Symptoms

	RPMI					RPMI-S					RPMI-O				
Variables	N	Mean	SD	t or F	*p*	N	Mean	SD	t or F	*p*	N	Mean	SD	t or F	*p*
MS symptoms in lifetime															
Yes	346	4.07	0.98	0.824	.411	347	3.85	1.09	1.508	.132*	346	4.28	1.00	-0.010	.992
No	9	3.79	1.08			9	3.30	1.09			9	4.29	1.34		
MS symptoms in the past 12 mo.															
Yes	316	4.10	0.98	1.491	.137*	317	3.90	1.07	2.655	.008*	316	4.29	1.00	0.091	.928
No	34	3.83	1.02			34	3.39	1.12			34	4.27	1.10		
Major symptoms (12 mo.)															
Yes	174	4.32	0.94	4.582	.000*	174	4.16	1.01	5.211	.000*	174	4.48	0.96	3.339	.001*
No	163	3.84	0.98			164	3.57	1.06			163	4.11	1.04		
Work-related symptoms (12 mo.)															
Yes	252	4.26	0.93	1.768	.078*	252	4.08	1.02	1.242	.215	252	4.45	0.96	1.943	.053*
No	8	3.67	0.93			9	3.65	0.96			8	3.78	0.91		

	RPMI			RPMI-S			RPMI-O		
Variables	N	*r*	*p*	N	*r*	*p*	N	*r*	*p*
MS symptom index	.331	.275	.000*	332	.332	.000*	331	.179	.001*

RPMI: Risk perception of musculoskeletal injury, RPMI-S: Risk perception of musculoskeletal injury to self, RPMI-O: Risk perception of musculoskeletal injury to coworkers
* $p < .20$

Table 18

Correlations Between Risk Perception of Musculoskeletal Injury and Physical, Psychosocial, and Organizational Factors

	RPMI			RPMI-S			RPMI-O		
Variables	N	*r*	*p*	N	*r*	*p*	N	*r*	*p*
Frequency of patient handling	350	.106	.047*	351	.083	.121*	350	.118	.027*
Physical workload index	344	.331	.000*	345	.360	.000*	344	.260	.000*
Psychological demand	357	.342	.000*	358	.321	.000*	357	.319	.000*
Decision latitude	359	-.102	.052*	360	-.127	.016*	359	-.063	.234
Skill discretion	359	-.062	.242	360	-.074	.163*	359	-.042	.425
Decision authority	358	-.106	.046*	359	-.133	.012*	358	-.062	.241
Social support	357	-.090	.088*	358	-.100	.058*	357	-.069	.195*
Supervisor support	357	-.113	.033*	358	-.129	.015*	357	-.082	.122*
Coworker support	357	-.014	.796	358	-.010	.856	357	-.018	.737
Job strain	357	.317	.000*	358	.323	.000*	357	.269	.000*
Effort	339	.277	.000*	340	.312	.000*	339	.202	.000*
Reward	349	-.227	.000*	350	-.240	.000*	349	-.183	.001*
Financial and status reward	354	-.156	.003*	355	-.158	.003*	354	-.133	.012*
Esteem reward	354	-.207	.000*	355	-.215	.000*	354	-.172	.001*
Job security reward	344	-.188	.000*	345	-.206	.000*	344	-.144	.007*
Effort-reward ratio	335	.259	.000*	336	.287	.000*	335	.194	.000*
Overcommitment	357	.169	.001*	358	.209	.000*	357	.104	.049*
Safety climate	358	-.230	.000*	359	-.255	.000*	358	-.174	.001*

RPMI: Risk perception of musculoskeletal injury, RPMI-S: Risk perception of musculoskeletal injury to self, RPMI-O: Risk perception of musculoskeletal injury to coworkers

* $p < .20$

Table 19

Safe Work Behavior by Demographic Characteristics

Variables	N	*r*	*p*
Age	357	.090	.089*
Height	359	-.031	.561

Variables	N	Mean	SD	t or F	*p*
Gender					
Female	333	4.85	0.52	-0.436	.663
Male	26	4.90	0.57		
Race					
White	297	4.83	0.53	-2.240	.026*
Others	62	4.99	0.49		
Education					
Diploma	32	4.83	0.58	0.759	.520
Associate	68	4.93	0.54		
Bachelor	211	4.83	0.50		
Master/Doctoral	50	4.89	0.57		
Marital status					
Married	268	4.87	0.53	0.642	.521
Others	92	4.83	0.52		
BMI					
Underweight/Normal	176	4.82	0.52	-1.079	.281
Overweight/Obese	182	4.88	0.53		

* $p < .20$

Table 20

Safe Work Behavior by Job Characteristics

Variables	N	*r*	*p*
Total duration of employment	360	.080	.129*
Direct patient care (% time)	358	.048	.362
Hours worked per 2 wks	358	-.044	.402
Break (minutes)	355	.016	.759

Variables	N	Mean	SD	t or F	*p*
Nursing position					
Staff nurse	268	4.85	0.54		
Charge nurse	44	4.87	0.43	0.186	.830
Both staff & other roles	49	4.89	0.56		
Work status					
Full time	270	4.84	0.54	-0.511	.610
Others	88	4.88	0.49		
Work schedule					
Days	212	4.82	0.52		
Evenings	16	4.85	0.57	2.597	.052*
Nights	91	4.98	0.52		
Rotating	40	4.75	0.53		
Type of unit					
ICUs	294	4.87	0.52	1.354	.177*
Non-ICU	67	4.78	0.57		
Type of hospital					
Non-profit community hospital	197	4.88	0.50		
Profit community hospital	57	4.88	0.49	0.623	.601
University medical center	66	4.79	0.61		
Others	39	4.80	0.53		
Work setting					
Urban	169	4.84	0.53		
Suburban	139	4.88	0.51	0.257	.773
Rural	44	4.85	0.45		
Size of hospital (beds)					
<100	21	5.00	0.35		
100-299	64	4.83	0.56		
300-499	81	4.93	0.50	0.915	.456
500-799	44	4.83	0.61		
800+	13	4.73	0.68		
Number of break ≥ 10 minutes					
<1	34	4.90	0.53		
1	181	4.84	0.53	0.211	.810
>1	143	4.85	0.53		
Lifting devices or lifting team					
Yes	178	4.90	0.57	1.559	.120*
No	183	4.81	0.48		

* $p < .20$

Table 21

Safe Work Behavior by MS Symptoms

Variables	N	Mean	SD	t or F	*p*
MS symptoms in lifetime					
Yes	348	4.85	0.52	-1.548	.122*
No	9	5.12	0.64		
MS symptoms in the past 12 months					
Yes	318	4.85	0.52	-0.938	.349
No	34	4.94	0.53		
Major symptoms in the past 12 months					
Yes	175	4.79	0.51	-2.117	.035*
No	164	4.91	0.55		
Work-related symptoms in the past 12 months					
Yes	253	4.82	0.51	0.077	.940
No	9	4.80	0.82		

Variable	N	*r*	*p*
MS symptom index	333	-.137	.012*

* $p < .20$

Table 22

Correlations Between Safe Work Behavior and Physical, Psychosocial, and Organizational Factors

Variables	N	*r*	*p*
Frequency of patient handling	352	-.014	.795
Physical workload Index	345	-.139	.010*
Psychological demand	358	-.045	.399
Decision latitude	360	.197	.000*
Skill discretion	360	.126	.017*
Decision authority	359	.199	.000*
Social support	358	.254	.000*
Supervisor support	358	.226	.000*
Coworker support	358	.190	.000*
Job strain	358	-.151	.004*
Effort	341	-.061	.258
Reward	351	.131	.014*
Financial and status reward	356	.098	.064*
Esteem reward	356	.105	.047*
Job security reward	346	.106	.049*
Effort-reward ratio	337	-.073	.181*
Overcommitment	358	-.202	.000*
Safety climate	360	.366	.000*
Risk perception (RPMI)	359	-.132	.012*
Risk perception to self (RMPI-S)	360	-.140	.008*
Risk perception to coworkers (RPMI-O)	359	-.108	.041*

* $p < .20$

Table 23

Correlations Between Safe Work Behavior and Risk Perception

	Safe Work Behavior		
Variables	N	*r*	*p*
Risk perception (RPMI)	359	-.132	.012*
Risk perception to self (RMPI-S)	360	-.140	.008*
Risk perception to coworkers (RPMI-O)	359	-.108	.041*

* $p < .20$

Multivariate Analysis: Risk Perception of Musculoskeletal Injury

Multiple linear regression analyses were conducted to construct a multivariate model which included variables selected based on the findings from bivariate analyses (criterion for inclusion: $p < .20$). A reduced model was then constructed using significant variables found in the initial multivariate model (criterion for inclusion: $p < .05$). Regarding risk perception, if an independent variable demonstrated $p < .20$ in the bivariate association with any of the three risk perception variables, the variable was included in all three models. Thus, initial models for risk perception were constructed with 15 variables. Models for risk perception of musculoskeletal injury are presented in Tables 25 and 26. Since the numbers of missing data items vary across variables, the sample sizes differ between initial models and reduced models.

Overall risk perception. The initial model for overall risk perception explained 25.8% of the variability in risk perception of musculoskeletal injury among critical care nurses ($R^2 = .258$, $F_{19, 263} = 4.809$, $p < .001$). In this model, significant predictors for higher overall risk perception included higher MS symptom index, not having access to lift devices or lift teams, more frequent patient handling, higher physical workload index, and greater job strain. The strongest predictor for overall risk perception was job strain, and this variable uniquely explained 3.4% of the variability in overall risk perception. The reduced model constructed with the above five variables accounted for 23.2% of the variability in overall risk perception of musculoskeletal injury ($R^2 = .232$, $F_{5, 306} = 23.108$, $p < .001$). The frequency of patient handling per shift variable was not significant in the reduced model.

Risk perception to self. The model for risk perception to self explained 28.6% of the variability in risk perception of musculoskeletal injury among critical care nurses ($R^2 = .286$, $F_{19, 264} = 5.565$, $p < .001$), slightly more than did the model for overall risk perception. Significant predictors for higher risk perception to self were higher MS symptom index, not having access to lift devices or lift teams, higher physical workload index, and greater job strain. Unlike the model for overall risk perception, frequency of patient handling was not a significant variable in this model. In fact, the strongest predictor was the physical workload index, which uniquely explained 4.0% of the variability in risk perception to self. The reduced model constructed with the above four variables accounted for 22.4% of the variability in risk perception to self ($R^2 = .224$, $F_{4, 315} = 22.688$, $p < .001$).

Risk perception to coworkers. The model for risk perception to coworkers explained 20.5% of the variability in risk perception of musculoskeletal injury among critical care nurses ($R^2 = .205$, $F_{19, 263} = 3.566$, $p < .001$). Significant predictors for higher risk perception to coworkers included not having access to lift devices or lift teams, more frequent patient handling, and greater job strain. Among these variables, job strain was the strongest predictor, uniquely explaining 4.1% of the variability in risk perception to coworkers. Compared with the model for risk perception to self, the frequency of patient handling rather than the physical workload index was found to be significant in the model for risk perception to coworkers; and the MS symptom index was not significant. The reduced model constructed with these three variables accounted for 15.3% of the variability in risk perception to coworkers ($R^2 = .153$, $F_{3, 343} = 20.673$, $p < .001$).

Multivariate Analysis: Safe Work Behavior

The safe work behavior multivariate model (Table 28) included 13 variables and explained 23.7% of the variability in safe work behavior among critical care nurses (R^2 = .237, $F_{15, 276}$ = 5.711, p< .001). Significant predictors for safer work behavior included working the day shift (compared to rotating shift), a better safety climate, greater social support, higher ER ratio, and less overcommitment. The safety climate emerged as the strongest predictor, uniquely explaining 4.5% of the variability in safe work behavior. Risk perception of musculoskeletal injury was not significant in this model. The reduced model (Table 29) constructed with the above five variables explained 20.3% of the variability in safe work behavior (R^2 = .203, $F_{7, 2322}$ = 11.683, p< .001). In this reduced model, social support was not significant and working the night shift predicted safer work behavior compared to working the day shift.

Table 24

Correlations Between Variables in Multivariate Analysis for Risk Perception of Musculoskeletal Injury (N = 284)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. rpmisc	-													
2. phfreq	.111	-												
3. pwiq	.350	.038	-											
4. jobstrn	.355	.131	.274	-										
5. totspt	-.112	-.102	-.061	-.486	-									
6. erratio	.284	.179	.237	.573	-.421	-								
7. eroc	.220	.094	.118	.418	-.212	.391	-							
8. sc	-.209	-.195	-.178	-.523	.626	-.492	-.280	-						
9. wbtotc	-.100	-.049	-.145	-.147	.267	-.042	-.208	.363	-					
10. painidx	.314	.068	.180	.250	-.039	.268	.300	-.213	-.137	-				
11. ptcare	.134	.071	.052	.106	-.022	.060	.113	-.032	.025	.019	-			
12. breakm	.068	.011	.022	-.035	.088	-.105	-.095	.087	.009	-.024	-.029	-		
13. unit	.089	.158	.058	.150	-.088	.005	.116	-.057	-.099	.072	.068	.151	-	
14. lift	-.173	.086	-.140	-.092	.117	-.006	-.020	.188	.106	-.096	-.085	-.043	-.127	-

RPMISC: Risk perception to self; PHFREQ: Frequency of patient handling per shift; PWIQ: Physical workload Index; JOBSTRN: Job strain
TOTSPT: Social support; PAINIDXC: MS Symptom index; ERRATIO: Effort-reward ratio; EROC: Overcommitment
SC: Safety climate; LIFTDTC: Lift devices or team; WBTOTC: Safe work behavior; PAINIDX: MS Symptom index
PTCARE: Direct patient care; BREARM: Break; UNIT: Type of units; LIFT: lifting devices or lifting team

Table 25 *Multivariate Models of Risk Perception of Musculoskeletal Injury by Complete Case Analysis*

