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PSYCHOSOCIAL WORK FACTORS AND SHOULDER PAIN IN HOTEL ROOM CLEANERS

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Psychosocial Work Factors and Shoulder Pain in Hotel Room Cleaners

by

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DISSERTATION

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I wish to honor all workers. I have two dreams: safe work for all, and full worker access to the wonderful services provided by occupational health nurses.

Psychosocial Work Factors and Shoulder Pain in Hotel Room Cleaners

Barbara J. Burgel

Aims: To measure, among hotel room cleaners, the relationship between psychosocial work factors (job strain, iso-strain, and effort-reward imbalance [ERI]) and severe shoulder pain, controlling for selected socio-demographic, behavioral, anthropometric, biomechanical, and hotel factors.

Background: Hotel room cleaners have physically demanding jobs that place them at high risk for work-related shoulder pain (WRSP). Biomechanical factors have been associated with WRSP. Psychosocial work factors, including job strain (high psychological demand with low decision latitude), iso-strain (job strain with low coworker and supervisor support), and ERI (high effort with low rewards), may also play a role in WRSP, but this is not well studied.

Methods: 941 of 1,276 (74%) hotel room cleaners from 5 hotels in Las Vegas completed a survey in 2002. Of them, 493 with complete data for the shoulder pain outcome, the 3 key psychosocial independent variables, and 17 covariates were included in logistic analyses using Stata, Version 9.2.

Results: Fifty-six percent (n=274) reported WRSP in the prior 4-weeks. The sample was female (98%), Latina (78%), married/partnered (69%), born outside the USA (85%), and age 41 (SD 9.67). On average, participants had worked as a room cleaner 7.74 (SD 5.41) years, 40.26 hours (SD 11.00) per week, and made 19.35 beds/day (SD 6.72). In fully adjusted models, job strain and iso-strain were not associated with WRSP. However, ERI was significantly associated with WRSP: those with an ERI score greater than 1.0 had 3 times the odds of reporting severe shoulder pain, after adjusting for age, years of education, caregiving at home, current smoking and alcohol, height, number of years worked as a room cleaner, number of hours worked/week, number of beds made/day, and physical workload, work intensification and ergonomic indices (AOR 2.98, 95% CI 1.93-4.59, p=0.000).

Implications for nursing: These findings will aid occupational health professionals in developing "healthy work" policies to prevent WRSP. Creative job design and an enhanced reward system for hotel room cleaners may help to achieve a better balance between effort and rewards of work.

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CHAPTER I

Introduction

Purpose of Study

The purpose of this cross-sectional study is to determine if psychosocial work factors are related to work-related shoulder pain (WRSP) in hotel room cleaners. Job strain, iso-strain and effort-reward imbalance (ERI) are the psychosocial work constructs of interest. This study will describe the relationship between the three psychosocial work constructs and WRSP in hotel room cleaners, and identify the biomechanical and individual factors that are associated with shoulder pain. This is a secondary analysis of data collected in the 2002 Hotel Room Cleaner Study by Dr. Niklas Krause and his research team. Results of this study may guide policy development regarding the design of healthy work or other preventive interventions for hotel room cleaners, with the goal of reducing or preventing WRSP in this population.

Significance of Study

The relationship between psychosocial work factors and work-related shoulder pain (WRSP) is not well established. The science linking psychosocial work factors with an increased prevalence of WRSP has been inconsistent. Early studies were primarily cross-sectional in design, used a wide variety of case definitions and psychosocial measures, and failed to control for biomechanical work factors. Later cohort studies exploring the relationship between psychosocial work factors and WRSP continued to demonstrate inconsistent results with modest effect sizes. More importantly, there is no research describing psychosocial work factors for injury in hotel room cleaners. Although it is well established that the biomechanical work factors of repetition, force and awkward posture cause WRSP, the exploration of these potential WRSP risk factors in hotel room cleaners has also not been conducted.

Shoulder pain associated with work is increasing in prevalence (Marras, Cutlip, Burt, & Waters, 2008), with 12-month prevalence rates ranging from 19% (Silverstein et al., 2006) to 37% (Andersen et al., 2007). Shoulder injuries have a significant negative impact on health-related quality of life because of persistence of symptoms in those affected (Bonde et al., 2003; Silverstein et al., 2006), limitations in function (Chipchase, O'Connor, Costi, & Krishnan, 2000; Kennedy et al., 2006; MacDermid, Ramos, Drosdowech, Faber, & Patterson, 2004), and associated wage loss primarily due to inability to return to work (Reville, Neuhauser, Bhattacharya, & Martin, 2002).

Of the more than 900,000 maids and housekeepers employed in the USA, 46% are employed in traveler accommodation sites including hotels/motels and casino hotels. It is estimated that 19,380 maids and housekeepers were employed in all private industries in the Las Vegas region in 2006 (BLS, 2006b). Among all occupational groups, maids and housekeepers were ranked 13 in numbers of total cases of work-related musculoskeletal disorders (WRMSD) (BLS, 2006c). This group has an incidence rate of 90.5 WRMSD cases per 10,000 full-time workers, as compared to a national incidence rate of 38.6 WRMSD cases per 10,000 full time workers (BLS, 2006c). Of the 7,730 strain and sprain injuries reported in maids and housekeepers in 2006, the shoulder was involved in 1,290 of these cases (16.7%) (BLS, 2006a).

Cleaning jobs involve repetitive upper extremity movements, with awkward postures reaching above shoulder height, and lifting of loads, posing biomechanical risk for WRSP (Laursen, Sogaard, & Sjogaard, 2003; Mathiassen, Burdorf, van der Beek, &

Hansson, 2003; Messing, Chatigny, & Courville, 1998). Psychosocial work factors associated with injury in hotel room cleaners include increased workload, working alone, and working through rest breaks (Krause, Scherzer, & Rugulies, 2005; Seifert, 2006). Among these workers, there is also limited decision making about organizing their work and choosing equipment (Seifert, 2006; Zock, 2005). Social justice issues including low wages and disrespect for cleaning work may contribute to perceived work stress (Chen & Skillen, 2006; Messing, 1998). Job insecurity associated with immigrant status may further contribute to work stress in this diverse group of low-wage workers (Seifert, 2006).

Data collected in 2002 from five unionized casino hotels in Las Vegas by Dr. Krause and his colleagues provided an opportunity to explore psychosocial work factors and their relationship to WRSP, in the context of biomechanical, individual, and hotel factors.

Research Questions

The research questions were as follows:

a) Are there differences in job strain, iso-strain, or effort reward imbalance (ERI) between hotel room cleaners with and without work-related shoulder pain (WRSP) in this sample of hotel room cleaners from five unionized casino hotels in Las Vegas?

b) Are there differences in job strain, iso-strain or ERI across selected socio-demographic, behavioral, anthropometric, biomechanical and hotel factors?

c) What are the relationships between job strain, iso-strain and ERI and WRSP, after adjusting for socio-demographic, behavioral, anthropometric, biomechanical, and hotel factors?

CHAPTER II

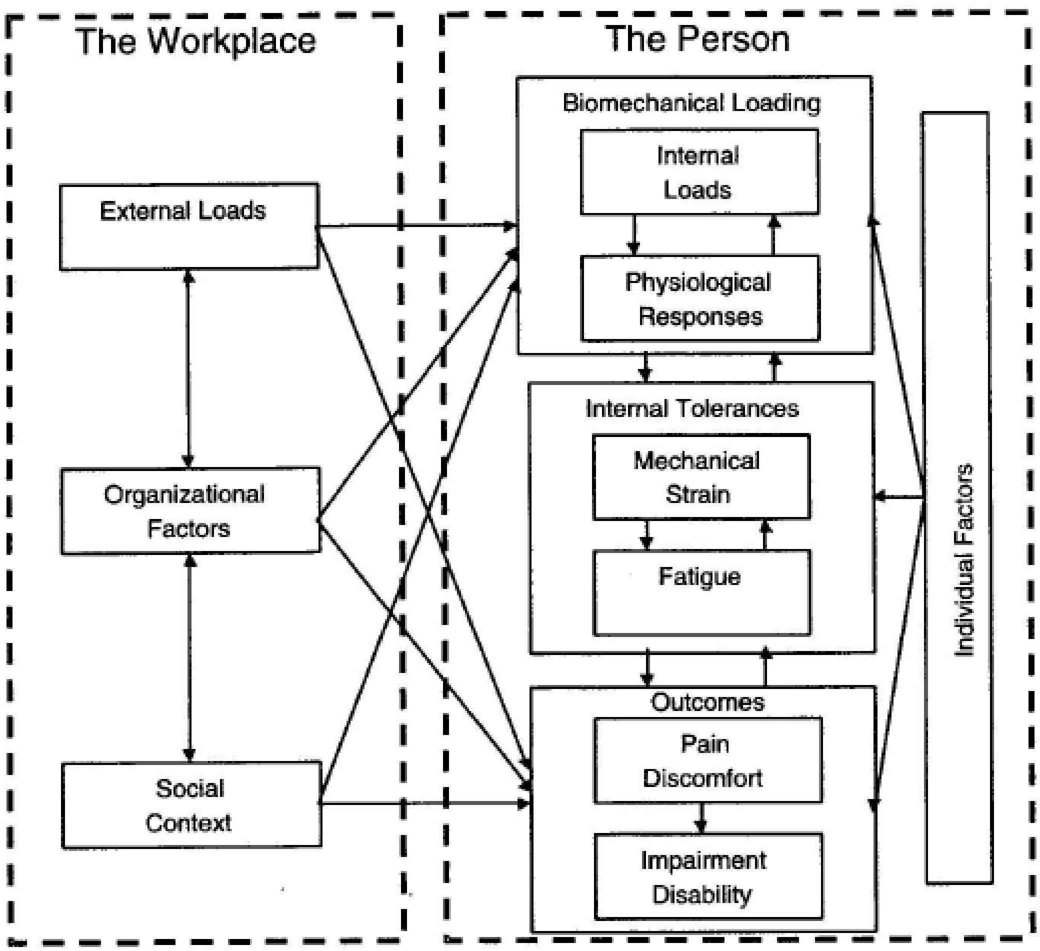
Conceptual Background And Review Of The Literature

Conceptual Framework

In 2001, the National Research Council (NRC) conducted a systematic review of current epidemiologic research exploring the relationship between psychosocial work factors and work-related musculoskeletal disorders (WRMSD) (National Research Council & The Institute of Medicine, 2001). The conceptual framework underpinning this systematic review posits that WRMSD may be caused by various factors, including those that are biomechanical, individual, and related to the psychosocial work setting. Figure 1 illustrates these factors, separating the workplace factors on the left of the figure, (external loads, organizational factors and the social context of the workplace) from the individual factors on the right of the figure. The NRC report defined organizational factors as "…the organization of tasks, work pace, characteristics of interpersonal interactions, and the utilization of ergonomic principles to modify tasks so as not to exceed the physical capacity of the worker" (NRC, 2001, p. 33-34). Social factors were defined as "factors which may influence both organizational procedures and worker expectations and motivations" (NRC, 2001, p. 33-34). These workplace and individual factors may henceforth lead to adverse outcomes in the person, including physiological responses, fatigue, pain/discomfort and impairment/disability.

This conceptual framework was used in this study to explore the relationships between psychosocial work factors and WRSP. Psychosocial work factors, the primary independent variables for this study, provide data about both the micro-organizational context of the job, in addition to the social context. However, for the purposes of this study, psychosocial work factors were conceptualized as providing data primarily about the social context of work. Biomechanical work factors provided data about the external loads facing the person. Organizational factors were defined, for the purposes of this study, to be the macro-organizational work factor available for study, i.e., grouping of workers by hotel.

Figure 1: A Conceptual Model of the possible roles and influences that various factors may play in the development of musculoskeletal disorders.



The National Research Council and the Institute of Medicine, 2001.