	RPMI (n = 283)					RPMI-S (n = 284)					RPMI-O (n = 283)				
Variables	R^2	Beta	sr^2	t	*p*	R^2	Beta	sr^2	t	*p*	R^2	Beta	sr^2	t	*p*
Overall	.258[a]					.286[b]					.205[c]				
Education (Ref.=Bachelor)[d]			.006	0.706[g]	.549			.014	1.731[g]	.161			.001	0.070[g]	.976
Diploma		0.041	.002	0.734	.463		0.055	.003	1.002	.317		0.019	.000	0.338	.736
Associate		-0.003	.000	-0.052	.958		-0.010	.000	-0.182	.855		0.003	.000	0.058	.954
MS/PhD		-0.063	.004	-1.132	.259		-0.102	.009	-1.874	.062		-0.014	.000	-0.250	.803
Shift (Reference=Days)[d]			.006	0.659[g]	.578			.004	0.504[g]	.680			.007	0.803[g]	.493
Evenings		0.055	.003	1.008	.314		0.030	.001	0.566	.572		0.075	.005	1.320	.188
Nights		0.016	.000	0.266	.790		0.000	.000	0.006	.995		0.027	.001	0.448	.655
Rotation		-0.041	.001	-0.720	.472		-0.051	.002	-0.916	.360		-0.028	.001	-0.473	.636
MS symptom index		**0.129**	**.014**	**2.189**	**.029**		**0.186**	**.028**	**3.233**	**.001**		0.050	.002	0.824	.411
Type of unit (ICUs)[e]		0.004	.000	0.069	.945		-0.012	.000	-0.221	.825		0.018	.000	0.310	.757
Direct patient care (% time)		0.049	.002	0.899	.369		0.080	.006	1.503	.134		0.011	.000	0.198	.844
Break (minutes)		0.072	.005	1.304	.193		0.080	.006	1.485	.139		0.057	.003	0.999	.319
Lift devices or lift teams (Yes)[f]		**-0.174**	**.026**	**-3.064**	**.002**		**-0.120**	**.013**	**-2.168**	**.031**		**-0.213**	**.040**	**-3.630**	**.000**
Safety climate		0.065	.002	0.809	.419		0.024	.000	0.306	.760		0.105	.005	1.262	.208
Freq. of pt handling per shift		**0.119**	**.013**	**2.120**	**.035**		0.067	.004	1.217	.225		**0.160**	**.023**	**2.748**	**.006**
Physical workload Index		**0.174**	**.026**	**3.009**	**.003**		**0.218**	**.040**	**3.842**	**.000**		0.106	.009	1.764	.079
Job strain		**0.261**	**.034**	**3.477**	**.001**		**0.203**	**.021**	**2.763**	**.006**		**0.288**	**.041**	**3.700**	**.000**
Social support		0.084	.004	1.145	.253		0.057	.002	0.789	.431		0.099	.005	1.306	.193
ER ratio		0.099	.005	1.340	.181		0.096	.005	1.336	.183		0.089	.004	1.164	.245
Overcommitment		-0.023	.000	-0.362	.718		0.023	.000	0.363	.717		-0.069	.003	-1.041	.299
Safe work behavior		-0.059	.003	-0.955	.341		-0.019	.000	-0.318	.751		-0.097	.007	-1.515	.131

a. Overall model for RPMI: $R^2 = .258$, $F_{19, 263} = 4.809$, $p < .001$ b. Overall model for RPMI-S: $R^2 = .286$, $F_{19, 264} = 5.565$, $p < .001$
c. Overall model for RPMI-O: $R^2 = .205$, $F_{19, 263} = 3.566$, $p < .001$ d. Categorical variables e. Binary variable: Reference = Non-ICU units f. Binary variable: Reference = No g. F value

Table 26 *Reduced Multivariate Models of Risk Perception of Musculoskeletal Injury by Complete Case Analysis*

	RPMI (n = 312)					RPMI-S (n = 320)					RPMI-O (n = 347)				
Variables	R^2	Beta	sr^2	t	*p*	R^2	Beta	sr^2	t	*p*	R^2	Beta	sr^2	t	*P*
Overall	.232					.224					.153[c]				
MS symptom index		**0.151**	**.021**	**2.892**	**.004**		**0.209**	**.040**	**4.037**	**.000**					
Lift devices or lift teams (Yes)[f]		**-0.145**	**.021**	**-2.870**	**.004**		**-0.101**	**.010**	**-2.018**	**.044**		**-0.171**	**.029**	**-3.421**	**.001**
Freq. of pt handling per shift		0.099	.010	1.960	.051							**0.133**	**.017**	**2.652**	**.008**
Physical workload Index		**0.190**	**.032**	**3.599**	**.000**		**0.249**	**.057**	**4.811**	**.000**					
Job strain		**0.255**	**.057**	**4.782**	**.000**		**0.188**	**.032**	**3.587**	**.000**		**0.301**	**.089**	**5.991**	**.000**

Overall models for RPMI: $R^2 = .232$, $F_{5, 306} = 18.532$, $p < .001$ RPMI-S: $R^2 = .224$, $F_{4, 315} = 22.688$, $p < .001$ RPMI-O: $R^2 = .153$, $F_{3, 343} = 20.673$, $p < .001$

Table 27

Correlations Between Variables in Multivariate Analysis for Safe Work Behavior (N = 292)

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. wbtotc	-												
2. pwiq	-.148	-											
3. jobstrn	-.165	.235	-										
4. totspt	.272	-.042	-.486	-									
5. erratio	-.051	.220	.580	-.426	-								
6. eroc	-.218	.103	.419	-.212	.395	-							
7. sc	.354	-.170	-.520	.628	-.500	-.284	-						
8. painidx	-.133	.177	.253	-.039	.269	.295	-.224	-					
9. rpmisc	-.106	.347	.302	-.092	.261	.216	-.194	.308	-				
10. lift	.124	-.140	-.109	.109	-.018	-.026	.182	-.108	-.173	-			
11. unit	-.103	.071	.144	-.066	-.005	.112	-.051	.071	.086	-.123	-		
12. totempl	.055	-.031	.059	-.127	.143	.082	-.019	.051	.104	.050	.113	-	
13. race	-.072	.089	.026	-.025	.017	.084	-.071	.131	-.071	.060	.044	.009	-

WBTOTC: Safe work behavior; PWIQ: Physical workload Index; JOBSTRN: Job strain; TOTSPT: Social support
ERRATIO: Effort-reward ratio; EROC: Overcommitment; SC: Safety climate; PAINIDXC: MS Symptom index
RPMISC: Risk perception to self; LIFT: Lift devices or team; UNIT: Type of units; TOTEMPL: Total duration of employment
RACE: Race

Table 28

Multivariate Model of Safe Work Behavior by Complete Case Analysis (N = 292)

Variables	R^2	Beta	sr^2	t	*p*
Overall[a]	.237				
Race (White)[b]		0.000	.000	0.006	.995
Years worked in nursing		0.053	.003	0.962	.337
Shift (Reference=Days)[c]			**.025**	**3.064[f]**	**.029**
Evenings		-0.047	.002	-0.864	.388
Nights		0.067	.004	1.157	.248
Rotation		**-0.127**	**.015**	**-2.294**	**.023**
MS symptom index		-0.065	.003	-1.101	.272
Type of unit (ICUs)[d]		-0.051	.002	-0.930	.353
Lift devices or lift teams (Yes)[e]		0.025	.001	0.451	.653
Safety climate		**0.306**	**.045**	**4.055**	**.000**
Physical workload Index		-0.106	.009	-1.819	.070
Job strain		0.072	.003	0.968	.334
Social support		**0.183**	**.018**	**2.524**	**.012**
ER ratio		**0.259**	**.036**	**3.613**	**.000**
Overcommitment		**-0.186**	**.025**	**-3.032**	**.003**
Risk perception to self		-0.019	.000	-0.317	.751

a. Overall model: $R^2 = .237$, $F_{15, 276} = 5.711$, $p < .001$
b. Binary variable: Reference = Non-white
c. Categorical variables
d. Binary variable: Reference = Non-ICU units
e. Binary variable: Reference = No
f. F value

Table 29

Reduced Multivariate Model of Safe Work Behavior by Complete Case Analysis (N = 330)

Variables	R^2	Beta	sr^2	t	*p*
Overall[a]	.203				
Shift (Reference=Days)[c]			**.023**	**3.097[f]**	**.027**
Evenings		-0.017	.000	-0.341	.733
Nights		**0.114**	**.011**	**2.152**	**.032**
Rotation		-0.079	.006	-1.531	.127
Safety climate		**0.387**	**.081**	**5.733**	**.000**
Social support		0.086	.004	1.328	.185
ER ratio		**0.243**	**.038**	**3.921**	**.000**
Overcommitment		**-0.155**	**.019**	**-2.803**	**.005**

Overall model: $R^2 = .203$, $F_{7, 2322} = 11.683$, $p < .001$

Chapter 5. Discussion

Discussion of Results

The study identified important factors influencing safe work behavior and perceptions of musculoskeletal injury risk to self and coworkers in a nation-wide random sample of 361 critical care nurses and also examined the relationship between risk perception and safe work behavior.

The critical care setting today is not limited to traditional ICUs but includes a variety of areas where intensive care for acutely and critically ill patients is provided. The study sample also included critical care nurses working in diverse areas, but the majority of the sample, 81%, was comprised of nurses working in traditional ICU settings. Critical care nurses, typically ICU nurses, provide care for patients who are physically dependent and in need of complex interventions, such as ventilator support and intensive monitoring, as well as frequent bedside procedures. Therefore, critical care nurses are often required to manage heavy equipment related to treatment or procedures and carry out patient care tasks in limited space between patient beds and ICU equipment in addition to the physical workload related to intensive patient care including patient handling (Carayon & Alvarado, 2007). ICUs have been identified as the area with the highest risk of musculoskeletal injury (Goldman et al., 2000), and also as the area with the greatest shortage of nurses (Buerhaus, Staiger, & Auerbach, 2000). In a study by Stone et al. (2006), 17% of ICU nurses reported that they intended to leave their jobs in the coming year, mostly attributing the reason to poor working conditions.

Therefore, preventing WRMSDs is imperative for the health of individual nurses as well as for retaining the current workforce. Since WRMSDs are multifactorial problems, interventions also require multifactorial approaches. In particular, since existing interventions have not totally eliminated the risk for WRMSDs, exploring contributing factors to WRMSDs from a comprehensive perspective should provide useful information for addressing gaps in current intervention programs. Accordingly, the study assumed that by performing high risk tasks safely, individual nurses play a role in controlling the remaining risk that is not reduced by existing engineering interventions. Based on this assumption, the study explored safe work behavior and risk perception among critical care nurses.

Safe Work Behavior and its Relationship with Risk Perception

Critical care nurses in this study reported that in performing patient handling tasks, they engaged in safe work behaviors more frequently than *often* but less frequently than *most of the time* (mean 4.85 ± 0.53 out of 6). In understanding the work behavior of critical care nurses, the author assumed that safe work behavior is not only determined by the individual nurse's personal practice, but also shaped by their working conditions. For example, when a lift device or assistance from coworkers is not available, the nurse inevitably performs work manually or alone. Such unsafe working conditions therefore negatively affect a worker's ability to maintain safety and result in behaviors that the individual worker might not otherwise choose. In fact, behaviors under the individual nurse's own control demonstrated higher safety performance scores in this study, whereas tasks relying on using a lifting device or coworker assistance scored the lowest in safety performance. These findings suggest that organizational support for better working conditions is critical to ensure that nurses engage in safer work behaviors.

Studies report that the use of good body mechanics alone is not sufficient to prevent injury (Hignett, 2003; Tveito et al., 2004). In reality, however, manual patient handling tasks are still an integral part of nursing, and good body mechanics are considered a basic tool for protecting oneself at the individual level. On average, critical care nurses reported using good body mechanics *most of the time,* but failed to use them *all of the time*. The nature of patient handling tasks may sometimes prevent nurses from maintaining good body mechanics. Other factors in critical care units, such as a wide variety of medical equipment or resistive/combative patients, may further compromise safe patient handling.

Although safe work behavior is not the same as health behavior, research on health behavior may serve to inform us about the role of risk perception. Numerous health behavior theories suggest that individual perceptions about themselves, their vulnerabilities, and their circumstances may affect their self protective, risk reduction or health promotion behaviors (Janz & Becker, 1984; Rogers, 1975). These theories lead us to believe that risk perception should play a key role in predicting a person's self-protective or risk reduction behaviors. Indeed, this positive role of risk perception has been demonstrated in many studies of health behaviors such as cancer screening, exercise, smoking cessation, vaccination, or adherence to treatment (Brewer et al., 2007; Floyd & Prentice-Dunn, 2000; Harrison et al., 1992). In addition, some studies of safe work behavior have reported significant associations with risk perception (Arezes & Miguel, 2006; Gershon et al., 1995; Tomas et al., 1999; Waddell, 1997).

Risk perception in this study, however, did not emerge as a significant predictor of safer work behavior, once characteristics of the work environment were included in the multivariate model. This finding is consistent with other studies which also failed to find an association between risk perception and safe work behavior (Rickett et al., 2006;

Rundmo, 1996; Seo, 2005). Similar to this study, meta-analysis studies have found small effects (the pooled effect size *r* ranging between .08 and .26) in the bivariate relationship between risk perception and health behaviors (Brewer et al., 2007; Harrison et al., 1992). The significant bivariate correlation found in this study between risk perception and safe work behavior argues for further research, particularly given scant information about nurses' safe work behavior in existing literature.

Moreover, the inverse relationship between risk perception and safe work behavior found in the bivariate analysis is interesting. Namely, a higher level of perceived musculoskeletal injury risk is likely to be related to less frequent engagement in safer work behaviors. Indeed, an expected relationship in this study was the exact opposite, that perception of increased risk promotes safe work behavior. This inverse relationship may have resulted from the cross-sectional study design, in which any relationship between two variables may result from bidirectional influences. Therefore, a reasonable interpretation of this relationship direction might be that nurses are more likely to perceive an elevated risk of injury when engaging in safer patient handling behaviors less frequently. This bidirectional influence of risk perception and behavior was demonstrated by Brewer, Weinstein, Cuite, and Herrington (2004). The researchers found supporting evidence both for the behavior motivation hypothesis, in which the perception of risk produces protective actions, and for the risk reappraisal hypothesis, in which behavior alters risk perception. As a result, studies on the relationship between risk perception and safe work behavior requires a more rigorous design such as a prospective study.

Predictors of Safe Work Behavior

Characteristics of the work environment appear to be more important in predicting safe work behavior than risk perception or other individual factors. In this study, safe work behavior among critical care nurses was predicted by safety climate, effort-reward imbalance, overcommitment, social support, and work shift.