The interrelationship between WRMSD and psychosocial work factors is a subject of ongoing debate. A brief review of occupational stress and coping will inform this discussion. The worker experiences stressful events in his/her environment, and with cognitive appraisal of the stressors, adapts to these stressors through the use of coping strategies. If stressors are ongoing, and/or coping strategies are inadequate, psychological distress may develop. This psychological distress may independently cause a physiologic response, leading to adverse health outcomes such as WRMSD. In the presence of biomechanical (i.e., external loads), organizational, and individual factors (such as age, gender, and prior medical conditions), this psychological distress may contribute to work-related adverse health outcomes.

There are several potential mechanisms that explain the adverse physiologic effects of psychosocial work factors (Faucett, 2005; National Research Council & The Institute of Medicine, 2001). Acute and chronic stress may increase muscle tension. This, then, may alter the manner in which work is done, such as applying more force with work tasks, or assuming awkward postures. Psychosocial factors at work, such as a hostile relationship with a supervisor, may alter the speed of work. Increasing speed may create fewer micro-pauses with less muscle recovery time, thereby potentially contributing to soft-tissue injury. Acute and chronic stress has hormonal, vascular, neurological and immunologic effects. These physiologic effects may alter tissue responses to known biomechanical work factors resulting in injury. And, finally, stress may alter one's perception of painful stimuli, and may not only alter work practices, but may also influence reporting and care seeking for these symptoms (Bongers, Kremer, &

ter Laak, 2002; Faucett, 2005; National Research Council & The Institute of Medicine, 2001).

The contribution of psychosocial work factors to the experience of shoulder pain for hotel room cleaners is the focus of this inquiry. This chapter will cover the research and evidence that pertains to pain in general and specifically work-related shoulder pain. The literature exploring the role of psychosocial factors, individual factors (socio-demographic, behavioral, and anthropometric) and biomechanical factors in relationship to shoulder pain will be synthesized to identify what is currently known about work-related shoulder pain.

Work-Related Shoulder Pain

The pain experience. Pain is defined as an "unpleasant sensation and emotional experience associated with actual or potential tissue damage…" (International Association for the Study of Pain, 1994). Pain is a subjective, personal experience. Pain is experienced through physiologic, cognitive, and affective pathways, and individually perceived and reported through one's past and current cultural and personal experiences. There are differing pain thresholds among individuals and cultural variations in expressing pain. Reporting pain is difficult when there is job uncertainty. The decision to seek care for pain symptoms is dependent on many extrinsic factors, such as the need to work, and the availability of health benefits, transportation and childcare (Von Korff, Jensen, & Karoly, 2000).

Pain is not a stable trait; it has many temporal aspects (Ong & Seymour, 2004). A self-report of pain reflects the pain experience at one point in time, yet it may vary over the course of a day or across seasons (Von Korff, Jensen, & Karoly, 2000). Pain may be transient, intermittent, or persistent. It may be aggravated by certain activities, for example, reaching overhead. The pain experience may be changed by pain management strategies such as stretching or after taking pain medication. Pain takes on different meanings over time, as one experiences the pain, lives with the pain, and reports the pain (Von Korff, Jensen, & Karoly, 2000).

Therefore, pain is difficult to measure because it is a private and dynamic state. Pain can be measured by: a) self-report, b) observing behavior known to be associated with pain, or c) measuring physiologic parameters characteristic of a person in pain (Ong & Seymour, 2004). But because pain is a subjective, personal experience, self-report of pain is considered the most valid pain measure. Self-report is beneficial because persons can describe, in their own words, their pain experience. The qualitative description associated with the self-report of pain is rich in meaning, and can aid in the accurate diagnosis and management of the symptom. Self-report can capture the overlapping symptom presentations common with WRMSD (Schierhout & Myers, 1996). A self-report of pain in a work setting may signal the need for ergonomic evaluation and intervention. However, pain recall also engages the physiologic, cognitive and affective pathways, with subjective interpretation. More recent and severe painful experiences may be remembered more easily or suppressed more readily. Therefore, a study participant who is currently experiencing pain may be more likely to recall their prior painful experiences, in contrast to a healthy participant not currently experiencing pain, raising the issues of reporting bias.

Work-related shoulder pain (WRSP) rates. Shoulder pain is widespread in working populations, although precise prevalence and incidence rates are difficult to ascertain because of differences in measurement of shoulder pain across studies. Table 1 summarizes the measures used to determine prevalence and incidence rates described in this section.

Table 1: Summary of Prevalence and Incidence of Shoulder Pain Outcomes				
Author	**Sample**	**Outcome measured and Prevalence (P) or Incidence (I)**	**Prevalence/ Incidence Time Period**	**Rates**
Miranda et al., 2005	Working adults from population-based survey in Finland	a) Nonspecific shoulder pain (no clinical findings) (P) b) Rotator cuff tendonitis by physician exam (P)	7 days	a) 12% nonspecific shoulder pain b) 2% rotator cuff tendonitis
Leroyer et al., 2006	Administrative employees in France	Any shoulder pain experienced (P)	7 days	20.3%
Nordander et al., 2008	Two high risk repetitive industries in Sweden (rubber manufacturing & mechanical assembly) Malmo Neck and Shoulder Study	Pain or discomfort in neck/shoulder region, with standardized physical exam (P)	7 days	a) 51% shoulder symptoms b) 17% diagnosed neck tension syndrome c) 12% shoulder tendonitis
Unge et al., 2007	Cleaners from two hospitals in Sweden; Malmo Neck and Shoulder Study	a) Pain or discomfort in neck/shoulder region (P) b) Diagnosis, per standardized physical examination (P)	7 days	a) Neck/shoulder complaints: 49%-64% b) Neck/shoulder diagnosis: 35%-48%
Nahit et al., 2001	Newly employed workers from 12 occupational groups in England	Any shoulder/upper arm ache or pain lasting more than one day (P)	1 month	20% (24% of men, 13% women)
Harkness et al., 2003	Newly employed workers from 12 occupational groups in England	Any shoulder/upper arm ache or pain lasting more than one day (I) assessed at baseline, year 1 and year 2	1 month	New onset shoulder pain 15% at 12 months, and an additional 15% at 24 months

Table 1: Summary of Prevalence and Incidence of Shoulder Pain Outcomes				
Author	**Sample**	**Outcome measured and Prevalence (P) or Incidence (I)**	**Prevalence/ Incidence Time Period**	**Rates**
Flores et al., 2003	Mexican American janitors at one University in Southwest USA	a) Shoulder pain location by body map (P)	1 month	31%
Andersen et al., 2003	Workers from 19 workplaces in Denmark	a) Shoulder symptom cases as determined by exam (I) b) Shoulder clinical cases by exam (I)	3 months summed score: a) Severity of pain at its worse b) Average severity of pain prior 3 months c) Impair-ment past 3 months d) Average pain prior 7 days	a) 14.1% shoulder symptom cases b) 1.7% shoulder clinical cases
Miranda et al., 2008	Working adults from population-based survey in Finland	Physician diagnosed chronic shoulder condition by history, exam, and x-ray (I)	3 months	7%
LeClerc et al., 2004	Repetitive workers from five industries in France	a) Any shoulder pain lasting one day at baseline (P) b) Any shoulder pain lasting one day in the prior 6 months 3 years later (P)	6 months	a) 37% men, 49% women b) 29% men, 21% women

Table 1: Summary of Prevalence and Incidence of Shoulder Pain Outcomes				
Author	**Sample**	**Outcome measured and Prevalence (P) or Incidence (I)**	**Prevalence/ Incidence Time Period**	**Rates**
Ostergren et al., 2005	Swedish Malmo Shoulder and Neck cohort	Self-report of any shoulder/neck pain experienced "often" or "all the time" (I)	12 months	5.8% Cumulative incidence rate (CIR) for middle level non- manual job class to a high of 13.6% CIR for unskilled - manual workers
Andersen et al., 2007	Workers from 19 workplaces in Denmark	a) Extent of being bothered by neck/shoulder pain "some" to "very much"=Severe neck/shoulder pain (P) b) Extent of being bothered by neck/shoulder pain "some" to "very much"=Severe neck/shoulder pain (I) assessed one year later	12 months	a) 37% (Range by industry: 22%-49%) b) 30% (Range by industry: 16%-37%)
Hoozemans et al., 2002	Workers from six companies exposed to pushing/pulling in their jobs in the Netherlands	a) Ache, pain or discomfort in shoulder region; (P) b) Pain intensity (0-10) with high >=5 (P) c) Disability (0-10) with high >=5 (P)	12 months	In high exposed group: a) 41% with shoulder trouble; b) 20% with high shoulder pain intensity; c) 10% with high shoulder disability

Table 1: Summary of Prevalence and Incidence of Shoulder Pain Outcomes				
Author	**Sample**	**Outcome measured and Prevalence (P) or Incidence (I)**	**Prevalence/ Incidence Time Period**	**Rates**
Svendsen et al., 2004	Denmark: machinists, house painters, car mechanics	Physician diagnosis of shoulder function by exam: a) Moderately troubled by shoulder pain or discomfort (P) b) Shoulder pain without disability (P) c) Shoulder pain with disability (P) d) Supraspinatus tendonitis (P)	12 months	a) Shoulder trouble: 16%-32% b) Shoulder pain without disability: 10%-19% c) Shoulder pain with disability: 4%-12% d) Supraspinatus tendonitis: 1%-4%
Silverstein et al., 2006	Workers from 12 different worksites in the USA, primarily manufacturing	a) Nonspecific shoulder symptoms (P) b) Rotator cuff tendonitis diagnosis, per physical examination and case definition (P)	1 week of shoulder pain or ≥3 episodes in prior 12 months	a) 19% nonspecific shoulder symptoms b) Rotator cuff diagnoses: 8%
Werner et al., 2005	Industrial and clerical workers in USA	Pain, stiffness, aching, burning or tenderness with physical exam confirmation, or self report of physician diagnosis of an upper extremity tendonitis (I)	1 week of shoulder pain or ≥3 episodes in prior 12 months	New shoulder tendonitis 15%

The 7-day prevalence of WRSP ranges from a low of 12% in a general working population (Miranda, Viikari-Juntura, Heistaro, Heliovaara, & Riihimaki, 2005) to a high of 51% in workers in high-risk repetitive jobs (Nordander et al., 2008). On average, 20% of newly employed workers from 12 occupational groups reported WRSP in the prior 1-month period (Nahit, Macfarlane, Pritchard, Cherry, & Silman, 2001). The 6-month prevalence of WRSP was 37% in male and 49% in female workers from repetitive industries (Leclerc, Chastang, Niedhammer, Landre, & Roquelaure, 2004). The 12-month prevalence of WRSP ranges from 10% to 49% for working populations (Andersen, Haahr, & Frost, 2007; Hoozemans, van der Beek, Frings-Dresen, van der Woude, & van Dijk, 2002; Svendsen, Bonde, Mathiassen, Stengaard-Pedersen, & Frich, 2004).

For cleaning personnel, the prevalence of WRSP is high. In a recent study of more than 4,000 Danish production and service workers, 49% of cleaning and kitchen staff reported severe neck and shoulder pain – asked together in a survey – in the prior 12 months, the highest prevalence rate of any job classification studied (Andersen, Haahr, & Frost, 2007). In a recent Swedish study of hospital cleaners in two hospitals, the prevalence of neck/shoulder symptom cases ranged from 49%-64% (Unge et al., 2007). In a small survey of Mexican American custodians, 31% reported experiencing shoulder pain within the prior one month (Flores & Deal, 2003). Although the prevalence of shoulder pain is not known in hotel room cleaners, there are data on overall bodily pain, neck and back pain from the 2002 Hotel Room Cleaner Survey. In this study, the 1-month prevalence of overall bodily pain was 47% (Krause, Scherzer, & Rugulies, 2005).

Forty-three percent of the room cleaners reported neck pain, 59% reported upper back pain and 63% reported lower back pain (Krause, Scherzer, & Rugulies, 2005).

The exact incidence of WRSP in hotel room cleaners is currently unknown. However, the incidence of new onset nonspecific shoulder pain in working adults has been reported to be from 5.8% to 30% per year of employment (Andersen, Haahr, & Frost, 2007; Andersen et al., 2003; Harkness, Macfarlane, Nahit, Silman, & McBeth, 2003; Leclerc, Chastang, Niedhammer, Landre, & Roquelaure, 2004; Miranda, Punnett, Viikari-Juntura, Heliovaara, & Knekt, 2008; Miranda, Viikari-Juntura, Martikainen, Takala, & Riihimaki, 2001; Ostergren et al., 2005; Silverstein et al., 2006; Werner, Franzblau, Gell, Ulin, & Armstrong, 2005).

Psychosocial Work Factors and WRSP

Job Demand-Control Model and Effort-Reward Imbalance. With regard to psychosocial work factors, two occupational stress models were chosen for the exploration of shoulder pain in hotel room cleaners: Karasek and Theorell's Job Demand-Control Model and Siegrist's Effort-Reward Imbalance Model. These two models led to the development of three ways to look at psychosocial work factors in this population.

Karasek and Theorell's occupational stress Job Demand-Control Model (JD-C Model) is commonly used to explore the stressors associated with the characteristics of the work environment, specifically the organization of work. Job *psychological demands* are defined as the psychological burden of working hard focusing primarily on mental workload (Karasek & Theorell, 1990). High mental workload is hypothesized to cause both increased stress and increased learning. Control is conceptualized as decision latitude. *Decision latitude* includes two highly correlated, but separate sub-concepts: personal control over decision-making (decision authority/autonomy) and skill discretion (task variety). In the JD-C Model, high decision latitude is hypothesized to buffer occupational stress, and increase learning. The dichotomization and combination of demands and controls creates four possible job outcomes: a) low demand in combination with low control are passive jobs, b) low demand in combination with high control are low strain jobs, c) high demand with low control are high strain jobs (i.e. job strain), and d) high demand with high control are active, learning-focused jobs (Karasek & Theorell, 1990). The focus of this study was to explore the high-strain job quadrant, i.e. those room cleaners reporting high demand and low control versus all other combinations.

The JD-C Model was later expanded to include the additional concept of *social support* in the workplace, that is, the helpful social interactions provided by supervisors and coworkers. There are two types of social support: socio-emotional and instrumental (Karasek & Theorell, 1990). Socio-emotional support buffers psychological strain. Instrumental support is the assistance in work tasks given by coworkers and supervisors. For those workers in high strain jobs with high demand and low control, the addition of low social support from coworkers and supervisors is labeled "iso-strain." Iso-strain is hypothesized to cause, when compared to job strain, additional adverse health outcomes.

The Effort-Reward Imbalance (ERI) Model is a newer alternative occupational stress model that explores the relationship between an imbalance within the social exchange of work and resultant adverse health outcomes (Siegrist & Peter, 1999a). It assesses the efforts at work and the rewards received in exchange for work efforts. Extrinsic *effort* is defined as the demands and obligations arising from the work situation.

Rewards are derived from money, esteem and job security/job opportunities. If effort at work is perceived to be high, and rewards are perceived to be low, this effort-reward imbalance (ERI) causes adverse strain.

An additional ERI Model scale is intrinsic effort, labeled "*overcommittment*." Overcommittment refers to a person's inability to withdraw from work and their personal need for control and approval (van Vegchel, de Jonge, Bosma, & Schaufeli, 2005). Overcommittment is theorized to independently, and in combination with ERI, cause adverse job strain. Overcommittment was not explored in this study.

Review of the Literature Exploring Psychosocial Work Factors and WRSP

Psychological demands. Several well-designed cross-sectional, case control and cohort studies in a variety of worker populations, using the JD-C Model, have documented that high psychological demands at work are associated with shoulder pain, and/or predict later development of new onset shoulder pain. However, these findings have not been observed consistently across studies.

In a cross-sectional analysis of administrative employees from a wide range of industries in France, Leroyer et al. (2006) found that those with high psychological demands were 1.9 times as likely to report shoulder pain in the prior 7 days, after adjusting for age, gender, and family or financial problems in the past 12 months (AOR 1.88, 95% CI 1.17-3.03) (Leroyer et al., 2006). Of note, biomechanical work demands were not assessed in this study, although all employees were thought to be doing similar administrative and computer work. In a cross-sectional study of painters, car mechanics, and machinists, high psychological demands were significantly associated with a diagnosis of supraspinatus tendonitis (AOR 3.19, 95% CI 1.62-6.31) and shoulder pain with disability (AOR 1.89, 95% CI 1.25-2.85), after adjusting for current upper arm elevation over 90 degrees, arm dominance, age, smoking, job control and social support (Svendsen, Bonde, Mathiassen, Stengaard-Pedersen, & Frich, 2004). In a large cross-sectional population-based study of working adults in Finland, psychological demands were significantly associated with chronic rotator cuff tendonitis (OR 1.7, 95% CI 1.0-3.0) in the bivariate analysis, however these relationships did not retain significance in the multivariate models (Miranda, Viikari-Juntura, Heistaro, Heliovaara, & Riihimaki, 2005).

In a nested case control, population-based study in Stockholm, high perceived psychological workload in women, but not in men, was associated with neck/shoulder disorders, after adjusting for a high physical workload index, repetitive hand movements at work and at home, low job control and smoking (AOR 1.6, 95% CI 0.9-2.6) (Fredriksson et al., 2000). In a separate analysis of a sub-sample of blue and white collar workers from this same cohort, women with high psychological demands at work were significantly more likely to report receiving medical treatment for a shoulder disorder up to 24 years later, after adjusting for age (AOR 1.8, 95% CI 1.0-3.5) (Fredriksson et al., 1999). This finding, however, did not continue to be significant in further multivariate modeling (Fredriksson et al., 1999).

In a cohort study of Danish industrial and service workers from 19 different industries, high psychological demands significantly predicted shoulder symptom cases (AOR 1.5, 95% CI 1.3-1.8) and shoulder clinical cases (AOR 1.7, 95% CI 1.1-2.9), after adjusting for decision latitude, social support, biomechanical risk factors, age, gender, body mass index (BMI), intrinsic effort (overcommittment), physical leisure time activity and level of distress (Andersen et al., 2003). However, with this same cohort in a different analysis looking at a different outcome, high psychological demands at baseline did not significantly predict a later self-report of severe neck/shoulder pain in the prior 12 months, after adjusting for age, gender, occupational group and intervention group (adj HR 0.9, 95% 0.7-1.3) (Andersen, Haahr, & Frost, 2007). In a cohort study of older Swedish workers, high psychological demand did not predict later neck/shoulder pain (Harkness, Macfarlane, Nahit, Silman, & McBeth, 2003; Ostergren et al., 2005). In an additional cohort study in England where job demand was defined as "hectic work at least half the time" and "stressful work at least half the time," these factors did not predict later onset of WRSP (Harkness, Macfarlane, Nahit, Silman, & McBeth, 2003).

Several systematic reviews found similar inconsistent findings between high psychological demands and WRSP. The National Research Council and the Institute of Medicine (NRC/IOM) report on "Musculoskeletal disorders and the workplace: Low back and upper extremities" reviewed over 130 studies on WRMSD (National Research Council & The Institute of Medicine, 2001). Of these, 28 studies examined psychosocial factors and upper extremity outcomes. After adjusting for age, gender, BMI, smoking, recreational activities and systemic disease, the report calculated attributable fractions (AF) psychosocial work factors; attributable fraction is an estimate of the proportion of disease that would be reduced in the exposed population if the exposure was eliminated. The higher the AF, the greater the importance of exposure reduction (Punnett & Wegman, 2004). For occupational psychosocial risk factors, and specific to the occurrence of shoulder disorders, the AF for a high psychologically demanding job ranged from 33-47% (National Research Council & The Institute of Medicine, 2001).

van der Windt et al. (2000) and Bongers et al. (2002, 2006) conducted systematic reviews exploring the relationships between psychosocial work factors and WRSP. van der Windt observed that high psychological demands were associated with WRSP with odds ratios ranging from 1.5 to 5.4, although the authors cautioned that the studies suffered from methodological concerns (van der Windt et al., 2000). Overall, the reviewers found that exposure assessments and assessment for potential confounders were not well described in the publications, and that data about past history of shoulder pain were not presented (van der Windt et al., 2000). In the 2002 Bongers et al. review, positive findings supporting a relationship between high psychological demands and WRSP were found in six of twelve methodologically strong studies, with odds ratios ranging from 1.1 to 1.6 (Bongers, Kremer, & ter Laak, 2002). In a later 2006 review examining longitudinal data, eight studies examined psychological demand and WRSP, and of these, three reported positive associations, and five reported negative associations (Bongers, Ijmker, van den Heuvel, & Blatter, 2006). In summary, the current research supporting an association between high psychological demands at work and WRSP is inconsistent, likely due, in part, to differences in populations studied, but also because of methodological differences in study design, definitions of psychological demands, and other issues.

Decision Latitude. Low control/decision latitude at work has been inconsistently shown to predict new onset shoulder symptoms. In a Danish cohort study of workers from 19 different industries, those with low decision latitude at baseline were 1.2 times as likely to report shoulder symptom cases (AOR 1.2, 95% CI 1.0-1.5) (Andersen et al., 2003). However, low decision latitude did not significantly predict shoulder clinical cases (AOR 1.3, 95% CI 0.8-2.1) (Andersen et al., 2003). Low control at work was also found to predict new onset shoulder symptom cases in men, but not women, in a cohort study of five different industries involving repetitive work in France. After adjusting for repetitive use of a tool, years on the job and depressive symptoms, male workers with low job control at baseline were 3.7 times as likely to later report at least one day of shoulder symptoms in the prior six months (AOR 3.68, 95% CI 1.44-9.41, p=0.01) (Leclerc, Chastang, Niedhammer, Landre, & Roquelaure, 2004).

However, several cross-sectional studies did not find significant relationships between low control at work and WRSP (Leroyer et al., 2006; Svendsen, Bonde, Mathiassen, Stengaard-Pedersen, & Frich, 2004). Additionally, in a nested case control, population-based study in Stockholm, low job control, defined as few possibilities for advancement and low influence over working conditions, was not found to be associated with neck/shoulder disorders (Fredriksson et al., 2000). Further, in a cohort study in Denmark, low job control was not found to be predictive of severe neck/shoulder pain in the prior 12 months, after adjusting for age, gender, occupational group and intervention group (Andersen, Haahr, & Frost, 2007). Likewise, in a cohort study of newly employed workers from 12 different occupational groups in the United Kingdom, low job control – defined as seldom having control over own work and seldom learning new things at work – was not predictive of later shoulder pain in the prior one month (Harkness, Macfarlane, Nahit, Silman, & McBeth, 2003). Finally in a large cohort study of older Swedish workers, low job control did not predict later neck/shoulder pain (Ostergren et al., 2005).

In the systematic review conducted by The National Research Council, the AF for low control (i.e., low decision latitude) was 37-47% (National Research Council &

The Institute of Medicine, 2001). In the van der Windt review, in those studies judged to be methodologically strong, low control (i.e., low decision latitude) was significantly associated with WRSP, with odds ratios ranging from 1.6 to 4.0 (van der Windt et al., 2000). In the 2002 Bongers et al. review, positive findings for low control (i.e., low decision latitude) were found in six of eleven studies with odds ratios ranging from 1.1 to 1.9 (Bongers, Kremer, & ter Laak, 2002). The reviewers cautioned that of the twenty shoulder studies reviewed, only five adjusted for individual, psychosocial and biomechanical confounders in the analyses. Additionally, all twenty studies were cross-sectional designs, and therefore it was difficult to determine if low decision control preceded the shoulder pain, or was in response to shoulder pain at work. In the 2006 Bongers et al. review of cohort studies exploring psychosocial work factors and WRSP, of the eight studies exploring shoulder pain and low job control, three found positive findings and five reported null findings (Bongers, Ijmker, van den Heuvel, & Blatter, 2006).