Safety climate was found to be the strongest predictor for safe work behavior among critical care nurses in this study. Consistently, Seo (2005) also found that safety climate was the strongest predictor of safety behavior in grain industry workers. A number of studies of health care workers also found significant associations between safety climate and safe work practices regarding compliance with Universal Precautions (Felknor et al., 2000; Gershon et al., 1995; Gershon et al., 2000). Safety climate derives from the organizational work environment and reflects management leadership and organizational efforts to promote workplace safety and good communication regarding safety issues (Gershon et al., 2000; Zohar, 1980). This study found that safe work behavior is determined by perception of organizational-level safety efforts, rather than risk perception at an individual level. These findings suggest that the critical importance of organizational support for safe work practices and a safety culture.

Along with safety climate, social support also emerged as a predictor for safe work behavior among critical care nurses. Overall, the significant effects of social support and safety climate suggest that safe work behavior is greatly influenced by the interpersonal or social environment at work. Although the significant effect of social support was not retained in the reduced multivariate model, this may be explained by the inclusion of safety climate. This explanation is supported in that social support was moderately correlated with safety climate and that in the reduced model, the unique contribution of safety climate to the variance in safe work behavior increased about twofold over that in the initial model. Unfortunately, few if any studies have examined the relationship between social support and safe work behavior. On the other hand, many studies have demonstrated that social support affects health behaviors such as physical activity or cancer screening (Magai, Consedine, Neugut, & Hershman, 2007; McNeil, Kreuter, & Subramanian, 2006).

Another significant predictor for safe work behavior among critical care nurses was effort-reward imbalance. The concept of effort-reward imbalance as the mechanism of job stress was developed by Johannes Siegrist. The effort-reward imbalance model assumes that effort at work is socially exchanged for rewards such as money, esteem, and career opportunities. A lack of reciprocity between efforts (costs) and rewards (gains) evokes emotional distress and stress responses and in the long run, adverse health consequences (Peter & Siegrist, 2000). According to the effort-reward imbalance model, greater ER ratio indicates greater job stress. Surprisingly, increased ER ratio was associated with high levels of safe work behavior in this study. One possible interpretation of this finding is that nurses with high levels of job-related stress may feel more vulnerable at work and, therefore, are more likely to engage in safer behaviors. In fact, this study found that nurses with greater job strain perceived greater risk of musculoskeletal injury. However, risk perception was not a significant predictor for safe work behavior in this study. Gershon et al. (1995) found the opposite, demonstrating a significant bivariate association between high job stress and low levels of compliance with Universal Precautions. In a study by Seo (2005), safe work behavior was not predicted by perceived work pressure. In another study of health behaviors, high job strain was associated with adverse health behaviors such as smoking, heavy drinking, overweight, and physical inactivity (Kouvonen et al., 2007). Therefore, additional studies are needed to validate this study finding regarding the contribution of effort-reward imbalance to safe work behavior.

In addition to effort-reward imbalance, overcommitment, which is also a construct of the effort-reward imbalance model, was found to be a significant predictor of safe work behavior among critical care nurses. The effort-reward imbalance model defines overcommitment as a person’s cognitive and motivational pattern of coping with demands characterized by excessive work-related commitment. It assumes that overcommitment modifies the effect of effort-reward imbalance on health and increases risk of health problems (Siegrist et al., 2004). In this study, greater overcommitment was associated with lower levels of safe work behavior, meaning that nurses who overcommitted to work engaged less frequently in safe work behavior. This finding suggests that management needs to redouble efforts to emphasize safety and health, especially for nurses who have a reputation for strong dedication to patient care. The study categorized overcommitment as a psychosocial work factor, but given its definition, it may be more accurate to regard it as an individual factor.

The above findings support the utility of the effort-reward imbalance model in research on safe work behavior. Until the effort-reward imbalance model emerged, the job strain model had dominated research on job stress. The effort-reward imbalance model has now gained in popularity, demonstrating both its utility as a job stress theory and the validity and reliability of ERI measures. Interestingly, effort-reward imbalance was a better model for predicting safe work behavior among critical care nurses than job strain. In bivariate analysis, both job strain and effort-reward imbalance were significantly associated with safe work behavior. However, the effort-reward imbalance model proved to be the superior measure in the multivariate model. Comparing the two models, the effort-reward imbalance model measures the worker's subjective experience regarding job stressors, whereas the job strain model is considered to measure objective job characteristics. Therefore, the findings suggest that the more subjective concept of job stress, effort-reward imbalance, has a theoretically stronger influence on work behavior than the more objective concept of job strain. However, further evidence is needed to support this explanation.

The final significant predictor of safe work behavior was work shift. However, the initial comprehensive model and the reduced model produced different findings. In the comprehensive model, day shift nurses reported safer work behavior than nurses who worked rotating shifts. In the reduced model, night shift nurses reported higher levels of safe work behavior than day shift nurses. The simplest explanation for this discrepancy is due to missing data for some variables, which resulted in different sample sets for the two types of multivariate analysis. In addition, much smaller numbers of cases for three shifts (evenings, nights, rotating) compared to cases for days might contribute to this inconsistent result.

As a result of this discrepancy, it is hard to determine what role shift plays in terms of safe work behavior; minimally, this study suggests that safe work behavior differs among nursing shifts. What differences may exist among different work shifts? In a secondary analysis, shifts were compared on physical and psychosocial work factors and safety climate, and demonstrated differences in terms of physical workload, job demands, job strain, effort, and effort-reward imbalance. Further post-hoc analysis showed that all these risk factors were significantly greater for day shift nurses than for night shift nurses. This study provides a preliminary view of the relationship of work shift and safe work behavior. More research is needed to detail the relationship.

Overall, psychosocial and cultural factors within the organizational work setting proved to be more important in predicting safe work behavior than individual factors. Therefore, safe work behavior is best understood as a socio-cultural phenomenon, largely dependent on the social work environment rather than an aspect of individual health behavior.

Predictors of Risk Perception of Musculoskeletal Injury

Although this study did not find a role of risk perception as a motivator of safe work behavior, this does not obviate the need to understand risk perception among critical care nurses. Risk perception may contribute indirectly to nurses' health and safety and possibly also to quality of work life through different routes. Given the little information known about nurses' risk perception, identifying factors influencing risk perception will help us better understand this complex phenomenon.

Overall, a higher perception of risk for musculoskeletal injury among critical care nurses was predicted by a variety of risk factors, including greater job strain, greater physical workload, more frequent patient handling tasks, the lack of lifting devices or a lifting team, and more serious self-reported musculoskeletal symptoms. The study also revealed some differences in perceptions of risk to self, coworkers, and risk in general.

Job strain was found to be the strongest predictor of overall risk perception as well as the perception of risk to coworkers. Perception of risk to self was also predicted by job strain. The relationship between psychosocial job stress and risk perception of injury has been rarely examined, however. Instead, many studies have shown that psychosocial work factors affect actual injury such as WRMSDs (Bernard, 1997). Furthermore, job strain has been significantly associated with WRMSDs among health care workers (Ahlberg-Hulten et al., 1995; Josephson et al. 1997). Nurses in high-strain jobs may feel more vulnerable regarding their health or be more aware of negative aspects of working conditions, leading to perceptions of a heightened risk for musculoskeletal injury. An alternative interpretation is also plausible; that is, heightened awareness about risk from work results in increased negative psychological loading, and thus reports of higher strain in jobs. Although we cannot determine the direction of this relationship when using a cross-sectional study design, the first interpretation may be more theoretically reasonable since job strain is more likely to reflect objective job characteristics that cause distress. Interestingly, job strain was a better model for predicting risk perception than effort-reward imbalance, which reflects subjective stressful experiences about the job. This finding suggests that perception of risk from work may be more strongly related to the judgment about objective work conditions rather than simply a subjective emotional response.

In addition to psychosocial factors, physical work factors (as measured by the physical workload index and the frequency of patient handling tasks) were also found to be significant predictors of overall risk perception for musculoskeletal injury among critical care nurses. Physical work has been clearly identified as a major risk factor for WRMSDs (Bernard, 1997). Thus, an increase in perceived risk accompanying increased physical workload may reflect appropriate awareness of the risk. Similarly, Landry (2006) found that exposures to repeated strenuous physical activity and repetitive hand motion were significant predictors for perception of risk of injury to self among women workers. Interestingly, in this study, perception of one's own risk of injury was predicted by the physical workload index, whereas the perception of the risk to one's coworkers was better predicted by the frequency of patient handling tasks. Subjects may know more about their own overall physical exposures at work (as reflected in the more comprehensive measure of the physical workload index, a measure of cumulative load from work postures and work activities) than they do about the exposure of their coworkers (for whom the frequency of patient handling may have been a more accessible estimate for subjects to make).

Provision of lift devices or lift teams in the workplace was another significant predictor for risk perception among critical care nurses, predicting all three variables of risk perception. Risk perception of musculoskeletal injury was lower among nurses who had lift devices or lift teams than among those who had neither. The use of lift devices or lift teams may encourage nurses to feel safer about patient handling tasks and thus lead to reduced perceptions of risk. On the other hand, the provision of lift devices or lift teams variable may also be understood to reflect organizational efforts to prevent injury, rather than the actual use of the devices or lift teams for several reasons. First, the study did not limit assessment of risk perception to patient handling tasks, and it also measured risk from work in general and activities other than patient handling. Second, lift devices or lift teams were not available for many subjects. Furthermore, it was shown that the majority of nurses were exposed to manual patient handling irrespective of whether lift devices or teams were provided. In fact, secondary analysis revealed that the perception of a safety climate was significantly higher among nurses working with lift devices or lift teams compared to those working without them ($t = 3.503$, $p = .001$), suggesting that hospitals providing lift devices or lift teams may have instituted a better organizational safety culture. However, the MS symptom index was not associated with the provision of lift devices or lift teams.

Although the provision of lift devices or lift teams was found to affect risk perception of musculoskeletal injury, the study also revealed that lift devices or lift teams were not available for the vast majority of nurses. Among the study participants, only 46.5% reported having lifting devices available on their unit, and only 7.2% reported the presence of lift teams in their hospitals. In addition, 76% of nurses who performed patient lift and transfer tasks reported that that all of the tasks were performed manually. Only 3% reported that they never engaged in manual patient lift and transfer tasks at any time. This finding indicates that protective intervention programs for nurses do not exist in many real-world hospitals. Although hospital-provided WRMSDs intervention programs beyond the provision of lifting devices or lift teams were not assessed, there is no question that the study revealed that many nurses lack effective organization-level intervention programs.

The final predictor for risk perception of musculoskeletal injury among critical care nurses was the MS symptom index. The measure of current symptom severity was significantly associated with overall risk perception and risk perception to self, but not with the perception of risk to coworkers. Landry (2006) reported a similar finding, where bodily pain measured by SF-36 among women workers was associated with perception of injury risk to self, but not risk to other women workers. Since the MS symptom index reflects one's personal state and cannot capture the experience of other workers, its value in predicting only risk perception to self is understandable. Although we cannot determine the direction of relationship between variables in this cross-sectional study, it is plausible to interpret that experiencing more musculoskeletal symptoms causes nurses to have heightened awareness of injury risks from work, 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 the development of WRMSDs. Characterizing how risk perception influences injury prevention should be of interest to occupational health researchers.

The experience of musculoskeletal symptoms measured with the MS symptom index was found to be associated with risk perception. Additional findings on other MS symptom variables may broaden our understanding about risk perception of musculoskeletal injury although the relationship is from the bivariate analysis. Experiencing major symptoms in the past 12 months was associated with all three risk perceptions of overall, risk to self, and risk to coworkers, while experiencing any symptoms in the past 12 months was associated only with perception of risk to self. On the other hand, experiencing any symptoms in their lifetime or work-related symptoms in the past 12 months was not associated with risk perception at all. These findings suggest that risk perception is more likely to be influenced by recent and major symptoms, and whether or not the symptom is work-related seems to play little or no role in risk perception.

Overall, this study reveals that risk perception of musculoskeletal injury is shaped by the physical, psychosocial, and organizational work environment, as well as by personal experience of symptoms. The study findings also reveal an interesting difference in prediction of risk perception. Whereas the physical workload index and the MS symptom index were stronger predictors for risk perception to self, job strain and the provision of lifting devices or a lifting team were stronger predictors for perception of risk to coworkers and overall risk perception. It is difficult to explain this finding, but it is possible that when nurses perceive occupational risk to themselves, their perception is more affected more by their personal condition and physical experiences related to their own work situation rather than by more general job characteristics.

Risk and Impacts of Musculoskeletal Symptoms to Critical Care Nurses

The study also confirmed the high prevalence of musculoskeletal symptoms among critical care nurses and identified the impact of those symptoms. The overall 12-month prevalence of musculoskeletal symptoms, in at least one body region, was 90% in this study sample. The most common problem was low back pain, followed by neck pain and shoulder pain, with a 12-month prevalence of 76%, 63%, and 47%, respectively. These numbers were somewhat higher than those reported by Trinkoff et al. (2002), which employed the same measure, and estimated an overall prevalence of 73% in a random sample of 1,163 U.S. nurses (47% for back, 46% for neck, and 35% for shoulders).

Compared to findings in international studies of nursing staff, the prevalence of musculoskeletal symptoms in critical care nurses is at the uppermost end of the scale. A European study reported a prevalence of 62-75% for low back pain, 39-47% for neck pain, and 37-41% for shoulder pain in Dutch and Greek nurses (Alexopoulos et al., 2006). Asian studies of Korean and Japanese nurses reported similar or higher prevalence compared with the European study: 71-72% for low back pain, 55-63% for neck pain, and 72-75% for shoulder pain (Smith et al., 2005; Smith, Mihashi, Adachi, Koga, & Ishitake, 2006). Interestingly, shoulder pain was found to be the most common disorder in Asian nurses and was more prevalent than among American critical care nurses.

This study showed that the majority of reported symptoms (63-82%) were caused or worsened by work, suggesting a lack of effective workplace intervention programs for critical care nurses. In fact, more than half of the sample did not have access to lifting devices on their unit, and thus, they were fully exposed to manual patient handling. The study also revealed that more than a third of symptoms (36-45%) were at major levels in terms of combined duration, intensity and frequency. Musculoskeletal symptoms considerably affected nurses' functioning at work as well as in their personal lives and led, moreover, to considerable health care utilization (31-38%) and lost work time (9-16%). Previous studies have also reported 13-37% incidence of symptoms leading to medical consultation and 3-27% incidence of symptoms resulting in lost work time (Alexopoulos et al., 2003; Elfering et al., 2002; Smedley et al., 1997; Smedley et al., 2003). However, these numbers are not directly comparable since the current study evaluated those impacts within a subset of symptomatic subjects, whereas results in other studies reflected the entire sample.