In summary, the research supporting a relationship between low control and WRSP is inconsistent. This may be possibly due to different study populations, varying definitions of low control, methodological design issues, and varying covariates included in the analyses.

Social support from coworkers and supervisors. There is very limited scientific evidence to support that lower social support from coworkers and supervisors is associated with WRSP. In a cohort study of USA clerical and industrial workers, Werner et al. observed significantly less coworker (p=0.02) and supervisor support (p=0.00) at baseline in incident shoulder tendonitis cases when compared to controls in the bivariate analysis (Werner, Franzblau, Gell, Ulin, & Armstrong, 2005). Additionally, in a study of primarily manufacturing workers in the State of Washington, workers with current shoulder symptoms at baseline reported less social support than those without shoulder symptoms or clinical findings (42% with high social support vs. 67% with high social support) (Silverstein et al., 2006). In both of these studies, there was no adjustment for age, gender, occupational group, and other potential confounders; moreover, the cross-sectional nature of the data precludes any causal inferences.

In the majority of other studies, however, low social support did not demonstrate a relationship with WRSP. In several cross-sectional (Leroyer et al., 2006; Svendsen, Bonde, Mathiassen, Stengaard-Pedersen, & Frich, 2004) and cohort studies (Andersen et al., 2003; Harkness, Macfarlane, Nahit, Silman, & McBeth, 2003; Ostergren et al., 2005), low social support from colleagues/supervisors was not associated with WRSP. In the Bongers et al. review, five studies reflected null findings between low social support and a higher prevalence of WRSP (Bongers, Kremer, & ter Laak, 2002). Furthermore, in the 2006 Bongers et al. review, of the nine cohort studies exploring social support and WRSP, only one study reported positive findings and only in men (Bongers, Ijmker, van den Heuvel, & Blatter, 2006).

Job strain. Most of the WRSP studies using the JD-C Model did not explore job strain, except for Ostergren's cohort study (2005). They found that the separate subscales of high psychological demand and low decision latitude were not predictors of later shoulder/neck pain. Interestingly though, job strain significantly predicted new onset neck and shoulder pain in women after adjusting for age, marital status, country of origin, education, pain from other regions, and mechanical exposure (AOR 1.49, 95% CI 1.10-

2.03) (Ostergren et al., 2005). However, in the Danish cohort study by Andersen et al., there was no influence of job strain on shoulder pain (Andersen et al., 2003). In the Bongers et al. review, job strain was evaluated in four WRSP studies, with positive findings observed in three of them with odds ratios ranging from 1.5-2.1, including the Ostergren study summarized above (2006).

Iso-strain. In Miranda's large cross-sectional study in Finland, iso-strain (job strain with low social support) was significantly associated with nonspecific shoulder pain in the prior 7 days in the bivariate analysis (OR 1.8, 95% CI 1.2-2.7). However, this did not retain significance in the multivariate models (Miranda, Viikari-Juntura, Heistaro, Heliovaara, & Riihimaki, 2005).

Fredriksson studied a modified iso-strain construct of high psychological demands in combination with low family support (1999). In a population-based, cohort study in Stockholm of blue and white collar workers examining risk factors for later medical treatment and consultation for disorders of the neck and/or shoulder, high psychological demands and low family support were explored (Fredriksson et al., 1999). The combination of factors significantly predicted medical treatment up to 24 years later for shoulder disorders in women (cumulative incidence ratio 2.8, 95% CI 1.1-6.8) but not in men (Fredriksson et al., 1999). As with job strain, the Danish cohort study by Andersen et al. did not find significant results exploring this combination with regard to shoulder pain (Andersen et al., 2003).

Although the research to support a relationship between job strain and iso-strain and WRSP is limited, there are additional studies where job strain and iso-strain are associated with severe neck pain, for example the findings of Rugulies and Krause (2007).

Effort-Reward Imbalance. No studies were found that explored the independent effect of high effort on WRSP. However, in one cross-sectional study of administrative employees in France, those with high rewards had significantly less shoulder pain in a minimally adjusted model (i.e., age and gender) (AOR 0.58, 95% CI 0.36-0.94) (Leroyer et al., 2006). In a model adjusting for age, gender, and family or financial problems in the past 12 months, this significant relationship was not maintained (AOR 0.74, 95% CI 0.44-1.23) (Leroyer et al., 2006).

The research examining the relationship between ERI (the combined efforts and rewards measure) and WRSP is also limited. In the two systematic reviews examining ERI and adverse health outcomes research conducted prior to 2003 (Tsutsumi & Kawakami, 2004; van Vegchel, de Jonge, Bosma, & Schaufeli, 2005), three English language, cross-sectional studies on musculoskeletal outcomes were identified and are summarized here (Joksimovic, Starke, von dem Knesebeck, & Siegrist, 2002; Peter, Geisler, & Seigrist, 1998; Tsutsumi, Ishitake, Peter, Siegrist, & Matoba, 2001).

The Peter et al. study involved German transport employees, with a subset of bus drivers. After adjusting for gender, reported health, physical demands, and physical/chemical hazards, bus drivers with ERI (using a proxy ERI measure) were twice as likely to report musculoskeletal symptoms (AOR 2.0, 95% CI 1.2-3.2) (Peter, Geisler, & Seigrist, 1998). Tsutsumi et al. (2001) conducted a cross-sectional survey of Japanese male dental technicians to evaluate musculoskeletal symptoms. They found that dental technicians with ERI were twice as likely to report “recent” musculoskeletal symptoms, although the results were not significant (AOR 2.0, 95% CI 0.5-8.3) (Tsutsumi, Ishitake, Peter, Siegrist, & Matoba, 2001). Joksimovic et al., (2002) evaluated 316 male and female German transportation employees for musculoskeletal symptoms. After adjusting for age, gender, education, income, shift-work, and negative affectivity, those with ERI were 3 times more likely to report hip pain (AOR 3.1, 95% CI 1.4-7.1). Other sites of musculoskeletal pain were not significantly associated with ERI in this study (Joksimovic, Starke, von dem Knesebeck, & Siegrist, 2002).

Since 2003, additional research has explored the relationship between ERI and WRMSD. For example, Leroyer et al., using a cross-sectional study design, studied administrative employees from a variety of work settings in France. They explored psychosocial and work scheduling factors and their relationship with any upper extremity musculoskeletal symptoms self-reported in the prior week (2006). In addition to using items from the Job Content Questionnaire (Karasek, 1985), they also used the Reward subscale (11 items) from the ERI questionnaire. Those with strong recognition at work reported significantly less neck pain (AOR 0.63, 95% CI 0.43-0.93), less shoulder pain (AOR 0.58, 95% CI 0.36-0.94) and less wrist/hand pain (AOR 0.53, 95% CI 0.30-0.97), after adjusting for age and gender. However, after adjusting for the number of hours worked, these associations did not maintain significance.

In a case-control study of hospital workers with neck/upper extremity injuries or back/lower extremity injuries, both the ERI and Job Content Questionnaires were used to measure psychosocial factors (Gillen et al., 2007). ERI was measured using the 17-item questionnaire (6 items for extrinsic effort, and 11 items for rewards), and scored according to the Siegrist protocol (Siegrist & Peter, 1999b). Those with ERI were 1.3

times as likely to have a neck/upper extremity injury (AOR 1.3, 95% CI 1.1-1.7), after adjusting for educational level, annual family income, job strain, ergonomic assessment, and job group (Gillen et al., 2007). In the multivariate models, ERI continued to be associated with neck/upper extremity injuries. In model 1, those with ERI were 1.5 times as likely to experience a neck/upper extremity injury, after controlling for job group and ergonomic assessment (AOR 1.5, 95% CI 1.1-1.9). In model 2, those with ERI were 1.3 times as likely to experience a neck/upper extremity injury, after adjusting for ergonomic assessment, and for educational and income level. Of note, in both the bivariate and multivariate models, job strain was not significantly associated with neck/upper extremity injury.

Self-reported productivity loss was explored in relationship to neck/shoulder symptoms and arm/hand symptoms in a sample of computer users in The Netherlands (van den Heuvel, Ijmker, Blatter, & de Korte, 2007). The researchers defined this loss as a slowing of work pace, a decrease in working hours, or an inability to work for one or more days because of symptoms. Neck/shoulder and hand/wrist symptoms were assessed for the prior 3 months. Of importance, although the Dutch version of the ERI questionnaire was used, the authors used a scoring method that differed from the Siegrist protocol to classify high effort and low reward (1999b). In this cross-sectional analysis, neck/shoulder symptoms (16%) were more prevalent than arm/wrist symptoms (7.5%); with 10% of the sample reporting symptoms in both anatomical regions. Productivity losses were similar in those who had either neck/shoulder symptoms (80%) or arm/wrist symptoms (76%). Of the group who had symptoms in both regions, 64% reported productivity losses. In the final logistic regression model, symptomatic employees with high effort and low reward (as defined by van den Heuvel et al.) were almost 2 times as likely to report productivity losses, when compared to those in the low effort, high reward group, after controlling for potential confounders such as age, gender, level of education, intensity of symptoms, and job satisfaction (AOR 1.95, 95% CI 1.09-3.50) (van den Heuvel, Ijmker, Blatter, & de Korte, 2007).

Additional research about the ERI Model and other musculoskeletal outcomes exists. For example, in a large cross-sectional study of nursing staff from seven European countries, the highest tertile of the effort-reward imbalance ratio was associated with disability from low back and neck pain (Simon et al., 2008). Similarly, using a proxy measure of ERI, Rugulies and Krause observed an association between the highest quartile of ERI and compensated low back and neck injuries in transit operators (2007). In summary, although there is need for additional research in the study of ERI and WRSP, there is growing evidence supporting a relationship between ERI and WRMSD. Therefore, ERI merits further evaluation in this study, exploring its specific association with WRSP.

Biomechanical Work Factors and WRSP

Overview. The four recognized biomechanical risk factors for the development of WRMSD are repetition, force, posture and vibration. While none of these factors were available in the data analyzed for this study, it is appropriate to review them in order to present a complete discussion of the role of biomechanics in WRMSD in general and WRSP specifically. Repetition is defined as repeated movements within a specified work cycle. For the shoulder, repetition is defined as work activities that involve cyclical flexion, extension, abduction or rotation of the shoulder joint (NIOSH, 1997). In the presence of repetition, cold temperatures are an additional risk factor for WRMSD, specifically for upper extremity disorders (National Research Council & The Institute of Medicine, 2001). Force is defined as an external load or internal force on a body structure, expressed usually in Newtons or pounds. For the shoulder, force refers to strenuous work involving shoulder abduction, flexion, extension or rotation that could generate loads to the shoulder (NIOSH, 1997). Posture refers to the neutral position of a body structure; awkward, extreme, or static posture poses risk for WRMSD. For the shoulder, neutral posture is defined as the arm hanging straight by the side of the torso. Once the arm is elevated, the deltoid and supraspinatus muscles are activated. Also, the space between the humeral head and acromium is narrowed, potentially compressing the rotator cuff muscles, posing risk for soft tissue injury (NIOSH, 1997). Vibration is defined as a motion with both a direction and a magnitude component. The acceleration of the motion is usually what is measured. Vibration can affect the whole body, or when using a tool, impact the hand and the arm. Adverse health effects to the vascular, neurologic and musculoskeletal systems may occur when vibration energy is transferred to the hand of the worker while the vibrating tool is in use (NIOSH, 1997).

Repetition. In the NIOSH systematic review, for *repetition,* only three studies explored repetition at work and its relationship with shoulder clinical cases. In these studies, however, repetition was studied in combination with awkward or static postures. Six additional studies explored repetition and its relationship with shoulder symptom cases. Repetition was defined in four different ways in these studies. Regardless of the definition of repetition used, repetition was found to have a significant positive association with both shoulder symptom cases and shoulder clinical cases, with odds ratios ranging from 1 to 3. Of the four methodologically strong studies, the odds ratios ranged from 3.5 to 5.0 for the association between repetition and shoulder clinical cases. In summary, of the four levels of evidence used in the NIOSH review, ranging from none to strong, there is *evidence* (Level 3) for repetition and its association with WRSP (NIOSH, 1997). The National Research Council concluded that the attributable fraction for repetition and the occurrence of an upper extremity disorder was 53-71% (National Research Council & The Institute of Medicine, 2001).