Given the high prevalence of musculoskeletal symptoms found, it is not surprising that nurses do not feel safe in their work environments. This study identified that critical care nurses perceived that a musculoskeletal injury was more likely than not to occur to themselves or coworkers within the relatively short time frame of one year. The study also identified that critical care nurses were highly aware of risks from manual patient handling, and they felt safer when performing tasks using a lifting device. However, they perceived that a musculoskeletal injury was overall more likely to occur than not, even when using a lifting device. The perception that their work is unsafe may influence nurses negatively (e.g., creating the desire to change jobs), or positively (e.g., requesting organizational safety improvements). Either way, organizational efforts must serve as the foundation for all improvements to nursing job safety.

On average, critical care nurses were found to be more optimistic about their personal risks for musculoskeletal injury compared with their perceptions of risks to coworkers. This optimistic bias in personal risk perception has been documented previously (Katapodi, Lee, Facione, & Dodd, 2004; Weinstein, 1987). Interestingly, the risk to coworkers from tasks not related to patient handling was perceived as higher than the risk to oneself from patient handling tasks performed using a lifting device. This may reflect an appropriate awareness among nurses regarding ergonomic risks from various physical tasks not related to patient handling.

In summary, this study identified and reinforced the need for effective WRMSDs intervention programs for critical care nurses. The prevalence of musculoskeletal symptoms is high, and this impact on personal work, quality of life, and social and medical costs is significant. Moreover, nurses perceive that their work is unsafe. In the absence of perfect WRMSDs intervention, appropriate risk perceptions and safe work behaviors by individual nurses may play a role in protecting their on-the-job safety. However, the study did not find evidence that risk perception motivates safe work behavior. Rather, the study showed that safe work behavior is a socio-cultural phenomenon, greatly influenced by psychosocial and organizational work environments, and in particular, safety climate and stressful working conditions. Therefore, management efforts to improve working conditions and enhance the organizational safety climate could prove to be crucial in ensuring that nurses feel safe at work and engage in safe work behavior.

Significance

There has been a paucity of research on the topic of risk perception and safe work behavior in nurses. This study pioneers research on this topic and provides detailed and valuable information for understanding safe work behaviors among critical care nurses and their perceptions about risk of musculoskeletal injury. It is hoped that this information will contribute to developing more effective intervention programs for WRMSDs.

The study identified influencing factors that shape safe work behavior and risk perception among critical care nurses, and examined their bi-directional relationship. In particular, by investigating the phenomena of safe work behavior and risk perception based on a preliminary model of WRMSDs, the study expanded existing knowledge on risk or preventive factors for WRMSDs. Furthermore, the study investigated the magnitude and impact of WRMSDs among critical care nurses.

The study focused specifically on a population of critical care nurses performing similar tasks in the U.S., thereby providing a homogeneous sample for examination. Previous studies about the risk of injury to nurses have been conducted among nurses in multiple types of acute care practice settings or nurses pooled with other types of trained nursing staff, such as LPNs/LVNs or CNAs. Furthermore, this study surveyed a national population-based random sample, thus providing a good representation of the target population of U.S. critical care nurses and enhancing its generalizability across critical care units. The sample size was also large enough to detect small effects of theoretically important study variables. Since this study is one of the first in this area, these exploratory findings provide a useful foundation for future research from which to investigate theory-based interventions.

Another key contribution of this study is that the researcher developed new measures for risk perception of musculoskeletal injury and safe work behavior related to patient handling. Since the main interest of this study was WRMSDs in nurses, these measures were developed to assess risk perception and safe work behavior very specifically related to musculoskeletal risk from patient handing. Psychometric testing demonstrated acceptable reliability and validity for the measures, and these tools may prove useful for future research in this area. Finally, the study also employed other theoretically derived and well tested measures to evaluate the contributions of other risk factors.

Limitations

The study, nonetheless, has several limitations. First, the cross-sectional design of this study limits our ability to establish causal relationships between study variables. Second, although the study attempted to obtain a representative sample by using a nation-wide population-based random sample, the response rate of 42% potentially limits the representativeness of the study sample and raises the question of selection bias. Nurses who voluntarily join AACN may differ from nurses who are not members. Likewise, respondents may differ from non-respondents, although examinations of a subset demonstrated comparability between these two groups. Third, study findings relying solely on self-reported measures must be interpreted cautiously. Self-reported data can be biased by overreporting or underreporting of study variables related to negative affectivity or social desirability. Lastly, missing data for some variables in the survey also limits the study's accuracy.

Implications for Nursing

Many nursing settings have begun to provide WRMSDs intervention programs including lift equipment and/or lift teams to protect nurses from musculoskeletal injury. Despite these interventions, this study found that nurses continued to experience musculoskeletal symptoms. Indeed, the high prevalence of musculoskeletal symptoms found among critical care nurses calls for more aggressive intervention efforts to prevent WRMSDs.

While the study highlights the need for organizational efforts for nurses' safety, it also revealed a lack of intervention programs in many hospitals. Fewer than half of the study participants reported access to lifting devices on their units and only 7% reported that a lift team was available in the hospital. Clearly, occupational health professionals, nurse managers, and nursing organizations should make more concerted efforts to ensure the safety of nurses by providing and improving intervention strategies.

In addition to organizational efforts to create safety, individual nurses are also required to protect their safety while performing work tasks. No existing interventions have totally eliminated the risk for WRMSDs. Furthermore, the implementation and safe use of lift equipment and the utilization of lift teams continue to rely on nurses' own behaviors. This study provides a framework to assist occupational health professionals and nurse managers in understanding the nature of safe work behavior among critical care nurses and their perceptions about their personal risks. These factors may prove to be important aspects of preventive interventions.

Although safe work behavior and risk perception are individual factors, this study shows that these are significantly shaped by organizational culture and work environment. Organizational safety climate and stressful working conditions emerged as the most influential factors for safe work behavior, and physically demanding and psychosocially stressful working conditions were the most influential factors for risk perception. Accordingly, safe work behavior and risk perception are best understood as socio-cultural phenomena influenced by organizational, physical, and psychosocial work characteristics. The study provides insight about the key role of organizational and work environment in modifying safe work behavior and risk perception. Workplace-level interventions aimed at preventing WRMSDs must therefore address safety climate and organizational culture specifically. Furthermore, the study indicates that the worker-oriented approaches (e.g. training programs) complement and should be well integrated within workplace-level efforts to maximize synergy.

In this study, risk perception was not associated with safe work behavior. This finding differs from other studies which have demonstrated a role for risk perception in health promotion or other preventive health-related behaviors (Brewer et al., 2007; Floyd et al., 2000; Harrison et al., 1992). This study indicates that safer work behavior is determined differently from personal health behavior. A theoretical framework for safe work behavior needs to include the important determinants of social and work environment factors. Thus, a different approach is also needed in designing an intervention program to change safety behaviors of workers. For example, training interventions that emphasize the risks inherent in patient handling may not be as effective as developing a team safety culture. Examples of interventions for safety culture might include managers' emphasizing safety as a crucial aspect of high-quality patient care and encouraging free communication about safety issues among supervisors and coworkers.

In conclusion, management efforts are critical in creating safe work environments and promoting safe work behavior. Nurses' safe work behaviors may rely on the presence of a safe organizational climate, a supportive working environment, and the means to improve stressful working conditions. Improving the physical work environment via engineering and administrative interventions may also affect nurses' perceptions of risk positively, by making the job safer and thus reducing the risk of WRMSDs. Ultimately, all these efforts would contribute to enhancing safety in nursing settings and to maintaining a healthy nursing workforce.

Future Research

Future research is needed to confirm the study findings and expand our knowledge about risk perception and work behavior in nurses.

First, research is needed to explore the unexplained variation in the phenomena of risk perception and safe work behavior. Analyses in this study explained only 20-30% of the variability in risk perception and safe work behavior among critical care nurses. In investigating factors which may influence safe work behavior, this study was based on a framework specific for the study of WRMSDs. Other concepts of behavioral theories, such as self-efficacy, could be explored as well.

Second, future research on this topic is also indicated for nursing settings other than critical care units. Since this study was conducted on a sample of critical care nurses, the study findings are not widely generalizable to other groups of nurses. Moreover, the study findings should be validated via research on other groups of health care workers, such as nursing aides, in addition to nurses across different settings. Study using homogeneous samples would better support internal validity while studies using heterogeneous samples would better support external validity.

Third, prospective studies are needed to establish causal relationships between study variables and confirm theoretical relationships. This cross-sectional study identified an association between risk perception and musculoskeletal symptoms, but it could not establish causality. In addition, the relationship between safe work behaviors and job characteristics should be further refined. A prospective study could also examine the moderating role of risk perception and safe work behavior on the relationship between the various risk factors and WRMSDs.

Fourth, the unexpected finding of a positive relationship between safe work behavior and effort-reward imbalance needs to be further validated. Although a plausible interpretation was put forth about their relationship, the finding was still unexpected and requires further confirmative evidence. This type of support could be obtained with a prospective study.

Lastly, the lack of relationship between risk perception and safe work behavior needs to be validated through future studies. This study found a weak association in bivariate analysis, which did not persist in multivariate analysis. Since risk perception has been shown to affect health behaviors in other types of studies, this finding should be confirmed or explained further, perhaps yielding a more concrete theoretical foundation for the prevention of WRMSDs.

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Appendix A

Study Questionnaires

(Wave 1 & Wave 2)

NURSES' SAFETY STUDY

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THANK YOU VERY MUCH FOR PARTICIPATING IN THIS STUDY!

A. ABOUT YOUR WORK AS A NURSE

1. Are you currently working as a nurse?
   □₁ Yes □₂ Yes, but on sick leave or disability leave □₃ No
2. How long have you worked as a nurse, in total? _______ Years ______Months
3. How long have you worked in your current workplace? _______ Years ______Months
4. Your current nursing position:
   - □₁ Staff Nurse
   - □₂ Charge Nurse
   - □₃ Nurse Manager/Supervisor
   - □₄ Clinical Nurse Specialist/Nurse Practitioner
   - □₅ Other (specify):___________________________
5. Your current specialty (type of unit):
   - □₁ ICU
   - □₂ CCU
   - □₃ Combined ICU/CCU
   - □₄ Combined Adult/Pediatric ICU
   - □₅ Medical ICU
   - □₆ Surgical ICU
   - □₇ Cardiovascular/Surgical ICU
   - □₈ Pediatric ICU
   - □₉ Neonatal ICU
   - □₁₀ Neuro/Neurosurgical ICU
   - □₁₁ Respiratory ICU
   - □₁₂ Telemetry
   - □₁₃ Emergency Department
   - □₁₄ Recovery Room/PACU
   - □₁₅ Trauma Unit
   - □₁₆ Progressive Care Unit
   - □₁₇ Critical Care Transport/Flight
   - □₁₈ General Medical/Surgical
   - □₁₉ Operating Room
   - □₂₀ Other (specify): ___________________________
6. Your current type of workplace:
   - □₁ Community Hospital (Non-Profit)
   - □₂ Community Hospital (Profit)
   - □₃ University Medical Center
   - □₄ Military/Government Hospital
   - □₅ County Hospital
   - □₆ Other (specify):___________________________
7. Are you a travel nurse? □₁ Yes □₂ No
8. In what setting do you work? □₁ Rural □₂ Suburban □₃ Urban
9. Your work status: □₁ Full-time □₂ Part-time □₃ Per-diem □₄ Other:_____________
10. Your normal work schedule:
    □₁ Days □₂ Evenings □₃ Nights □₄ Rotating- Days, Evenings
    □₅ Rotating- Days, Nights □₆ Rotating- Evenings, Nights □₇ Rotating- Days, Evenings, Nights
11. On average, how many hours do you work per SHIFT, including overtime? ______________ Hours/Shift
12. On average, how many hours do you work per TWO WEEK PAY PERIOD, including overtime?
    ___________ Hours/Two Weeks
13. On average, how many hours do you <u>float</u> off your unit per WEEK? ________________ Hours/Week
14. On average, how much time at work do you spend performing <u>direct patient care</u>? ________% Time/Shift
15. During a typical workday, how many BREAKS <u>lasting 10 minutes or more, including meals</u>, do you take?
    ____________ Breaks/Shift

16. During a typical workday, what is the total number of MINUTES you spend on breaks?
_______________Minutes/Shift

17. How many nurses work on your unit? _______________ Nurses/Unit

18. Does your workplace have a lifting team (a team of two professional patient movers)?
☐1 Yes ☐2 No ☐3 Don't Know

18-1. If your workplace has a lifting team, how often is the team actually available when you need it?
☐1 Always ☐2 Most of the time ☐3 Often ☐4 Occasionally ☐5 Rarely ☐6 Never

19. Does your workplace provide mechanical lifting devices on the unit where you work?
☐1 Yes ☐2 No ☐3 Don't Know

19-1. If lifting devices are provided, how often are they actually available when you need them?
☐1 Always ☐2 Most of the time ☐3 Often ☐4 Occasionally ☐5 Rarely ☐6 Never

20. Is your unit equipped with height-adjustable beds? ☐1 Yes ☐2 No

B. About Work

IF YOU DO NOT PERFORM ANY PATIENT HANDLING TASKS (E.G., LIFTS, TRANSFERS, REPOSITIONING), PLEASE CHECK HERE _______ AND SKIP TO **PAGE** 4.

(a) "**Lifts and transfers**" means moving a patient from one place to another; for example, from bed to stretcher, from wheelchair to bed, or from wheelchair to commode.

1. On average, how many patient lifts and transfers do you perform during your usual shift?
___________ Times/Shift
2. Of those lifts and transfers you perform during a usual shift, how many do you do manually (without patient handling aids)? ___________Times/Shift
3. Of those lifts and transfers you perform manually during a usual shift, how many do you perform with the help of another person? ___________ Times/Shift
4. Of those lifts and transfers you perform during a usual shift, how many are done with mechanical equipment, such as sit-to-stand lifts or full body sling lifts? ___________ Times/Shift
5. Of those lifts and transfers you perform during a usual shift, how many are done with patient handling aids, such as gait belts and friction-reducing devices? ___________ Times/Shift

(b) "**Repositioning**" refers to altering a patient's body position in the same place; for example, pulling a patient up in bed or wheelchair or turning a patient from side to side in bed.

1. On average, how many times do you reposition patients during your usual shift? ________Times/Shift
2. During a usual shift, how many times do you reposition patients with the help of at least one other staff person? ___________ Times/Shift

PLEASE INDICATE HOW OFTEN YOU ENGAGE IN THE FOLLOWING ACTIONS WHEN PERFORMING PATIENT HANDLING TASKS (E.G., LIFTING, TRANSFERRING, REPOSITIONING).
IF YOU DO NOT PERFORM PATIENT HANDLING, PLEASE CHECK HERE _______AND SKIP TO PAGE 4.

Before I perform a patient handling task,	**Never**	**Rarely**	**Sometimes**	**Often**	**Most of the time**	**All of the time**	
1. I assess the condition of the patient.	☐1	☐2	☐3	☐4	☐5	☐6	
2. I assess whether the space is too crowded to perform the task.	☐1	☐2	☐3	☐4	☐5	☐6	
3. I clear space to make enough room for the task if needed.	☐1	☐2	☐3	☐4	☐5	☐6	
4. I ask help from coworkers if needed.	☐1	☐2	☐3	☐4	☐5	☐6	
5. If no coworker is readily available, I perform the task by myself.	☐1	☐2	☐3	☐4	☐5	☐6	
6. I encourage the patient to assist if possible.	☐1	☐2	☐3	☐4	☐5	☐6	
7. I assess the height of bed to see if it is at the proper height (at waist level).	☐1	☐2	☐3	☐4	☐5	☐6	
8. I adjust the height of bed when it is not appropriate for my height.	☐1	☐2	☐3	☐4	☐5	☐6	☐ Not Ever Available
9. If the patient is physically dependent, I use a lifting device or transfer aid.	☐1	☐2	☐3	☐4	☐5	☐6	☐ Not Ever Available
10. If a lifting device is not readily available, I perform the task manually.	☐1	☐2	☐3	☐4	☐5	☐6	☐ Not Ever Available

During the patient handling tasks,	**Never**	**Rarely**	**Sometimes**	**Often**	**Most of the time**	**All of the time**
11. I face the patient.	☐1	☐2	☐3	☐4	☐5	☐6
12. I keep my feet apart (shoulder width).	☐1	☐2	☐3	☐4	☐5	☐6
13. I keep my back straight.	☐1	☐2	☐3	☐4	☐5	☐6
14. I bend my knees, not my back.	☐1	☐2	☐3	☐4	☐5	☐6
15. I turn my whole body towards the patient, and do not twist my back.	☐1	☐2	☐3	☐4	☐5	☐6

PLEASE ESTIMATE HOW OFTEN YOU HAVE TO WORK WITH THE BODY POSTURES DISPLAYED BELOW AND HOW OFTEN YOU HAVE TO LIFT OR TO CARRY THE WEIGHTS MENTIONED BELOW, INCLUDING ALL WORK TASKS. CHECK THE BOX THAT IS APPROPRIATE FOR YOU WHILE YOU ARE WORKING.

Trunk Posture	**Never**	**Seldom**	**Sometimes**	**Often**	**Very Often**
1. Straight, upright	☐0	☐1	☐2	☐3	☐4
2. Bent half-way forward (about 45°)	☐0	☐1	☐2	☐3	☐4
3. Bent very forward (about 75°)	☐0	☐1	☐2	☐3	☐4
4. Twisted/Rotated	☐0	☐1	☐2	☐3	☐4
5. Bent to the side	☐0	☐1	☐2	☐3	☐4

Arm Position	**Never**	**Seldom**	**Sometimes**	**Often**	**Very Often**
6. Both arms raised above shoulder height	☐0	☐1	☐2	☐3	☐4
7. One arm raised above shoulder height	☐0	☐1	☐2	☐3	☐4
8. Both arms below shoulder height	☐0	☐1	☐2	☐3	☐4

Leg Position	**Never**	**Seldom**	**Sometimes**	**Often**	**Very Often**
9. Sitting	☐0	☐1	☐2	☐3	☐4
10. Standing	☐0	☐1	☐2	☐3	☐4
11. Squatting	☐0	☐1	☐2	☐3	☐4
12. Kneeling (on one or both knees)aa	☐0	☐1	☐2	☐3	☐4
13. Walking, moving	☐0	☐1	☐2	☐3	☐4

Lifting, pushing, pulling, or carrying with upright trunk posture	**Never**	**Seldom**	**Sometimes**	**Often**	**Very Often**
14. Light weight or force (up to 25 lbs.)	☐0	☐1	☐2	☐3	☐4
15. Moderate weight or force (25-50 lbs.)	☐0	☐1	☐2	☐3	☐4
16. Heavy/high weight or force (more than 50 lbs.)	☐0	☐1	☐2	☐3	☐4

Lifting, pushing, pulling, or carrying with bent trunk	**Never**	**Seldom**	**Sometimes**	**Often**	**Very Often**
17. Light weight or force (up to 25 lbs.)	☐0	☐1	☐2	☐3	☐4
18. Moderate weight or force (25-50 lbs.)	☐0	☐1	☐2	☐3	☐4
19. Heavy/high weight or force (more than 50 lbs.)	☐0	☐1	☐2	☐3	☐4

PLEASE CIRCLE THE NUMBER THAT INDICATES HOW RISKY THE FOLLOWING WORK ACTIVITIES ARE TO YOUR SAFETY AND HEALTH. **0=Not al all Risky ~ 10=Extremely Risky**

	Not at all Risky										Extremely Risky
1. Your nursing job in general	0	1	2	3	4	5	6	7	8	9	10
2. Your patient handling tasks (e.g., lifting, transferring, repositioning)	0	1	2	3	4	5	6	7	8	9	10
3. Your use of sharps devices	0	1	2	3	4	5	6	7	8	9	10
4. Your handling of biological specimens	0	1	2	3	4	5	6	7	8	9	10
5. Your handling of chemical drugs	0	1	2	3	4	5	6	7	8	9	10
6. Your exposure to radiation	0	1	2	3	4	5	6	7	8	9	10

PLEASE ESTIMATE THE LIKELIHOOD OF EXPERIENCING A MUSCULOSKELETAL INJURY FROM YOUR WORK WITHIN A YEAR. MUSCULOSKELETAL INJURIES REFER TO MUSCULOSKELETAL PAIN OR DISCOMFORT THAT LIMITS YOUR MOVEMENT OR INTERFERES WITH YOUR WORK ON THE JOB OR AT HOME.

A. How likely it is that YOU will experience a musculoskeletal injury within a year related to:

	Extremely Unlikely	Moderately Unlikely	Somewhat Unlikely	Somewhat Likely	Moderately Likely	Extremely Likely
1. Nursing work in general	☐1	☐2	☐3	☐4	☐5	☐6
2. Patient handling tasks (e.g., lifting, transferring, repositioning) that you perform using a mechanical lifting device	☐1	☐2	☐3	☐4	☐5	☐6
3. Patient handling tasks (e.g., lifting, transferring, repositioning) that you perform manually	☐1	☐2	☐3	☐4	☐5	☐6
4. Work tasks not related to patient handling	☐1	☐2	☐3	☐4	☐5	☐6

B. How likely it is that ANOTHER NURSE ON YOUR UNIT will experience a musculoskeletal injury within a year related to:

	Extremely Unlikely	Moderately Unlikely	Somewhat Unlikely	Somewhat Likely	Moderately Likely	Extremely Likely
1. Nursing work in general	☐1	☐2	☐3	☐4	☐5	☐6
2. Patient handling tasks (e.g., lifting, transferring, repositioning) performed using a mechanical lifting device	☐1	☐2	☐3	☐4	☐5	☐6
3. Patient handling tasks (e.g., lifting, transferring, repositioning) performed manually	☐1	☐2	☐3	☐4	☐5	☐6
4. Work tasks not related to patient handling	☐1	☐2	☐3	☐4	☐5	☐6

PLEASE INDICATE THE EXTENT TO WHICH YOU AGREE OR DISAGREE WITH THE FOLLOWING STATEMENTS. PLEASE CHECK THE BOX THAT IS APPROPRIATE FOR YOU.

	Strongly Disagree	Disagree	Agree	Strongly Agree
1. My job requires working very fast.	☐1	☐2	☐3	☐4
2. My job requires working very hard.	☐1	☐2	☐3	☐4
3. I am not asked to do an excessive amount of work.	☐1	☐2	☐3	☐4
4. I have enough time to get the job done.	☐1	☐2	☐3	☐4
5. I am free from conflicting demands that others make.	☐1	☐2	☐3	☐4
6. My job requires that I learn new things.	☐1	☐2	☐3	☐4
7. My job involves a lot of repetitive work.	☐1	☐2	☐3	☐4
8. My job requires me to be creative.	☐1	☐2	☐3	☐4
9. My job requires a high level of skill.	☐1	☐2	☐3	☐4
10. I get to do a variety of different things on my job.	☐1	☐2	☐3	☐4
11. I have an opportunity to develop my own special abilities.	☐1	☐2	☐3	☐4
12. My job allows me to make a lot of decisions on my own.	☐1	☐2	☐3	☐4
13. On my job, I have very little freedom to decide how I do my work.	☐1	☐2	☐3	☐4
14. I have a lot of say about what happens on my job.	☐1	☐2	☐3	☐4
15. My supervisor is concerned about the welfare of those under her/him	☐1	☐2	☐3	☐4
16. My supervisor pays attention to what I am saying.	☐1	☐2	☐3	☐4
17. My supervisor is helpful in getting the job done.	☐1	☐2	☐3	☐4
18. My supervisor is successful in getting people to work together.	☐1	☐2	☐3	☐4
19. People I work with are competent in doing their jobs.	☐1	☐2	☐3	☐4
20. People I work with take a personal interest in me.	☐1	☐2	☐3	☐4
21. People I work with are friendly.	☐1	☐2	☐3	☐4
22. People I work with are helpful in getting the job done.	☐1	☐2	☐3	☐4
23. I get easily overwhelmed by time pressures at work.	☐1	☐2	☐3	☐4
24. As soon as I get up in the morning, I start thinking about work problems.	☐1	☐2	☐3	☐4
25. When I get home, I can easily relax and 'switch off' work.	☐1	☐2	☐3	☐4
26. People close to me say I sacrifice too much for my job.	☐1	☐2	☐3	☐4
27. Work rarely lets me go, it is still on my mind when I go to bed.	☐1	☐2	☐3	☐4
28. If I postpone something that I was supposed to do today, I'll have trouble sleeping at night.	☐1	☐2	☐3	☐4

FOR THE FOLLOWING QUESTIONS ABOUT YOUR WORKING CONDITIONS, FIRST CHECK 'AGREE' OR 'DISAGREE.' THEN, IF YOU **DISAGREE** WITH THE STATEMENT, ALSO CIRCLE THE EXTENT TO WHICH YOU ARE DISTRESSED BY THE CONDITION.

	Agree	Disagree				
Example 1.	☑	☐				
Example 2.	☐	☑ →	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed

	Agree	Disagree	*If you answer "DISAGREE," select how distressed you are by the condition.*			
1. I receive the respect I deserve from my superiors.	☐	☐ →	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
2. I receive the respect I deserve from my colleagues.	☐	☐ →	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
3. I experience adequate support in difficult situations.	☐	☐ →	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
4. My current occupational position adequately reflects my education and training.	☐	☐ →	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
5. Considering all my efforts and achievements, I receive the respect and prestige I deserve at work.	☐	☐ →	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
6. Considering all my efforts and achievements, my work prospects are adequate.	☐	☐ →	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
7. Considering all my efforts and achievements, my salary/income is adequate.	☐	☐ →	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed

FOR THE FOLLOWING QUESTIONS ABOUT YOUR WORKING CONDITIONS, FIRST CHECK 'AGREE' OR 'DISAGREE.' THEN, IF YOU **AGREE** WITH THE STATEMENT, ALSO CIRCLE THE EXTENT TO WHICH YOU ARE DISTRESSED BY THE CONDITION.

Example 1.	Disagree ☑	Agree ☐				
Example 2.	Disagree ☐	Agree ☑	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed

	Disagree	Agree	*If you answer "**AGREE**", select how distressed you are by the condition.*			
1. I have constant time pressure due to a heavy work load.	☐	☐	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
2. I have many interruptions and disturbances in my job.	☐	☐	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
3. I have a lot of responsibility in my job.	☐	☐	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
4. I am often pressured to work overtime.	☐	☐	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
5. My job is physically demanding.	☐	☐	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
6. Over the past few years, my job has become more and more demanding.	☐	☐	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
7. I am treated unfairly at work.	☐	☐	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
8. My job promotion prospects are poor.	☐	☐	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
9. I have experienced or I expect to experience an undesirable change in my work situation.	☐	☐	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
10. My job security is poor.	☐	☐	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed

PLEASE CHECK THE APPROPRIATE BOX.

	Never	Rarely	Sometimes	Often	Always
1. The protection of the health of workers is considered to be very important with management where I work.	☐1	☐2	☐3	☐4	☐5
2. On my unit, all reasonable steps are taken to minimize hazardous job tasks and procedures.	☐1	☐2	☐3	☐4	☐5
3. On my unit, employees, supervisors, and managers work together to ensure the safest possible working conditions.	☐1	☐2	☐3	☐4	☐5
4. Where I work, the protection of workers is a priority when decisions are made.	☐1	☐2	☐3	☐4	☐5
5. On my unit, unsafe work practices are corrected by supervisors.	☐1	☐2	☐3	☐4	☐5
6. My work area is kept clean.	☐1	☐2	☐3	☐4	☐5
7. My work area is cluttered.	☐1	☐2	☐3	☐4	☐5
8. On my unit, senior level management gets personally involved in safety activities.	☐1	☐2	☐3	☐4	☐5
9. My immediate supervisor is concerned about my safety on the job.	☐1	☐2	☐3	☐4	☐5
10. On my unit, unsafe work practices are corrected by coworkers.	☐1	☐2	☐3	☐4	☐5
11. I feel free to report safety violations where I work.	☐1	☐2	☐3	☐4	☐5

PLEASE INDICATE THE LIKELIHOOD THAT YOU WOULD ENGAGE IN THE FOLLOWING ACTIVITY OR BEHAVIOR IF YOU WERE TO FIND YOURSELF IN THAT SITUATION. PROVIDE A RATING FROM EXTREMELY UNLIKELY TO EXTREMELY LIKELY.