There are additional studies supporting repetitive work as a risk factor for WRSP. In a large cohort study of 39 workplaces in Denmark, workers with high rates of repetitive work, defined as 16 to 40 movements per minute, were 1.5 times as likely to develop a neck/shoulder symptom case (AOR 1.5, 95% CI 1.2-1.9), and 3.9 times as likely to develop a neck/shoulder clinical case (AOR 3.9, 95% CI 1.5-5.8), when compared to those without repetitive work (Andersen et al., 2003). Furthermore, this study found that workers with a lack of shoulder recovery time, defined as greater than 80% of the time where there were no micro-pauses during the task cycle time, were 1.3 times as likely to develop a neck/shoulder symptom case (AOR 1.0-1.5), and 2.1 times as likely to develop a neck/shoulder clinical case (AOR 1.1-1.39) (Andersen et al., 2003).

In a separate analysis of the same Danish cohort, workers who performed repetitive work for 45-60 minutes/hour at baseline were 1.5 times as likely to self-report severe neck/shoulder pain in the prior 12 months, after adjusting for age, gender, occupational group and intervention group (adj HR 1.5, 95% CI 1.0-2.1) (Andersen, Haahr, & Frost, 2007).

In a cohort study of five industry sectors in France, LeClerc et al. found that repetitive use of a tool significantly predicted new onset of WRSP in men, after adjusting for number of years on the job, depression, and low job control (2004). Likewise, in several well designed cross-sectional studies, repetition was associated with WRSP (van der Windt et al., 2000).

Awkward postures. In the NIOSH review, six studies examined the association between *awkward postures* and shoulder clinical cases. An additional seven studies explored awkward postures and shoulder symptom cases. Awkward postures were defined in numerous ways, including overhead work, work above shoulders, arm elevation, and degrees of arm elevation and shoulder abduction. Significant associations were found in all studies using all definitions of awkward postures. Of the four studies that met the four evaluation criteria for well-designed studies, odds ratios ranged from 3.5 to 5.0. In summary, there is *evidence* for a relationship between repeated or sustained shoulder postures, with more than 60 degrees of flexion or abduction, and both shoulder clinical and symptom cases. The evidence is strongest when combined with other biomechanical risk factors of repetition and force.

There is additional more current research supporting awkward postures as a risk factor for WRSP. Working above shoulder height was found to be significantly associated with a physician diagnosed chronic rotator cuff tendonitis in a large, well designed cross-sectional population-based study of working adults in Finland (Miranda, Viikari-Juntura, Heistaro, Heliovaara, & Riihimaki, 2005). For rotator cuff tendonitis, there was a dose-response relationship between the number of years working with the hand above shoulder level for more than one hour/day and the prevalence of rotator cuff tendonitis, and this varied by gender. Men with 1-3 years of exposure of over shoulder work were 3 times as likely to have a rotator cuff tendonitis diagnosis, after adjusting for age and diabetes (AOR 3.1, 95% CI 1.1-8.4); with 4-13 years of exposure, men were 3 times as likely to have the same diagnosis (AOR 3.0, 95% CI 1.2-7.7), and for those men with 14-23 years of exposure, they were almost 5 times as likely to have such a condition (AOR 4.8, 95% CI 1.9-12.1). For men with greater than 23 years of exposure, the odds ratio dropped to 2.3 and became non-significant, which may represent a healthy worker effect (AOR 2.3, 95% CI 0.7-7.0). For women, a similar dose-response relationship was observed. However, only those women with 14-23 years of exposure to work above shoulder height showed a significant relationship at an alpha of 0.05. Women with 14-23 years of exposure were over 4 times as likely to have a rotator cuff tendonitis diagnosis, after adjusting for age, years of education, and duration of heavy lifting over 20 kg more than 10 times/day (AOR 4.4, 95% CI 1.5-12.4) (Miranda, Viikari-Juntura, Heistaro, Heliovaara, & Riihimaki, 2005). This study also explored self-reported nonspecific shoulder pain within the prior 7 days, where there was no association with awkward shoulder postures (Miranda, Viikari-Juntura, Heistaro, Heliovaara, & Riihimaki, 2005).

In a large Danish cohort study from 39 different workplaces, lifting at or above shoulder level more than 50 kg/hour at baseline was predictive of self-reported severe neck/shoulder pain in the prior 12 months, after adjusting for age, gender, occupational group and intervention group (adj HR 2.1, 95% CI 1.3-3.5) (Andersen, Haahr, & Frost, 2007). Standing more than 30 minutes/hour (adj HR 1.8, 95% CI 1.2-2.9) and squatting more than 5 minutes/hour (adj HR 1.6, 95% CI 1.1-2.2) were each predictive of a subsequent report of severe neck/shoulder pain (Andersen, Haahr, & Frost, 2007). Sitting more than 30 minutes/hour was not a risk factor for severe neck/shoulder pain. In the final multivariate model, lifting at or above shoulder height with at least 50 kg/hour and squatting more than 5 minutes/hour were the two significant biomechanical predictors for severe neck/shoulder pain, after adjusting for age, gender, occupational group, intervention group, job satisfaction, education and other chronic disease (Andersen, Haahr, & Frost, 2007).

In a separate analysis of the same cohort, Andersen et al. (2003) observed that workers who spent greater than 66% of their task cycle time with their neck flexed greater than 20 degrees, were 1.4 times as likely to develop a neck/shoulder symptom case (OR 1.4, 95% CI 1.1-1.8). In addition, they were 2.6 times as likely to develop a neck/shoulder clinical case (AOR 2.6, 95% CI 1.3-5.1).

Assembly workers who flexed or abducted their right or left arms "severely" and car mechanics, machinists, and house painters who worked with arms elevated above 90 degrees had a significantly higher prevalence of shoulder disorders (Punnett, Fine, Keyserling, Herrin, & Chaffin, 2000; Svendsen, Bonde, Mathiassen, Stengaard-Pedersen, & Frich, 2004). Working above shoulders for more than 15 minutes/day was predictive of subsequent shoulder pain in a cohort study of five industries from the United Kingdom, after adjusting for age group, gender, occupation, lifting over 22 pounds, pushing/pulling over 70 pounds, monotonous work, and pain from other body sites, although this did not reach a level of significance at an alpha of 0.05 (AOR 1.6, 95% CI 0.98-2.5) (Harkness, Macfarlane, Nahit, Silman, & McBeth, 2003).

Force. The NIOSH review found insufficient evidence for force as a risk factor for WRSP (NIOSH, 1997). However, the National Research Council concluded that the attributable fraction (AF) for the occurrence of an upper extremity disorder for force alone was 78%; the AF for repetition with force was 88-93% (National Research Council & The Institute of Medicine, 2001).

Several more recent cohort studies have documented that high force jobs predict later onset of new shoulder pain. Workers with job tasks that required high force, defined as >10% maximal voluntary contraction, were 1.3 times as likely to develop a neck/shoulder symptom case (AOR 1.3, 95% CI 1.0-1.7), and twice as likely to develop a neck/shoulder clinical case (AOR 2.0, 95% CI 1.0-4.2) in a Danish cohort study of a wide variety of workers (Andersen et al., 2003). In a separate analysis of this same cohort, lifting over 100 kg cumulatively per hour (adj HR 1.9, 95% CI 1.3-2.7) and pushing over 355 kg cumulatively per hour (adj HR 1.5, 95% CI 1.0-2.2) at baseline were each predictive of severe neck/shoulder pain, after adjusting for age, gender, occupational group and intervention group (Andersen, Haahr, & Frost, 2007).

In a cohort study of 5 industries in the United Kingdom, in the final model, after adjusting for age group, gender, occupation, and other factors in the model, pushing and pulling over 70 pounds (AOR 1.9, 95% CI 1.1-3.3) predicted future shoulder pain in the prior one month, after adjusting for age group, gender, occupation, overhead reaching, lifting, monotonous work, and pain from other body sites (Harkness, Macfarlane, Nahit, Silman, & McBeth, 2003). Although not significant at an alpha of 0.05, this study documented 1.7 times the odds of developing new onset shoulder pain with baseline work exposure which included lifting with one or two hands of over 22 pounds (AOR 1.7, 95% CI 0.9-3.0) (Harkness, Macfarlane, Nahit, Silman, & McBeth, 2003).

In a large cross-sectional Finnish study, years of high hand force for more than 1 hour/day were significantly associated with non-specific shoulder pain in the prior 7 days for women, but not for men. Women with over 23 years of exposure to high hand force were more than 2 times as likely to report nonspecific shoulder pain in the prior 7 days, after adjusting for age, duration of years of intensive keying, and depression (AOR 2.3, 95% CI 1.3-4.1) (Miranda, Viikari-Juntura, Heistaro, Heliovaara, & Riihimaki, 2005). For women, but not for men, duration of lifting more than 20 kg 10 times or more per day was significantly associated with a rotator cuff tendonitis diagnosis, after adjusting for age, years of education, and duration of working above shoulder height (For women with 4-13 years of exposure: AOR 5.0, 95% CI 2.0-12.2) (Miranda, Viikari-Juntura, Heistaro, Heliovaara, & Riihimaki, 2005).

Vibration. The NIOSH review found insufficient evidence for vibration as a risk factor for WRSP (NIOSH, 1997). There was very little research found exploring vibration and WRSP. Any work involving vibration (either whole body or use of a vibrating tool) was predictive of a subsequent chronic shoulder disorder in one cohort study (Miranda, Punnett, Viikari-Juntura, Heliovaara, & Knekt, 2008). Working with vibrating tools more than 5% of the day, however, did not predict care seeking for neck or shoulder pain in another study (Fredriksson et al., 2002).

Summed biomechanical workload scales. Three summed biomechanical workload scales were developed for the 2002 Hotel Room Cleaner Survey and thus were available for this dissertation analysis: a physical workload index, a work intensification index and an ergonomic index. The research involving summed biomechanical workload scales will be reviewed here.

Several well-designed studies found dose-response relationships between the number of biomechanical risk factors and WRSP (Grooten, Mulder, Josephson, Alfredsson, & Wiktorin, 2007; Nahit, Macfarlane, Pritchard, Cherry, & Silman, 2001; Punnett, Gold, Katz, Gore, & Wegman, 2004). One cohort study found a significant relationship between a summed biomechanical index and WRSP (Ostergren et al., 2005). In a Swedish cohort study of older workers, self-reported biomechanical demands were summed to form a mechanical exposure index quantifying perceived postural demands. Those in the upper quartile of this index were identified as having a high mechanical exposure index. For men, high mechanical exposure significantly predicted new onset neck and shoulder pain, adjusting for age, marital status, country of origin, education, pain from other regions, and the psychosocial predictors (psychological demand, decision latitude, job support, job strain) (AOR 1.73, 95% CI 1.28-2.36) (Ostergren et al., 2005). High mechanical exposure in women significantly predicted higher incidence rates of neck and shoulder pain. For those women in high mechanical exposure jobs, the odds of developing new onset neck and shoulder pain were 1.39 times higher when compared to those in low mechanical exposure jobs, after adjusting for age, four psychosocial factors, country of origin, marital status, and education (AOR 1.39, 95% CI 1.05-1.82) (Ostergren et al., 2005).

In summary, there is strong evidence supporting the relationship between biomechanical work factors and WRSP. Repetition, awkward shoulder postures, and force involved in pushing/pulling/lifting are risk factors for WRSP. Vibration is not currently identified as a risk factor for WRSP. Therefore, biomechanical work factors need to be thoroughly assessed as potential confounders in any study exploring the relationships between psychosocial work factors and WRSP.