	Extremely Unlikely	Moderately Unlikely	Somewhat Unlikely	Not Sure	Somewhat Likely	Moderately Likely	Extremely Likely
1. Drinking heavily at a social function.	☐1	☐2	☐3	☐4	☐5	☐6	☐7
2. Engaging in unprotected sex.	☐1	☐2	☐3	☐4	☐5	☐6	☐7
3. Driving a car without wearing a seat belt.	☐1	☐2	☐3	☐4	☐5	☐6	☐7
4. Riding a motorcycle without a helmet.	☐1	☐2	☐3	☐4	☐5	☐6	☐7
5. Sunbathing without sunscreen.	☐1	☐2	☐3	☐4	☐5	☐6	☐7
6. Walking home alone at night in an unsafe area of town.	☐1	☐2	☐3	☐4	☐5	☐6	☐7
7. Eating high cholesterol foods.	☐1	☐2	☐3	☐4	☐5	☐6	☐7
8. Driving while taking medication that may make you drowsy.	☐1	☐2	☐3	☐4	☐5	☐6	☐7

PLEASE CHECK THE APPROPRIATE BOX. **How often do you do the following?**

	Never	Rarely	Sometimes	Often	Always
1. Dispose of sharp objects into a sharps container.	☐1	☐2	☐3	☐4	☐5
2. Take special caution when using scalpels or other sharp objects.	☐1	☐2	☐3	☐4	☐5
3. Dispose of all potentially contaminated material into a red (and/or labeled) bag for disposal as biomedical waste.	☐1	☐2	☐3	☐4	☐5
4. Wear gloves while drawing a patient's blood.	☐1	☐2	☐3	☐4	☐5
5. Wear disposable gloves whenever there is a possibility of exposure to blood or other body fluids.	☐1	☐2	☐3	☐4	☐5
6. Eat or drink while working in an area where there is a possibility of becoming contaminated with blood or body fluids.	☐1	☐2	☐3	☐4	☐5
7. Recap needles that have been contaminated with blood.	☐1	☐2	☐3	☐4	☐5
8. Wash my hands after removing my disposable gloves.	☐1	☐2	☐3	☐4	☐5
9. Treat all materials that have been in contact with a patient's saliva as if they were infectious.	☐1	☐2	☐3	☐4	☐5
10. Promptly wipe all potentially contaminated spills with a disinfectant.	☐1	☐2	☐3	☐4	☐5
11. Unscrew needles from needle holders that have been used to draw a patient's blood.	☐1	☐2	☐3	☐4	☐5
12. Wear a disposable outer garment that is resistant to blood and bodily fluids whenever there is a good chance of soiling my clothes.	☐1	☐2	☐3	☐4	☐5
13. Wear protective eye shields whenever there is a possibility of a splash or splatter to my eyes.	☐1	☐2	☐3	☐4	☐5
14. Wear a disposable face mask whenever there is a possibility of a splash or splatter to my mouth.	☐1	☐2	☐3	☐4	☐5

C. About Your Physical Symptoms

(a) YOUR LOW BACK

← Low Back Region

1. Have you EVER had pain, aching, stiffness, burning, numbness, or tingling in the area shown on the diagram?

   ☐1 Yes ☐2 No

2. Have you EVER had pain radiating into your leg?

   ☐1 Yes ☐2 No

※ *If you answered "No" to both Questions 1 and 2, skip to (b) NECK on Page 12.*
If you answered "Yes" to either Question 1 or 2, go ahead to Question 3 on this page.

3. During the PAST 12 MONTHS, did you have pain, aching, stiffness, burning, numbness or tingling in the area shown on the above diagram, or pain radiating into your leg?

   ☐1 Yes ☐2 No (→ skip to Question 4 on Page 12.)

   3-1. During the PAST 12 MONTHS, how often did you have this LOW BACK problem?

   ☐1 Daily
   ☐2 Almost daily
   ☐3 Weekly
   ☐4 Monthly
   ☐5 Every 2-3 months
   ☐6 Every 4-6 months
   ☐7 One time only

   3-2. When you have this LOW BACK problem, how long does it last, on average?

   ☐1 Less than one day (1-23 hours)
   ☐2 Less than one week (1-6 days)
   ☐3 Less than two weeks (7-13 days)
   ☐4 2 weeks to less than 1 month
   ☐5 1-3 months
   ☐6 More than 3 months

   3-3. During the PAST 12 MONTHS, how severe has pain from this LOW BACK problem been, on average?

   ☐1 None/No pain
   ☐2 Mild/Minimal
   ☐3 Moderate
   ☐4 Severe
   ☐5 Worst pain ever in my life

   3-4. During the PAST 12 MONTHS, has this LOW BACK problem resulted in your:

   a. Seeing a doctor or other provider …………………………………… ☐1 Yes ☐2 No
   b. Missing work ……………………………………………………………… ☐1 Yes ☐2 No
   c. Changing the way you do your work ………………………………… ☐1 Yes ☐2 No

d. Changing the way you do non-work activities (e.g., housework)......☐1 Yes ☐2 No
e. Changing the way you exercise or do leisure activities .... ☐1 Yes ☐2 No

3-5. Do you think that this LOW BACK problem was:
a. Made worse by working? ......☐1 Yes ☐2 No ☐3 Don't Know
b. Caused by work? .... ☐1 Yes ☐2 No ☐3 Don't Know

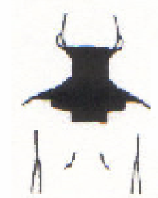
4. Have you EVER changed jobs because of LOW BACK problems?
☐1 Yes ☐2 No

5. Was your first time LOW BACK problem related to work?
☐1 Yes, related to this current job
☐2 Yes, related to a prior job:(specify)____________________________
☐3 No, not related to work
☐4 Don't know/Not sure

6. Have you ever had an accident or injury to your LOW BACK that was NOT work-related?
☐1 Yes ☐2 No

(b) YOUR NECK

1. Have you EVER had pain, aching, stiffness, burning, numbness, or tingling in the area shown on the diagram?
☐1 Yes ☐2 No (→skip to (c) SHOULDER on Page 13.)



← Neck Region

2. During the PAST 12 MONTHS, did you have this NECK problem?
☐1 Yes ☐2 No (→skip to Question 3 on Page 13.)

2-1. During the PAST 12 MONTHS, how often did you have this NECK problem?
☐1 Daily
☐2 Almost daily
☐3 Weekly
☐4 Monthly
☐5 Every 2-3 months
☐6 Every 4-6 months
☐7 One time only

2-2. When you have this NECK problem, how long does it last, on average?
☐1 Less than one day (1-23 hours)
☐2 Less than one week (1-6 days)
☐3 Less than two weeks (7-13 days)
☐4 2 weeks to less than 1 month
☐5 1-3 months
☐6 More than 3 months

2-3. During the past 12 months, how severe has pain from this NECK problem been, on average?

- ☐1 None/No pain
- ☐2 Mild/Minimal
- ☐3 Moderate
- ☐4 Severe
- ☐5 Worst pain ever in my life

2-4. During the past 12 months, has this NECK problem resulted in your:

a. Seeing a doctor or other provider .... ☐1 Yes ☐2 No
b. Missing work .... ☐1 Yes ☐2 No
c. Changing the way you do your work .... ☐1 Yes ☐2 No
d. Changing the way you do non-work activities (e.g., housework)..... ☐1 Yes ☐2 No
e. Changing the way you exercise or do leisure activities ....☐1 Yes ☐2 No

2-5. Do you think that this NECK problem was:

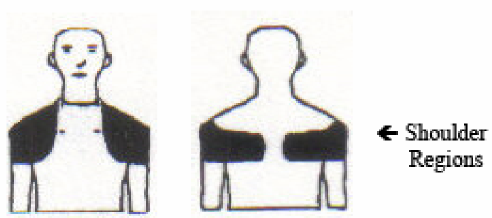
a. Made worse by working? ......☐1 Yes ☐2 No ☐3 Don't Know
b. Caused by work? ....☐1 Yes ☐2 No ☐3 Don't Know

3. Have you EVER changed jobs because of NECK problems?
☐1 Yes ☐2 No

4. Was your first time NECK problem related to work?
- ☐1 Yes, related to this current job
- ☐2 Yes, related to a prior job:(specify)___________________________
- ☐3 No, not related to work
- ☐4 Don't know/Not sure

5. Have you ever had an accident or injury to your NECK that was NOT work-related?
☐1 Yes ☐2 No

(C) YOUR SHOULDER



1. Have you EVER had pain, aching, stiffness, burning, numbness, or tingling in the area shown on the above diagrams?
☐1 Yes ☐2 No (→skip to D. ABOUT YOU on Page 15.)

2. During the PAST 12 MONTHS, did you have this SHOULDER problem?
☐1 Yes ☐2 No (→skip to Question 3 on Page 14.)

2-1. During the past 12 months, how often did you have this SHOULDER problem?

- ☐1 Daily
- ☐2 Almost daily
- ☐3 Weekly
- ☐4 Monthly
- ☐5 Every 2-3 months
- ☐6 Every 4-6 months
- ☐7 One time only

2-2. When you have this SHOULDER problem, how long does it last, on average?

- ☐1 Less than one day (1-23 hours)
- ☐2 Less than one week (1-6 days)
- ☐3 Less than two weeks (7-13 days)
- ☐4 2 weeks to less than 1 month
- ☐5 1-3 months
- ☐6 More than 3 months

2-3. During the past 12 months, how severe has pain from this SHOULDER problem been, on average?

- ☐1 None/No pain
- ☐2 Mild/Minimal
- ☐3 Moderate
- ☐4 Severe
- ☐5 Worst pain ever in my life

2-4. During the past 12 months, has this SHOULDER problem resulted in your:

a. Seeing a doctor or other provider ……………………………….	☐1 Yes	☐2 No
b. Missing work ……………………………………………………….	☐1 Yes	☐2 No
c. Changing the way you do your work ……………………………	☐1 Yes	☐2 No
d. Changing the way you do non-work activities (e.g., housework)…...	☐1 Yes	☐2 No
e. Changing the way you exercise or do leisure activities ……………...	☐1 Yes	☐2 No

2-5. Do you think that this SHOULDER problem was:

a. Made worse by working? ……	☐1 Yes	☐2 No	☐3 Don't Know
b. Caused by work? ……………	☐1 Yes	☐2 No	☐3 Don't Know

3. Have you EVER changed jobs because of SHOULDER problems? ☐1 Yes ☐2 No

4. Was your first time SHOULDER problem related to work?
   - ☐1 Yes, related to this current job
   - ☐2 Yes, related to a prior job:(specify)____________________________
   - ☐3 No, not related to work
   - ☐4 Don't know/Not sure

5. Have you ever had an accident or injury to your SHOULDER that was NOT work-related?
   ☐1 Yes ☐2 No

D. About You

1. Your Gender: ☐1 Female ☐2 Male

2. Your Age: ___________ Years Old

3. Your Marital Status:
   ☐1 Married
   ☐2 Separated/Divorced
   ☐3 Widowed
   ☐4 Never been married
   ☐5 Unmarried couple
   ☐6 Other (specify) ______________________

4. Are you of Latino or Hispanic origin or descent? ☐1 Yes ☐2 No

5. What is your racial background?
   ☐1 White
   ☐2 African-American
   ☐3 American Indian or Alaskan Native
   ☐4 Asian or Pacific Islander
   ☐5 Other (specify) __________________

6. What is your educational background (the highest level)?
   ☐1 Diploma degree
   ☐2 Associate degree
   ☐3 Bachelor's degree
   ☐4 Master's degree
   ☐5 Doctoral degree
   ☐6 Other (specify) __________________

7. How many children under age 10 do you have? _________________

8. Your Height: ___________Feet ________Inches

9. Your Weight: ___________ Pounds

10. Are you currently pregnant?
    ☐1 Yes ☐2 No/Not Applicable ☐3 Don't Know

11. The date you completed this questionnaire: ____________________ (mm/dd/yy)

THANK YOU VERY MUCH

FOR TAKING THE TIME TO COMPLETE THIS SURVEY!!

NURSES' SAFETY STUDY

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THANK YOU VERY MUCH FOR PARTICIPATING IN THIS STUDY!

A. ABOUT YOUR WORK AS A NURSE

1. Are you currently working as a nurse?
   ☐1 Yes ☐2 Yes, but on sick leave or disability leave ☐3 No
2. How long have you worked as a nurse, in total? _______ Years ______Months
3. How long have you worked in your current workplace? _______ Years ______Months
4. Your current nursing position:
   ☐1 Staff Nurse
   ☐2 Charge Nurse
   ☐3 Nurse Manager/Supervisor
   ☐4 Clinical Nurse Specialist/Nurse Practitioner
   ☐5 Other (specify):_________________________
5. Your current type of unit:
   ☐1 ICU
   ☐2 CCU
   ☐3 Combined ICU/CCU
   ☐4 Combined Adult/Pediatric ICU
   ☐5 Medical ICU
   ☐6 Surgical ICU
   ☐7 Cardiovascular/Surgical ICU
   ☐8 Pediatric ICU
   ☐9 Neonatal ICU
   ☐10 Neuro/Neurosurgical ICU
   ☐11 Respiratory ICU
   ☐12 Telemetry
   ☐13 Emergency Department
   ☐14 Recovery Room/PACU
   ☐15 Trauma Unit
   ☐16 Progressive Care Unit
   ☐17 Critical Care Transport/Flight
   ☐18 General Medical/Surgical
   ☐19 Operating Room
   ☐20 Other (specify): _________________________
6. Your current type of workplace:
   ☐1 Community Hospital (Non-Profit)
   ☐2 Community Hospital (Profit)
   ☐3 University Medical Center
   ☐4 Military/Government Hospital
   ☐5 County Hospital
   ☐6 Other (specify):_________________________
7. What is the estimated number of beds in your hospital? ____________________ Beds
8. Are you a travel nurse? ☐1 Yes ☐2 No
9. In what setting do you work? ☐1 Rural ☐2 Suburban ☐3 Urban
10. Your work status: ☐1 Full-time ☐2 Part-time ☐3 Per-diem ☐4 Other:____________
11. Your normal work schedule:
    ☐1 Days ☐2 Evenings ☐3 Nights ☐4 Rotating- Days, Evenings
    ☐5 Rotating- Days, Nights ☐6 Rotating- Evenings, Nights ☐7 Rotating- Days, Evenings, Nights
12. On average, how many hours do you work per SHIFT, including overtime? _____________ Hours/Shift
13. On average, how many hours do you work per TWO WEEK PAY PERIOD, including overtime?
    ___________ Hours/Two Weeks
14. On average, how many hours do you <u>float</u> off your unit per WEEK? _______________ Hours/Week
15. On average, how much time at work do you spend performing <u>direct patient care</u>? ________% Time/Shift
16. During a typical workday, how many BREAKS <u>lasting 10 minutes or more, including meals</u>, do you take?
    ___________ Breaks/Shift

17. During a typical workday, what is the total number of MINUTES you spend on <u>breaks</u>? ________________Minutes/Shift

18. How many nurses work on your SHIFT? ________________ Nurses/Shift

19. How many nurses work on your UNIT, including all shifts? ________________ Nurses/Unit

20. Does your workplace have a lifting team (a team of two professional patient movers)?
    ☐1 Yes ☐2 No ☐3 Don't Know

    18-1. If your workplace has a lifting team, how often is the team actually available when you need it?
    ☐1 Always ☐2 Most of the time ☐3 Often ☐4 Occasionally ☐5 Rarely ☐6 Never

21. Does your workplace provide mechanical lifting devices on the unit where you work?
    ☐1 Yes ☐2 No ☐3 Don't Know

    19-1. If lifting devices are provided, how often are they actually available when you need them?
    ☐1 Always ☐2 Most of the time ☐3 Often ☐4 Occasionally ☐5 Rarely ☐6 Never

22. Is your unit equipped with height-adjustable beds? ☐1 Yes ☐2 No

B. About Work

IF YOU DO <u>NOT</u> PERFORM ANY PATIENT HANDLING TASKS (E.G., LIFTS, TRANSFERS, REPOSITIONING), PLEASE CHECK HERE _______ AND SKIP TO **PAGE** 4.

(a) "**Lifts and transfers**" means moving a patient from one place to another; for example, from bed to stretcher, from wheelchair to bed, or from wheelchair to commode.

1. On average, how many patient lifts and transfers do you perform during your usual shift? ___________ Times/Shift
2. Of those lifts and transfers you perform during a usual shift, how many do you do <u>manually</u> (without patient handling aids)? ____________Times/Shift
3. Of those lifts and transfers you perform <u>manually</u> during a usual shift, how many do you perform <u>with the help</u> of another person? ___________ Times/Shift
4. Of those lifts and transfers you perform during a usual shift, how many are done <u>with mechanical equipment</u>, such as sit-to-stand lifts or full body sling lifts? ___________ Times/Shift
5. Of those lifts and transfers you perform during a usual shift, how many are done with <u>patient handling aids</u>, such as gait belts and friction-reducing devices? ___________ Times/Shift

(b) "**Repositioning**" refers to altering a patient's body position in the same place; for example, pulling a patient up in bed or wheelchair or turning a patient from side to side in bed.

1. On average, how many times do you reposition patients during your usual shift? ________Times/Shift
2. During a usual shift, how many times do you reposition patients <u>with the help</u> of at least one other staff person? ____________ Times/Shift

PLEASE INDICATE HOW OFTEN YOU ENGAGE IN THE FOLLOWING ACTIONS WHEN PERFORMING PATIENT HANDLING TASKS (E.G., LIFTING, TRANSFERRING, REPOSITIONING).
IF YOU DO NOT PERFORM PATIENT HANDLING, PLEASE CHECK HERE ______AND SKIP TO PAGE 4.

Before I perform a patient handling task,	Never	Rarely	Sometimes	Often	Most of the time	All of the time	
1. I assess the condition of the patient.	☐1	☐2	☐3	☐4	☐5	☐6	
2. I assess whether the space is too crowded to perform the task.	☐1	☐2	☐3	☐4	☐5	☐6	
3. I clear space to make enough room for the task if needed.	☐1	☐2	☐3	☐4	☐5	☐6	
4. I ask help from coworkers if needed.	☐1	☐2	☐3	☐4	☐5	☐6	
5. If no coworker is readily available, I perform the task by myself.	☐1	☐2	☐3	☐4	☐5	☐6	
6. I encourage the patient to assist if possible.	☐1	☐2	☐3	☐4	☐5	☐6	
7. I assess the height of bed to see if it is at the proper height (at waist level).	☐1	☐2	☐3	☐4	☐5	☐6	
8. I adjust the height of bed when it is not appropriate for my height.	☐1	☐2	☐3	☐4	☐5	☐6	☐ Not Ever Available
9. If the patient is physically dependent, I use a lifting device or transfer aid.	☐1	☐2	☐3	☐4	☐5	☐6	☐ Not Ever Available
10. If a lifting device is not readily available, I perform the task manually.	☐1	☐2	☐3	☐4	☐5	☐6	☐ Not Ever Available

During the patient handling tasks,	Never	Rarely	Sometimes	Often	Most of the time	All of the time
11. I face the patient.	☐1	☐2	☐3	☐4	☐5	☐6
12. I keep my feet apart (shoulder width).	☐1	☐2	☐3	☐4	☐5	☐6
13. I keep my back straight.	☐1	☐2	☐3	☐4	☐5	☐6
14. I bend my knees, not my back.	☐1	☐2	☐3	☐4	☐5	☐6
15. I turn my whole body towards the patient, and do not twist my back.	☐1	☐2	☐3	☐4	☐5	☐6

PLEASE ESTIMATE HOW OFTEN YOU HAVE TO WORK WITH THE BODY POSTURES DISPLAYED BELOW AND HOW OFTEN YOU HAVE TO LIFT OR TO CARRY THE WEIGHTS MENTIONED BELOW, INCLUDING ALL WORK TASKS. CHECK THE BOX THAT IS APPROPRIATE FOR YOU WHILE YOU ARE WORKING.

Trunk Posture	**Never**	**Seldom**	**Sometimes**	**Often**	**Very Often**
1. Straight, upright	☐0	☐1	☐2	☐3	☐4
2. Bent half-way forward (about 45°)	☐0	☐1	☐2	☐3	☐4
3. Bent very forward (about 75°)	☐0	☐1	☐2	☐3	☐4
4. Twisted/Rotated	☐0	☐1	☐2	☐3	☐4
5. Bent to the side	☐0	☐1	☐2	☐3	☐4
Arm Position	**Never**	**Seldom**	**Sometimes**	**Often**	**Very Often**
6. Both arms raised above shoulder height	☐0	☐1	☐2	☐3	☐4
7. One arm raised above shoulder height	☐0	☐1	☐2	☐3	☐4
8. Both arms below shoulder height	☐0	☐1	☐2	☐3	☐4
Leg Position	**Never**	**Seldom**	**Sometimes**	**Often**	**Very Often**
9. Sitting	☐0	☐1	☐2	☐3	☐4
10. Standing	☐0	☐1	☐2	☐3	☐4
11. Squatting	☐0	☐1	☐2	☐3	☐4
12. Kneeling (on one or both knees)aa	☐0	☐1	☐2	☐3	☐4
13. Walking, moving	☐0	☐1	☐2	☐3	☐4
Lifting, pushing, pulling, or carrying with upright trunk posture	**Never**	**Seldom**	**Sometimes**	**Often**	**Very Often**
14. Light weight or force (up to 25 lbs.)	☐0	☐1	☐2	☐3	☐4
15. Moderate weight or force (25-50 lbs.)	☐0	☐1	☐2	☐3	☐4
16. Heavy/high weight or force (more than 50 lbs.)	☐0	☐1	☐2	☐3	☐4
Lifting, pushing, pulling, or carrying with bent trunk	**Never**	**Seldom**	**Sometimes**	**Often**	**Very Often**
17. Light weight or force (up to 25 lbs.)	☐0	☐1	☐2	☐3	☐4
18. Moderate weight or force (25-50 lbs.)	☐0	☐1	☐2	☐3	☐4
19. Heavy/high weight or force (more than 50 lbs.)	☐0	☐1	☐2	☐3	☐4

PLEASE CIRCLE THE NUMBER THAT INDICATES HOW RISKY THE FOLLOWING WORK ACTIVITIES ARE TO YOUR SAFETY AND HEALTH. **0=Not al all Risky ~ 10=Extremely Risky**

	Not at all Risky										Extremely Risky
1. Your nursing job in general	0	1	2	3	4	5	6	7	8	9	10
2. Your patient handling tasks (e.g., lifting, transferring, repositioning)	0	1	2	3	4	5	6	7	8	9	10
3. Your use of sharps devices	0	1	2	3	4	5	6	7	8	9	10
4. Your handling of biological specimens	0	1	2	3	4	5	6	7	8	9	10
5. Your handling of chemical drugs	0	1	2	3	4	5	6	7	8	9	10
6. Your exposure to radiation	0	1	2	3	4	5	6	7	8	9	10

PLEASE ESTIMATE THE LIKELIHOOD OF EXPERIENCING A MUSCULOSKELETAL INJURY FROM YOUR WORK **WITHIN A YEAR**. MUSCULOSKELETAL INJURIES REFER TO MUSCULOSKELETAL PAIN OR DISCOMFORT THAT LIMITS YOUR MOVEMENT OR INTERFERES WITH YOUR WORK ON THE JOB OR AT HOME.

A. How likely it is that YOU will experience a musculoskeletal injury within a year related to:

	Extremely Unlikely	Moderately Unlikely	Somewhat Unlikely	Somewhat Likely	Moderately Likely	Extremely Likely
1. Nursing work in general	☐1	☐2	☐3	☐4	☐5	☐6
2. Work tasks not related to patient handling	☐1	☐2	☐3	☐4	☐5	☐6
3. Patient handling tasks (e.g., lifting, transferring, repositioning) that you perform manually	☐1	☐2	☐3	☐4	☐5	☐6
4. Patient handling tasks (e.g., lifting, transferring, repositioning) that you perform using a mechanical lifting device	☐1	☐2	☐3	☐4	☐5 (Not Available ☐)	☐6

B. How likely it is that ANOTHER NURSE ON YOUR UNIT will experience a musculoskeletal injury within a year related to:

	Extremely Unlikely	Moderately Unlikely	Somewhat Unlikely	Somewhat Likely	Moderately Likely	Extremely Likely
1. Nursing work in general	☐1	☐2	☐3	☐4	☐5	☐6
2. Work tasks not related to patient handling	☐1	☐2	☐3	☐4	☐5	☐6
3. Patient handling tasks (e.g., lifting, transferring, repositioning) performed manually	☐1	☐2	☐3	☐4	☐5	☐6
4. Patient handling tasks (e.g., lifting, transferring, repositioning) performed using a mechanical lifting device	☐1	☐2	☐3	☐4	☐5 (Not Available ☐)	☐6

PLEASE INDICATE THE EXTENT TO WHICH YOU AGREE OR DISAGREE WITH THE FOLLOWING STATEMENTS. PLEASE CHECK THE BOX THAT IS APPROPRIATE FOR YOU.

	Strongly Disagree	Disagree	Agree	Strongly Agree
1. My job requires working very fast.	☐1	☐2	☐3	☐4
2. My job requires working very hard.	☐1	☐2	☐3	☐4
3. I am not asked to do an excessive amount of work.	☐1	☐2	☐3	☐4
4. I have enough time to get the job done.	☐1	☐2	☐3	☐4
5. I am free from conflicting demands that others make.	☐1	☐2	☐3	☐4
6. My job requires that I learn new things.	☐1	☐2	☐3	☐4
7. My job involves a lot of repetitive work.	☐1	☐2	☐3	☐4
8. My job requires me to be creative.	☐1	☐2	☐3	☐4
9. My job requires a high level of skill.	☐1	☐2	☐3	☐4
10. I get to do a variety of different things on my job.	☐1	☐2	☐3	☐4
11. I have an opportunity to develop my own special abilities.	☐1	☐2	☐3	☐4
12. My job allows me to make a lot of decisions on my own.	☐1	☐2	☐3	☐4
13. On my job, I have very little freedom to decide how I do my work.	☐1	☐2	☐3	☐4
14. I have a lot of say about what happens on my job.	☐1	☐2	☐3	☐4
15. My supervisor is concerned about the welfare of those under her/him	☐1	☐2	☐3	☐4
16. My supervisor pays attention to what I am saying.	☐1	☐2	☐3	☐4
17. My supervisor is helpful in getting the job done.	☐1	☐2	☐3	☐4
18. My supervisor is successful in getting people to work together.	☐1	☐2	☐3	☐4
19. People I work with are competent in doing their jobs.	☐1	☐2	☐3	☐4
20. People I work with take a personal interest in me.	☐1	☐2	☐3	☐4
21. People I work with are friendly.	☐1	☐2	☐3	☐4
22. People I work with are helpful in getting the job done.	☐1	☐2	☐3	☐4
23. I get easily overwhelmed by time pressures at work.	☐1	☐2	☐3	☐4
24. As soon as I get up in the morning, I start thinking about work problems.	☐1	☐2	☐3	☐4
25. When I get home, I can easily relax and 'switch off' work.	☐1	☐2	☐3	☐4
26. People close to me say I sacrifice too much for my job.	☐1	☐2	☐3	☐4
27. Work rarely lets me go, it is still on my mind when I go to bed.	☐1	☐2	☐3	☐4
28. If I postpone something that I was supposed to do today, I'll have trouble sleeping at night.	☐1	☐2	☐3	☐4

FOR THE FOLLOWING QUESTIONS ABOUT YOUR WORKING CONDITIONS, FIRST CHECK 'AGREE' OR 'DISAGREE.' THEN, IF YOU **DISAGREE** WITH THE STATEMENT, ALSO CIRCLE THE EXTENT TO WHICH YOU ARE DISTRESSED BY THE CONDITION.

	Agree	Disagree				
Example 1.	☑	☐				
Example 2.	☐	☑	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed

	Agree	Disagree	*If you answer "DISAGREE," select how distressed you are by the condition.*			
1. I receive the respect I deserve from my superiors.	☐	☐	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
2. I receive the respect I deserve from my colleagues.	☐	☐	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
3. I experience adequate support in difficult situations.	☐	☐	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
4. My current occupational position adequately reflects my education and training.	☐	☐	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
5. Considering all my efforts and achievements, I receive the respect and prestige I deserve at work.	☐	☐	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
6. Considering all my efforts and achievements, my work prospects are adequate.	☐	☐	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
7. Considering all my efforts and achievements, my salary/income is adequate.	☐	☐	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed

FOR THE FOLLOWING QUESTIONS ABOUT YOUR WORKING CONDITIONS, FIRST CHECK 'AGREE' OR 'DISAGREE.' THEN, IF YOU **AGREE** WITH THE STATEMENT, ALSO CIRCLE THE EXTENT TO WHICH YOU ARE DISTRESSED BY THE CONDITION.