Socio-demographic, Behavioral, and Anthropometric Factors and Shoulder Pain

Age. It is commonly accepted that age is a risk factor for musculoskeletal disorders, and age may be an indicator of cumulative work exposures. Therefore age should always be included in data analyses. In the review of studies exploring risk factors for WRSP, age was indeed associated with later development of shoulder pain in a 20-year Finnish cohort study (Miranda, Punnett, Viikari-Juntura, Heliovaara, & Knekt, 2008), and in a 3-year French cohort study (Leclerc, Chastang, Niedhammer, Landre, & Roquelaure, 2004). Those over age 55 were 2.3 times as likely to develop a subsequent chronic shoulder disorder, adjusting for gender (95% CI 1.0-5.3) (Miranda, Punnett, Viikari-Juntura, Heliovaara, & Knekt, 2008). Older age was a predictor of greater shoulder disability (Kennedy et al., 2006) and any upper extremity tendonitis (Werner, Franzblau, Gell, Ulin, & Armstrong, 2005). Higher prevalence of disabling shoulder pain was found in older workers (Pope, Silman, Cherry, Pritchard, & Macfarlane, 2001). In several cohort studies, there was a decreased prevalence of WRSP observed in the oldest age groupings, and this was most likely due to a healthy worker effect (Leclerc, Chastang, Niedhammer, Landre, & Roquelaure, 2004; Ostergren et al., 2005).

Gender. It is generally accepted that women have a higher prevalence of shoulder disorders, even after controlling for occupation (Larsson, Sogaard, & Rosendal, 2007), although some studies have reported contradictory gender findings. In one cross-sectional survey of a general working population in Finland, being female was significantly associated with nonspecific shoulder pain; however, rotator cuff diagnoses were not significantly more prevalent in women (Miranda, Viikari-Juntura, Heistaro, Heliovaara, & Riihimaki, 2005). In a later cohort analysis of this same population, gender was not predictive of shoulder pain (Miranda, Punnett, Viikari-Juntura, Heliovaara, & Knekt, 2008). Hoozemans et al. observed associations between female gender and an increased prevalence of shoulder trouble and high shoulder pain intensity, but not for high shoulder disability (Hoozemans, van der Beek, Frings-Dresen, van der Woude, & van Dijk, 2002). Female gender was more consistently associated with a higher prevalence of shoulder pain (Treaster & Burr, 2004), and a higher incidence of shoulder pain (Fredriksson et al., 2002; Ostergren et al., 2005). In a cohort study of Danish workers, women had higher odds of developing a shoulder symptom case, but not a shoulder clinical case (Andersen et al., 2003). Being female was also predictive of later shoulder disability (Kennedy et al., 2006; Pope, Silman, Cherry, Pritchard, & Macfarlane, 2001). In the most recent analysis of gender influences and WRSP, when compared to men, women with identical repetitive industrial tasks had twice the odds of neck/shoulder pain complaints in the prior seven days, after adjusting for age, employment time, rest breaks/recovery time greater than one hour/work per day, household work greater than 10 hours/week and exercise greater than 30 minutes/week (adj POR 2.3, 95% CI 1.2-4.6) (Nordander et al., 2008). Of interest, there were no significant differences in psychological demand, job control and job strain between men and women, regardless of pain status, so therefore this factor was not added to the final model. This study also evaluated postural assessments with electromyograms (EMG) on a subset of the study participants (note: it is unclear if any of these subjects had pain). Although the working postures and movements of men and women were similar, women showed higher muscular activity as a percent of maximum voluntary contraction, and less muscular rest as measured by EMG, when compared to men. Although this study did not demonstrate that higher muscular activity was associated with a higher prevalence of WRMSD, this study adds to the research on working postures and muscle activity of men and women performing the same work tasks.

Marital Status. Marital status is also viewed as a marker of socio-economic status, or as a proxy measure for personal social support. Many studies did not present data on marital status. In one cohort study, in bivariate analyses, being unmarried at baseline was predictive of later development of WRSP (Ostergren et al., 2005).

Ethnicity/Country of birth. The ethnicity of subjects was not shared in any of the studies. Likewise, country of birth was only identified in one cohort study. Being born outside of Sweden was not predictive of later development of WRSP (Ostergren et al., 2005). While much of the research has been in European countries with different immigration patterns, this may be a factor of increasing interest in the United States in the future.

Education. Low education, defined as 7-9 years of education, was significantly predictive of a subsequent self report of severe neck/shoulder pain in the prior 12 months after adjusting for age, gender, occupational group and intervention group (adj HR 1.8, 95% CI 1.1-3.0) (Andersen, Haahr, & Frost, 2007). This risk factor had a similar point estimate but did not remain statistically significant in the multivariate model: those with 7-9 years of education compared to those with 10 or more years were 1.6 times as likely to later report severe neck/shoulder pain in the prior 12 months, after adjusting for age, gender, occupational group, intervention group, overhead lifting greater than 50 kg/hour, squatting more than 5 minutes/hour, low job satisfaction, and other chronic disease (adj HR 1.6, 95% 0.9-2.7) (Andersen, Haahr, & Frost, 2007).

Ostergren et al. found that fewer years of education was significantly predictive of later development of WRSP: men with fewer than nine years of education were 1.86 times as likely to develop WRSP, after adjusting for age, as compared to those with 12 years or more of education (95% CI 1.21-2.86) (2005). Using the same comparison, women were 1.75 times as likely to develop WRSP (95% CI 1.21-2.54), after adjusting for age (Ostergren et al., 2005). In a well-designed cross-sectional study from Finland, less than nine years of education was significantly associated with nonspecific shoulder pain in the prior seven days for men, but not women, in the bivariate analysis (OR 1.6, 95% CI 1.1-2.5) (Miranda, Viikari-Juntura, Heistaro, Heliovaara, & Riihimaki, 2005). Also fewer years of education was predictive of later shoulder pain-related sickness absence (Kuijpers et al., 2006), and observed to be associated with higher shoulder pain intensity (Hoozemans, van der Beek, Frings-Dresen, van der Woude, & van Dijk, 2002).

Caregiving responsibilities at home. In a population-based cohort study in Stockholm, of blue and white collar workers, caregiving at home was explored as a risk factor for later medical treatment and consultation for disorders of the neck and/or shoulder (Fredriksson et al., 1999). "Additional domestic workload" was defined, for those who were gainfully employed, as the amount of time occupied by duties associated with having responsibility for children and household. In this study, 36% of women and 10% of men reported additional domestic workload at baseline (Fredriksson et al., 1999). High psychological demand in combination with additional domestic workload at baseline was evaluated to see if these factors predicted later medical treatment and consultation for disorders of the neck and/or shoulder. For seeking medical treatment for shoulder pain up to 24 years later, men with high psychological work demands in combination with additional domestic workload at baseline had a cumulative incidence ratio of 3.2 (95% CI 1.0-10.4) (Fredriksson et al., 1999).

Alcohol use/Current smoking. Although no studies were found exploring the relationship between alcohol use and WRSP, studies have been found regarding the relationship between smoking and WRSP. Current smoking was associated with neck/shoulder disorders in women, but not in men, after adjusting for high perceived workload, low job control, high physical workload index, and repetitive hand movements at work and at leisure (AOR for women 1.4, 95% CI 0.9-2.2) (Fredriksson et al., 2000). Current smoking was associated with disabling shoulder pain in a cross-sectional study of male car mechanics, machinists and house painters (Svendsen, Bonde, Mathiassen, Stengaard-Pedersen, & Frich, 2004).

In a cohort study of Danish workers, those who smoked at baseline were 1.3 times as likely to develop severe neck/shoulder pain, after adjusting for age, gender, occupational group and intervention group, although this did not reach significance at alpha = 0.05 (adj HR 1.3, 95% CI 0.9-1.7) (Andersen, Haahr, & Frost, 2007). However, smoking was not associated with rotator cuff or nonspecific shoulder pain in a cross-sectional study of a general working population in Finland (Miranda, Viikari-Juntura, Heistaro, Heliovaara, & Riihimaki, 2005).

BMI/Weight/Height. There have been inconsistent data about height, weight, and body mass index (BMI) and their relationships with WRSP. In the Andersen cohort study in Denmark, a BMI over 30 was a significant predictor for severe neck/shoulder pain in the prior 12 months, after adjusting for age, gender, occupational group and intervention group (adj HR 1.8, 95% CI 1.1-2.8) (Andersen, Haahr, & Frost, 2007). Similarly, Miranda observed that those with a BMI between 25-29 were at risk for later development of a chronic shoulder disorder, after adjusting for age and gender (AOR 2.5, 95% CI 1.4-4.6), and those with a BMI over 30 were almost 3 times as likely to develop a chronic shoulder disorder, after adjusting for age and gender (AOR 2.8, 95% CI 1.2-6.9) (2007). BMI over 30 significantly predicted higher incidence of upper extremity tendonitis (Werner, Franzblau, Gell, Ulin, & Armstrong, 2005).

However, in one study specifically exploring body morphology and WRSP, height and weight separately analyzed were not significantly associated with shoulder pain for industrial painters (Carnide, Veloso, Gamboa, Caldeira, & Fragoso, 2006). BMI was also not associated with nonspecific shoulder pain in the prior 7 days in a cross-sectional survey by Miranda (2005).

In summary, several socio-demographic, behavioral and anthropometric factors may be associated with or influence development of WRSP, specifically age, gender and years of education. There is inconsistent evidence for current smoking and BMI/height and weight as risk factors for WRSP. Likewise, little research was found to support ethnicity/country of origin, marital status, caregiving at home, and current alcohol use as risk factors for WRSP.

Gaps in the Current Research

Hotel room cleaners: Psychosocial work factors. Cleaning jobs are characterized by several select psychosocial work factors that may contribute to adverse health outcomes. Working alone at dispersed locations is a psychosocial risk factor of cleaning work (Zock, 2005). This solitary work poses a risk factor, not only for work-related violence, but also creates limited social contact with others (Chen & Skillen, 2006). Working alone limits support from coworkers and supervisors. Additionally, working alone restricts the opportunity to learn cleaning techniques from others. Ergonomic risk may also be increased because of fewer opportunities to ask others for help in manual handling tasks. Likewise, when working alone, workload cannot be shared with others in times of need, posing increased psychological demands.

The lack of respect from others is a potential psychosocial risk factor for cleaners as well. Cleaners have reported "lack of respect" from others for cleaning tasks (Messing, Chatigny, & Courville, 1998; Zock, 2005). Respect from others is considered part of the reward/self esteem system and is received in exchange for work (Siegrist, 2005). If there is an imbalance between the exchange of efforts and rewards, this may pose a risk for adverse health outcomes, including WRMSD (Gillen et al., 2007).

Marginal employment is an additional psychosocial risk factor posing risk for adverse health outcomes. Cleaning work is a low skill job, often an entry level position for those newly emigrated and for those with limited English skills (Zock, 2005). Karasek identified janitor work as an example of marginal employment (Karasek & Theorell, 1990). Cleaning work is ancillary to the main production of the business. It is also lowest in rewards, compensated with low wages and low benefits. Marginal employment jobs include many temporary workers who can be hired and fired at will. Job insecurity predominates.

Other psychosocial factors of interest in cleaning work are those associated with decision latitude. Cleaners rarely have a choice of cleaning supplies or equipment. They also lack work hour flexibility (Messing, Chatigny, & Courville, 1998; Zock, 2005). Likewise, there are few opportunities for cleaners to learn new skills and thus advance in their careers.

There is, however, no research on hotel room cleaners and their effort, rewards, psychological demands, decision latitude, and supervisor or coworker support. This study provided the opportunity to address this gap by evaluating the psychosocial work factors of hotel room cleaners, using measures from the JD-C Model and the ERI Model.