	Disagree	Agree				
Example 1.	☑	☐				
Example 2.	☐	☑ →	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed

	Disagree	Agree	*If you answer "**AGREE**", select how distressed you are by the condition.*			
1. I have constant time pressure due to a heavy work load.	☐	☐ →	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
2. I have many interruptions and disturbances in my job.	☐	☐ →	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
3. I have a lot of responsibility in my job.	☐	☐ →	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
4. I am often pressured to work overtime.	☐	☐ →	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
5. My job is physically demanding.	☐	☐ →	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
6. Over the past few years, my job has become more and more demanding.	☐	☐ →	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
7. I am treated unfairly at work.	☐	☐ →	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
8. My job promotion prospects are poor.	☐	☐ →	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
9. I have experienced or I expect to experience an undesirable change in my work situation.	☐	☐ →	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed
10. My job security is poor.	☐	☐ →	Not at All Distressed	Somewhat Distressed	Moderately Distressed	Very Distressed

PLEASE CHECK THE APPROPRIATE BOX.

	Never	Rarely	Sometimes	Often	Always
1. The protection of the health of workers is considered to be very important with management where I work.	☐1	☐2	☐3	☐4	☐5
2. On my unit, all reasonable steps are taken to minimize hazardous job tasks and procedures.	☐1	☐2	☐3	☐4	☐5
3. On my unit, employees, supervisors, and managers work together to ensure the safest possible working conditions.	☐1	☐2	☐3	☐4	☐5
4. Where I work, the protection of workers is a priority when decisions are made.	☐1	☐2	☐3	☐4	☐5
5. On my unit, unsafe work practices are corrected by supervisors.	☐1	☐2	☐3	☐4	☐5
6. My work area is kept clean.	☐1	☐2	☐3	☐4	☐5
7. My work area is cluttered.	☐1	☐2	☐3	☐4	☐5
8. On my unit, senior level management gets personally involved in safety activities.	☐1	☐2	☐3	☐4	☐5
9. My immediate supervisor is concerned about my safety on the job.	☐1	☐2	☐3	☐4	☐5
10. On my unit, unsafe work practices are corrected by coworkers.	☐1	☐2	☐3	☐4	☐5
11. I feel free to report safety violations where I work.	☐1	☐2	☐3	☐4	☐5

C. About Your Physical Symptoms

(a) YOUR LOW BACK

1. Have you EVER had pain, aching, stiffness, burning, numbness, or tingling in the area shown on the diagram?

   ☐1 Yes ☐2 No

← Low Back Region

2. Have you EVER had pain radiating into your leg?

   ☐1 Yes ☐2 No

※ *If you answered "No" to both Questions 1 and 2, skip to (b) NECK on Page 12.*
If you answered "Yes" to either Question 1 or 2, go ahead to Question 3 on this page.

3. During the PAST 12 MONTHS, did you have pain, aching, stiffness, burning, numbness or tingling in the area shown on the above diagram, or pain radiating into your leg?

   ☐1 Yes ☐2 No (→ skip to Question 4 on Page 12.)

   3-1. During the PAST 12 MONTHS, how often did you have this LOW BACK problem?

   ☐1 Daily
   ☐2 Almost daily
   ☐3 Weekly
   ☐4 Monthly
   ☐5 Every 2-3 months
   ☐6 Every 4-6 months
   ☐7 One time only

   3-2. When you have this LOW BACK problem, how long does it last, on average?

   ☐1 Less than one day (1-23 hours)
   ☐2 Less than one week (1-6 days)
   ☐3 Less than two weeks (7-13 days)
   ☐4 2 weeks to less than 1 month
   ☐5 1-3 months
   ☐6 More than 3 months

   3-3. During the PAST 12 MONTHS, how severe has pain from this LOW BACK problem been, on average?

   ☐1 None/No pain
   ☐2 Mild/Minimal
   ☐3 Moderate
   ☐4 Severe
   ☐5 Worst pain ever in my life

   3-4. During the PAST 12 MONTHS, has this LOW BACK problem resulted in your:

   a. Seeing a doctor or other provider …………………………………… ☐1 Yes ☐2 No
   b. Missing work ……………………………………………………………… ☐1 Yes ☐2 No
   c. Changing the way you do your work ………………………………… ☐1 Yes ☐2 No

d. Changing the way you do non-work activities (e.g., housework)……☐$_1$ Yes ☐$_2$ No
e. Changing the way you exercise or do leisure activities …………… ☐$_1$ Yes ☐$_2$ No

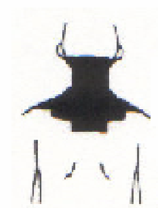
3-5. Do you think that this LOW BACK problem was:
a. Made worse by working? ……☐$_1$ Yes ☐$_2$ No ☐$_3$ Don't Know
b. Caused by work? …………… ☐$_1$ Yes ☐$_2$ No ☐$_3$ Don't Know

4. Have you EVER changed jobs because of LOW BACK problems?
☐$_1$ Yes ☐$_2$ No

5. Was your first time LOW BACK problem related to work?
☐$_1$ Yes, related to this current job
☐$_2$ Yes, related to a prior job:(specify)___________________________
☐$_3$ No, not related to work
☐$_4$ Don't know/Not sure

6. Have you ever had an accident or injury to your LOW BACK that was NOT work-related?
☐$_1$ Yes ☐$_2$ No

(b) YOUR NECK


← Neck Region

1. Have you EVER had pain, aching, stiffness, burning, numbness, or tingling in the area shown on the diagram?
☐$_1$ Yes ☐$_2$ No (→skip to (c) SHOULDER on Page 13.)

2. During the PAST 12 MONTHS, did you have this NECK problem?
☐$_1$ Yes ☐$_2$ No (→skip to Question 3 on Page 13.)

2-1. During the PAST 12 MONTHS, how often did you have this NECK problem?
☐$_1$ Daily
☐$_2$ Almost daily
☐$_3$ Weekly
☐$_4$ Monthly
☐$_5$ Every 2-3 months
☐$_6$ Every 4-6 months
☐$_7$ One time only

2-2. When you have this NECK problem, how long does it last, on average?
☐$_1$ Less than one day (1-23 hours)
☐$_2$ Less than one week (1-6 days)
☐$_3$ Less than two weeks (7-13 days)
☐$_4$ 2 weeks to less than 1 month
☐$_5$ 1-3 months
☐$_6$ More than 3 months

2-3. During the past 12 months, how severe has pain from this NECK problem been, on average?

- □1 None/No pain
- □2 Mild/Minimal
- □3 Moderate
- □4 Severe
- □5 Worst pain ever in my life

2-4. During the past 12 months, has this NECK problem resulted in your:

- a. Seeing a doctor or other provider .... □1 Yes □2 No
- b. Missing work .... □1 Yes □2 No
- c. Changing the way you do your work .... □1 Yes □2 No
- d. Changing the way you do non-work activities (e.g., housework)..... □1 Yes □2 No
- e. Changing the way you exercise or do leisure activities ....□1 Yes □2 No

2-5. Do you think that this NECK problem was:

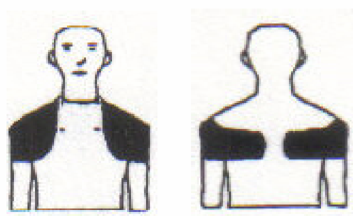
- a. Made worse by working? ......□1 Yes □2 No □3 Don't Know
- b. Caused by work? ....□1 Yes □2 No □3 Don't Know

3. Have you EVER changed jobs because of NECK problems?
   □1 Yes □2 No

4. Was your first time NECK problem related to work?
   - □1 Yes, related to this current job
   - □2 Yes, related to a prior job:(specify)____________________________
   - □3 No, not related to work
   - □4 Don't know/Not sure

5. Have you ever had an accident or injury to your NECK that was NOT work-related?
   □1 Yes □2 No

(C) YOUR SHOULDER



← Shoulder Regions

1. Have you EVER had pain, aching, stiffness, burning, numbness, or tingling in the area shown on the above diagrams?
   □1 Yes □2 No (→skip to D. ABOUT YOU on Page 15.)

2. During the PAST 12 MONTHS, did you have this SHOULDER problem?
   □1 Yes □2 No (→skip to Question 3 on Page 14.)

2-1. During the past 12 months, how often did you have this SHOULDER problem?

- ☐1 Daily
- ☐2 Almost daily
- ☐3 Weekly
- ☐4 Monthly
- ☐5 Every 2-3 months
- ☐6 Every 4-6 months
- ☐7 One time only

2-2. When you have this SHOULDER problem, how long does it last, on average?

- ☐1 Less than one day (1-23 hours)
- ☐2 Less than one week (1-6 days)
- ☐3 Less than two weeks (7-13 days)
- ☐4 2 weeks to less than 1 month
- ☐5 1-3 months
- ☐6 More than 3 months

2-3. During the past 12 months, how severe has pain from this SHOULDER problem been, on average?

- ☐1 None/No pain
- ☐2 Mild/Minimal
- ☐3 Moderate
- ☐4 Severe
- ☐5 Worst pain ever in my life

2-4. During the past 12 months, has this SHOULDER problem resulted in your:

a. Seeing a doctor or other provider	☐1 Yes	☐2 No
b. Missing work	☐1 Yes	☐2 No
c. Changing the way you do your work	☐1 Yes	☐2 No
d. Changing the way you do non-work activities (e.g., housework)......	☐1 Yes	☐2 No
e. Changing the way you exercise or do leisure activities	☐1 Yes	☐2 No

2-5. Do you think that this SHOULDER problem was:

a. Made worse by working?	☐1 Yes	☐2 No	☐3 Don't Know
b. Caused by work?	☐1 Yes	☐2 No	☐3 Don't Know

3. Have you EVER changed jobs because of SHOULDER problems? ☐1 Yes ☐2 No

4. Was your first time SHOULDER problem related to work?
   - ☐1 Yes, related to this current job
   - ☐2 Yes, related to a prior job:(specify)__________________________
   - ☐3 No, not related to work
   - ☐4 Don't know/Not sure

5. Have you ever had an accident or injury to your SHOULDER that was NOT work-related?
   ☐1 Yes ☐2 No

D. About You

1. Your Gender: ☐1 Female ☐2 Male

2. Your Age: ____________ Years Old

3. Your Marital Status:
   - ☐1 Married
   - ☐2 Separated/Divorced
   - ☐3 Widowed
   - ☐4 Never been married
   - ☐5 Unmarried couple
   - ☐6 Other (specify) _________________________

4. Are you of Latino or Hispanic origin or descent? ☐1 Yes ☐2 No

5. What is your racial background?
   - ☐1 White
   - ☐2 African-American
   - ☐3 American Indian or Alaskan Native
   - ☐4 Asian or Pacific Islander
   - ☐5 Other (specify) ___________________

6. What is your educational background (the highest level)?
   - ☐1 Diploma degree
   - ☐2 Associate degree
   - ☐3 Bachelor's degree
   - ☐4 Master's degree
   - ☐5 Doctoral degree
   - ☐6 Other (specify) ___________________

7. How many children under age 10 do you have? __________________

8. Your Height: ____________Feet ________Inches

9. Your Weight: ___________ Pounds

10. Are you currently pregnant?
    ☐1 Yes ☐2 No/Not Applicable ☐3 Don't Know

11. The date you completed this questionnaire: ______________________ (mm/dd/yy)

The research team may do a follow-up survey to identify the effect of work-related factors on your musculoskeletal health and safety. Your participation would be valuable for this investigation.

I am willing to have the research team contact me about participating in a follow up study.

☐1 Yes ☐2 No

Appendix B *Pearson Correlation Coefficients Between RPMI Subscales and Other Measures*

	AACN Sample (N=141)			UCSF Student Sample (N=66)		
Variables	RPMI	RPMI-S	RPMI-O	RPMI	RPMI-S	RPMI-O
RPNAH-general	.52**	.55**	.43**	.50**	.51**	.46**
RPNAH-patient handling	.50**	.53**	.42**	.66**	.69**	.59**
RPNAH-sharps	.44**	.47**	.36**	.30*	.33**	.26*
RPNAH-biological	.46**	.51**	.36**	.29*	.28*	.29*
RPNAH-chemical	.42**	.43**	.37**	.40**	.40**	.38**
RPNAH-radiation	.42**	.42**	.38**	.22	.23	.19
Safety Climate	-.22*	-.24**	-.17*	-.23	-.24	-.21
MS Symptom Index	.21*	.26**	.14	-	-	-
Safe Work Behavior	-.17*	-.17*	-.15	.15	.09	.20
Universal Precaution Compliance	-.04	-.08	.00	-.07	-.09	-.05
Risk Taking Behavior	.12	.10	.14	.09	.13	.04

RPNAH: Risk Perception of Nursing Activity Hazards
RPMI: Risk Perception of Musculoskeletal Injury
RPMI-S: Risk Perception of Musculoskeletal Injury to Self
RPMI-O: Risk Perception of Musculoskeletal Injury to Others
* $p < .05$ ** $p < .01$

Appendix C *Pearson Correlation Coefficients Between SWB-PH and Other Measures*

Scales	AACN Sample		UCSF Sample	
	N	γ	N	γ
Universal Precaution Compliance	140	.44**	65	.43**
Risk Taking Behavior	140	-.36**	65	-.50**
Safety Climate	140	.40**	65	.18
RPNAH-general	140	-.23**	65	.23
RPNAH-patient handling	141	-.21*	65	.21
RPNAH-sharps	141	-.07	65	-.08
RPNAH-biological	140	-.10	65	.05
RPNAH-chemical	140	-.15	64	.26*
RPNAH-radiation	140	-.19*	64	.16
RPMI	141	-.17*	65	.15
RPMI-S	141	-.17*	65	.09
RPMI-O	141	-.15	65	.20
MS Symptom index	137	-.11	-	-

RPNAH: Risk Perception of Nursing Activity Hazards
RPMI: Risk Perception of Musculoskeletal Injury
RPMI-S: Risk Perception of Musculoskeletal Injury to Self
RPMI-O: Risk Perception of Musculoskeletal Injury to Others
* $p < .05$ ** $p < .01$

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Date