Hotel room cleaners: biomechanical work factors. Although little is known about psychosocial work risks for cleaning work, more is known about the biomechanical work demands of cleaning. Most of the research on cleaners describes workload and biomechanical exposures (Johansson & Ljunggren, 1989; Mathiassen, Burdorf, van der Beek, & Hansson, 2003; Messing, Chatigny, & Courville, 1998; Sogaard, Fallentin, & Nielsen, 1996) and trapezius muscle dynamics (Larsson, Bjork, Elert, & Gerdle, 2000; Larsson, Bjork, Elert, Lindman, & Gerdle, 2001; Laursen, Sogaard, & Sjogaard, 2003), but do not assess psychosocial factors and their link to pain or functional outcomes. Krause et al., using data from the 2002 Hotel Room Cleaner Survey, described the biomechanical work demands associated with hotel room cleaning, and observed one-month period prevalence of severe pain for the following body regions: overall (47%), neck (43%), upper back (59%) and lower back pain (63%) (2005). Likewise, there was a dose-response relationship between severe pain prevalence and the highest quartiles of physical workload, ergonomic problems and work intensification over the preceding 5 years in this sample of unionized hotel room cleaners (Krause, Scherzer, & Rugulies, 2005). Further exploration into the relationship of psychosocial work factors and WRSP in hotel room cleaners, while controlling for these important biomechanical work factors, will help close this current gap in the research.

Summary. The prevention of WRSP in hotel room cleaners is an area of importance in occupational safety and health. Safe work and the prevention of work-related injury in this high-risk group deserve further research attention. Understanding fully the factors that are associated with WRSP is necessary before appropriate and potentially effective strategies can be developed. This study will describe and analyze the psychosocial work factors, the biomechanical work factors, and related socio-demographic, behavioral and anthropometric factors that may contribute to WRSP in this sample of unionized hotel room cleaners from five hotels in Las Vegas.

CHAPTER III

Research Methodology

Description of Original Study

Design. The Hotel Room Cleaner Study was a cross-sectional survey conducted in 2002 of hotel room cleaners from five unionized hotels in Las Vegas. Upon the request of the local Culinary Union, researchers from the UCSF Division of Occupational and Environmental Medicine and the UC Berkeley Labor Occupational Health Program partnered with the union to explore the relationships between working conditions and work-related pain of hotel room cleaners (Krause, Scherzer, & Rugulies, 2005). A hotel room cleaner advisory board was established to provide consultation and guidance during the study. Focus groups with the hotel room cleaner advisory board were conducted to discuss work demands, generate the physical workload items, develop the survey tool, and pilot test the questionnaire.

Research setting and sample. Using participatory research methods and in collaboration with the local Culinary Union, five casino hotels in Las Vegas were selected (Krause, Scherzer, & Rugulies, 2005; Lee & Krause, 2002). These hotels represented different types of hotels (e.g., those serving businesses, tour groups, or families), and those with varying labor-management relationships. All day shift hotel room cleaners were invited to participate. Of 1,276 eligible room cleaners in the five hotels, 941 participated (74% response rate).

Data collection process. The Las Vegas questionnaire was modified from an earlier survey tool used in a study of San Francisco hotel room cleaners (Lee & Krause, 2002). The Las Vegas questionnaire was 29 pages in length, and was self-administered in English, Spanish or Serbo-Croatian during the months of February through May 2002. Trained research assistants, fluent in English, Spanish or Serbo-Croatian, aided survey completion and were either college students or hotel room cleaners from non-participating hotels (Krause, Scherzer, & Rugulies, 2005; Lee & Krause, 2002).

Current Study: Psychosocial Work Factors and WRSP

Design and sample. Using the 2002 Hotel Room Cleaner Survey data, a secondary data analysis was conducted to explore the relationships between psychosocial work factors and WRSP. A sample of 493 (52%) hotel room cleaners was selected from the original data set. This analytic sample was comprised of those with complete data for 21 variables, described below, that included the dependent (shoulder pain) and independent variables (job strain, iso-strain and ERI), as well as selected covariates associated with job stress and/or shoulder pain.

Variables. Figure 1, presented and discussed in Chapter II, schematically diagrams the possible relationships between workplace and individual factors and the development of WRSP. Workplace factors include *external loads*, *organizational factors*, and the *social context* of work. Individual factors include, for example, socio-demographic, behavioral and anthropometric variables. Workplace and individual factors can act directly and/or indirectly to alter biomechanical loading (internal loads and physiologic responses), which, in turn, may change internal tolerances (mechanical strain and fatigue), ultimately leading to adverse health outcomes (pain/discomfort, and impairment and disability). For this study, to evaluate workplace factors that may be associated with WRSP, the following self-reported six biomechanical and work covariates were used to estimate *external loads*: the number of years worked as a hotel room cleaner, the number of hours worked/week, the number of beds made per day, a physical workload index, a work intensification index, and an ergonomic index. The place of employment (i.e., hotel) was used as a proxy variable to assess the impact of *organizational factors* on WRSP. Job strain, iso-strain and ERI were the psychosocial work constructs used to measure the *social context* of the workplace. Individual factors selected to explore in this study included the following socio-demographic variables: age, gender, marital status, ethnicity, if born in or outside the USA, years of education, and caregiving at home. A self-report of current smoking and alcohol use were the individual behavioral factors explored in this study. Height and weight were the individual anthropometric factors objectively measured in this study, and were the only variables that were not self-reported. Self-report of shoulder/upper arm pain within the prior 4 weeks was the outcome for this study.

Outcome variable: Measurement of shoulder pain. The dependent variable for this analysis was the self-report of shoulder/upper arm pain and its level of severity during the prior 4 weeks. This was measured by one item: "How much pain have you experienced in the following parts of your body during the past 4 weeks?" Twelve body parts were then listed, including "shoulder/upper arms", with pain recorded on a 6-item scale ranging from none, very mild, mild, moderate, severe, to very severe pain. Shoulder pain was dichotomized (0=none, very mild, mild and moderate pain, and 1=severe and very severe shoulder pain).

Independent variables: Measurement of psychosocial work factors. Three independent variables were used to measure psychosocial job factors: job strain, iso-strain and ERI. Job strain and iso-strain were ratios generated from the following subscales from Karasek's Job Content Questionnaire: psychological demands (5 items), decision latitude (a composite score of decision authority [3 items] and skill discretion [6 items]), coworker support (4 items), and supervisor support (3 items) (Karasek, 1985). Summing coworker support with supervisor support generated total social support. (Note: a modifier was applied to the supervisor subscale so that it was equally weighted with coworker support). Table 2 lists the items that generated these subscales.

Table 2: Questionnaire Items Forming the Job Strain and Iso-strain Variables[a.]

Psychological Demand (5 items)	My job requires working very fast.
	My job requires working very hard.
	I am not asked to do too much work.[b.]
	I have enough time to get the job done.[b.]
	I am free from conflicting demands that others make on me.[b.]
Decision latitude (9 items)	
Decision authority (3 items)	My job allows me to make a lot of decisions on my own.
	On my job, I have very little freedom to decide how I do my work.[b.]
	I have a lot of say about what happens on my job.
Skill discretion (6 items)	My job requires that I learn new things.
	My job involves doing a lot of things over and over again.[b.]
	My job requires me to be creative.
	My job requires a high level of skill.
	I get to do a variety of different things on my job.
Coworker support (4 items)	People I work with know how to do their jobs.
	People I work with take a personal interest in me.
	People I work with are friendly.
	People I work with are helpful in getting the job done.
Supervisor support (3 items)	My supervisor is concerned about the well-being of those under her.
	My supervisor pays attention to what I am saying.
	My supervisor is helpful in getting the job done.

[a.] Responses: strongly disagree, disagree, agree, and strongly agree
[b.] Reverse coded items.

Psychological demand, decision latitude and total social support subscale scores were calculated using the formulas recommended by Karasek (1985). For each subscale, any missing data was replaced with the subscale mean of the respondent, if the respondent had answered at least 50% of the subscale items. The possible range for the psychological demand subscale was 12-48. The possible range for decision latitude was 24-96. Dividing the psychological demand score by the summed decision latitude score generated the job strain ratio (Landsbergis, Schnall, Warren, Pickering, & Schwartz, 1994). Categories of high psychological demand (i.e., for this sample, anyone with a score equal to or greater than 36), and low decision latitude (i.e., for this sample, anyone with a score equal to or lower than 56) were determined by sample median split. Coding those with high psychological demand in combination with low decision latitude created the categorical job strain variable.

Iso-strain is the combination of job strain in combination with low social support from coworkers and supervisors, referred to as total support. The possible range for total support scores was 8-32. The iso-strain ratio was formulated by dividing the psychological demand score by the sum of decision latitude and total support scores. Likewise, coding those with high psychological demand (score equal to or greater than 36), low decision latitude (score equal to or lower than 56), and low total support (anyone with a score equal to or lower than 20, as determined by sample median split) created the iso-strain categorical variable.

ERI was assessed using items developed by Siegrist et al. (Siegrist, 2006; Siegrist & Peter, 1999b). There are two ERI subscales: extrinsic effort measured with 6 items (of which one assesses physical effort at work), and reward measured with 11 items. Table 3 lists the items that generated the ERI variable. Overcommittment, an additional construct aimed to assess intrinsic effort, was not measured and therefore not available in these data.

Table 3: Questionnaire Items Forming the ERI Variables[a.]

Extrinsic Effort (6 items)	I have constant time pressure due to a heavy work load.
	I have many interruptions and disturbances in my job.
	I have a lot of responsibility in my job.
	I am often pressured to work overtime.
	Over the past few years, my job has become more and more demanding.
	My job is physically demanding.
Reward (11 items)	
Self esteem (5 items)	I receive the respect I deserve from my superiors.
	I receive the respect I deserve from my immediate coworkers.
	I experience adequate support in difficult situations.
	I am treated unfairly at work.[b.]
	Considering all my efforts and achievements, I receive the respect and prestige I deserve at work.
Financial/status (4 items)	My job promotion prospects are poor.[b.]
	My current occupational position adequately reflects my education and training.
	Considering all my efforts and achievements, my prospects for job advancement are adequate.
	Considering all my efforts and achievements, my salary/income and benefits are adequate.
Job security (2 items)	I have experienced or expect to experience an undesirable change in my work situation.[b.]
	My job security is poor.[b.]

[a.] First level of response: agree or disagree; 2nd level of response (if applicable) to identify level of distress: not at all distressed, somewhat distressed, moderately distressed, and very distressed.
[b.] Reverse coded items

Effort and reward subscales were individually summed per the Siegrist protocol (Siegrist, 2006; Siegrist & Peter, 1999b). For each subscale, any missing data was replaced with the subscale mean of the respondent, if the respondent had answered at least 50% of the subscale items. The possible range for the effort (6-item) subscale score was from 6-30. The possible reward subscale range was from 11-55. To form the ERI ratio, per the Siegrist protocol, a multiplier was applied to the reward denominator, and effort was divided by reward to form a ratio. Any ratio score above 1.0 signified imbalance. The ERI ratio range was from 0.2 to 5.00.

As noted in Table 3, physical demand is one of the items included in the extrinsic effort subscale. In the study of WRMSD, this item has the potential to be collinear with the biomechanical work items. Therefore, a 5-item effort scale may be used (Joksimovic, Starke, von dem Knesebeck, & Siegrist, 2002), excluding this one item. If this is done, a different modifier is used to account for the different items in the numerator when forming the ratio (Siegrist, 2006). For the purposes of this study, both effort scales were evaluated.

Covariates: Biomechanical work factors. Biomechanical work factors were measured by the following covariates: the number of years worked as a hotel room cleaner, the number of hours worked/week, the number of beds made per day, a physical workload index, a work intensification index, and an ergonomic index. For the physical workload index, a list of 26 job tasks was generated through hotel room cleaner focus groups conducted for the 2002 Hotel Room Cleaner Survey (Krause, Scherzer, & Rugulies, 2005). Examples of physical workload items included work situations such as "lots of garbage left in rooms" and "putting three sheets on a bed." Respondents were asked to rank the frequency of the work task using an 8-point scale: never occurring (0), occurring in about 1 room per week (0.2), occurring in 2-4 rooms/week (0.42), occurring about 1 room/day (1.0), occurring in 2-5 rooms/day (3.5), occurring in 6-10 rooms/day (8.0), occurring in 11-15 rooms/day (13.0), or, occurring in 16 or more rooms/day (16.0).

The frequency of these job tasks was summed, using the values noted in parentheses above, to generate a physical workload index, with a possible range from 0.00 to a maximum of 416.00.

Work intensification was defined as an increasing frequency of these 26 job tasks as compared to five years ago. Respondents were asked if the work task occurred less frequently (1), about the same frequency (2), or more frequently (3) compared to 5 years ago. The work intensification index was a summed score for those job tasks that were performed "more" as compared to 5 years ago, with a possible range of 26-78.

The ergonomic index was a list of 11 items generated through focus group discussions with room cleaners, including work situations such as the "linen cart (is) difficult to stock" and the "vacuum cleaner cord (is) too short." Respondents were asked to determine if these were or were not problematic, using a 4-point scale, ranging from not a problem (1), very little problem (2), somewhat of a problem (3), to a big problem (4). The ergonomic index was a summed score of these 11 items, with a range from 11-44. In all three indices, higher scores represented higher biomechanical work demands.

Covariates: Socio-demographic, behavioral and anthropometric factors. Ten socio-demographic and anthropometric variables were evaluated for potentially confounding the relationship between psychosocial work factors and shoulder pain: age, ethnicity, place of birth in or outside of the USA, years of education, marital status (married/partnered versus all others), caregiving at home, current smoking, current alcohol, height (in cm), and weight (in kg). Ethnicity was analyzed as Latinos/Latinas versus all others because of the large representation of Latinos/Latinas in this sample, and the much smaller subsets of other ethnicities. Place of birth was used to represent émigré status. Caregiving at home was measured as the number of people currently living in the home needing childcare, elder care or disability care. Current alcohol use was measured as the number of drinks in the prior 30 days. Research staff measured participants' height and weight.

Covariates: Hotel. Five hotels participated in the study, and had been selected to represent different management styles and types of customers served (Lee & Krause, 2002). The hotel variable was therefore viewed as a macro-organizational factor, important in exploring occupational stress. Hotel A was a large upscale tourist hotel; Hotel B was a mid-level tour and tourist hotel; Hotel C was primarily a convention hotel; Hotel D was an upscale all suites hotel; and Hotel E was an older tourist economy hotel (Rugulies, Scherzer, & Krause, 2008).

Data Analysis Procedures

Evaluation of potential confounders, and selection of variables for analysis. Based on the literature and prior studies with this sample, an *a priori* model was created including three socio-demographic and anthropometric factors (age, caregiving at home, and height), five biomechanical factors (number of years worked as a room cleaner, number of hours worked per week, number of beds made per day, the physical workload index, and the work intensification index) and the one organizational factor (hotel). Although leisure and sports activities data was not available in this database, caregiving at home was chosen to capture home demands of this primarily female sample that could contribute to both job stress and shoulder pain. Height was included (instead of BMI) to control for its potential unique contribution, i.e., shorter height requires more frequent reaching above the shoulder. Reaching above the shoulder is a known biomechanical risk factor for shoulder pain (Andersen, Haahr, & Frost, 2007; Miranda, Viikari-Juntura, Heistaro, Heliovaara, & Riihimaki, 2005). The sample included 11 men. Males did not differ from females on severe/very severe shoulder pain, nor did they significantly vary on job strain, iso-strain, or ERI scores. Therefore, gender was not considered a confounder and not included in multivariate analyses.

The five biomechanical work factors were chosen to capture the external load factors potentially associated with both job stress and shoulder pain. Including the hotel variable controlled for any additional biomechanical and psychosocial job factors for shoulder pain not measured in the variables noted above. Because of a moderate correlation between the physical workload index and the ergonomic index (Pearson's r=0.3535, p=0.000), the ergonomic index was not included in this initial model, but evaluated later for confounding.

A sample, comprised of 558 (59%) participants with complete data for the above nine *a priori* covariates, the three key independent variables (job strain, iso-strain and ERI) and the shoulder pain outcome, was then used to evaluate additional socio-demographic and biomechanical risk factors for confounding. Eight additional variables were individually evaluated to determine if they confounded the relationship between each of the key independent variables and shoulder pain, using the above *a priori* model. Individual variables were included as confounders in later model building if their addition to the *a priori* model shifted the beta coefficient of the independent variable by 5% or more. The eight covariates evaluated were: marital status (married/partnered versus all others), ethnicity (Latinas versus all others), place of birth (in/outside of the USA), years of education, current smoking, current alcohol, weight, and the ergonomic index. These factors were chosen because of their conceptual and empirical evidence in the literature linking them to job stress/social support, and/or shoulder pain (Krause, Scherzer, & Rugulies, 2005; Miranda, Viikari-Juntura, Martikainen, Takala, & Riihimaki, 2001; Ostergren et al., 2005; Rugulies, Scherzer, & Krause, 2008; Werner, Franzblau, Gell, Ulin, & Armstrong, 2005).

For job strain and iso-strain, all eight additional covariates were confounders. For ERI, only years of education, current smoking, current alcohol and the ergonomic index individually confounded the relationship between ERI and shoulder pain. Therefore, using list-wise deletion, a final analytic sample consisted of 493 room cleaners with complete data for 21 variables (shoulder pain outcome, three main independent variables, and covariates: 10 socio-demographic variables, six biomechanical factors, and hotel).

Reliability of psychosocial work factor scales. Reliability testing of job strain, iso-strain and ERI scales and subscales was conducted, using Cronbach's alpha. Cronbach's alpha is the appropriate tool to evaluate the inter-item consistency of scales. If the alpha is high, it is concluded that the items in the scale are measuring the same underlying construct. However, Cronbach's alpha may be low where the underlying construct is multi-dimensional and complex (UCLA Academic Technology Services, 2008).

Descriptive statistics. All data analysis was conducted using Stata, version 9.2. The overall sample was first described in terms of shoulder pain prevalence.

To answer Research Question 1, "are there differences between job strain, iso-strain or ERI in room cleaners with and without WRSP in this sample of hotel room cleaners from five unionized casino hotels in Las Vegas," the distribution of all variables was described by WRSP status. These variables included the socio-demographic (age, marital status, ethnicity, place of birth, years of education, and caregiving at home), behavioral (current smoking and alcohol use), and anthropometric (weight and height) factors. Shoulder pain in the sample was then described by the organizational factor (hotel) and by biomechanical factors (years of work, hours worked/week, number of beds made/day, the physical workload index, the work intensification index, and the ergonomic index). The distribution of shoulder pain by each of the psychosocial factors, the main independent variables of interest in this study (psychological demand, decision latitude, coworker support, supervisor support, total support, job strain ratio, job strain median split, iso-strain ratio, iso-strain median split, effort, reward, ERI ratio, and ERI >1.0) were described. For these descriptions, means, standard deviations and medians were generated for continuous variables (e.g., age) and proportions were generated for categorical variables (e.g., ERI >1.0). Appropriate statistical analyses for each variable as compared to WRSP status (Student's *t* test or chi square test) were done to distinguish statistical differences likely not due to chance at alpha=0.05. Correlations were conducted where appropriate, using Pearson's product moment coefficient (*r*) for parametric variables or Spearman's rank correlation coefficient (rho) for non-parametric variables.

To answer Research Question 2, "are there differences in job strain, iso-strain or ERI across selected socio-demographic, behavioral, anthropometric, biomechanical and hotel factors," the distributions of each of the main, independent variables (job strain, iso-strain, and ERI) by the socio-demographic (age, marital status, ethnicity, place of birth, years of education, and caregiving at home), behavioral (current smoking and alcohol use), anthropometric (weight and height), organizational (hotel) and by biomechanical factors (years of work, hours worked/week, number of beds made/day, the physical workload index, the work intensification index, and the ergonomic index) were explored. Descriptive statistics (means, standard deviations, medians) were generated for continuous variables and proportions were generated for categorical variables. Appropriate analyses for each variable as compared to WRSP status (t test or chi square test) were performed to distinguish statistical differences likely not due to chance at alpha=0.05.

Model building. To answer Research Question #3, "what are the relationships between job strain, iso-strain and ERI and WRSP, after adjusting for socio-demographic, behavioral, anthropometric, biomechanical, and hotel factors," logistic regression was used. Logistic regression is the appropriate statistical analysis for the dichotomous outcome (severe or very severe shoulder pain vs. moderate, mild, very mild or no pain). Logistic regression was used to estimate adjusted odds ratios (AOR) and 95% confidence intervals (CI) to determine the relationship of job strain, iso-strain and ERI with shoulder pain in a series of models for each of the psychosocial factors and associated subscales. The 95% CI provides an interval around the AOR point estimate of the parameter that is 95% likely to contain the true value.

The interpretation of the AOR for each psychosocial variable is, for the continuous variables (job strain ratio, iso-strain ratio, and ERI ratio): for every unit increase in the ratio score, the odds of shoulder pain were AOR times greater. For quartiles, for those in the highest quartile of job strain, iso-strain or ERI, the odds of shoulder pain were AOR times greater, when compared to those in the lowest quartile of job strain, iso-strain or ERI. For the categorical variables (job strain median split, iso-strain median split and ERI >1.0), for those with job strain, iso-strain or ERI, the odds of shoulder pain were AOR times greater when compared to those without job strain, iso-strain or ERI.

Models were built first using the subscales of the three psychosocial constructs. For job strain and iso-strain subscales, psychological demand, decision latitude, coworker support, supervisor support, and total support were each individually tested in all models. For ERI subscales, effort and reward were each individually tested in all models. For all three psychosocial work factors, models were then built for the ratio, quartile, and categorical measures of each psychosocial work factor.

Socio-demographic, behavioral, and anthropometric factors were evaluated, as described above, for potential confounding. In addition to age and caregiving at home, for job strain and iso-strain and subscales, the additional confounders were marital status, place of birth, ethnicity, years of education, current smoking, current alcohol, weight, and height. For ERI and subscales, in addition to age and caregiving at home, the additional confounders were years of education, current smoking, current alcohol, and height.

For model building, the first model (Model 1) presented the odds ratios for reporting severe/very severe shoulder pain by the psychosocial work factor, adjusting for age only. The second model (Model 2) presented the odds ratios for reporting severe/very severe shoulder pain by the psychosocial work factor, adjusting for age and selected socio-demographic, behavioral and anthropometric factors as outlined above. The third model (Model 3) presented the odds ratios for reporting severe/very severe shoulder pain by psychosocial work factor adjusting for Model 1 and Model 2 factors, in addition to six biomechanical factors including: years as a hotel room cleaner, number of hours worked/week, number of beds made/day, the physical workload index, the work intensification index and the ergonomic index. The final model (Model 4) added the hotel variable to Model 3.

Additionally, to observe the relationships between all factors and severe shoulder pain, all Model 4 factors and their AOR are presented for the job strain ratio, iso-strain ratio, and ERI ratio. In these models, two significant variables, physical workload index and the ergonomic index, are presented as quartiles so as to aid in the discussion of findings.

Institutional Review Board. The UCSF Committee on Human Subjects approved this study. This secondary data analysis was conducted within the realm of this approval.

CHAPTER IV

Results

Introduction

This chapter presents the results of a secondary analysis exploring psychosocial work factors and shoulder pain in a sample of hotel cleaners employed at five unionized casino hotels in Las Vegas. The reliability testing of the instruments is presented, followed by a description of the study sample. Then, using logistic regression and model building, the statistically significant relationships between the independent variables (i.e., psychosocial work factors) and the dependent variable (i.e., severe shoulder pain) are examined.

Reliability of Psychosocial Work Factor Scales

Table 4 lists the Cronbach's alpha for psychological demand, decision authority, skill discretion, the combined subscale for decision authority, coworker support, supervisor support, effort and reward, compared to published reliability results for these scales.

Table 4: Reliability of Psychosocial Work Factor Scales

Scale	Cronbach's alpha in current study	Average Cronbach's alpha for women
Psychological demand (5 items)	.5140	.61[1]
Decision authority (3 items)	.0081	.66[1]
Skill discretion (6 items)	.4934	.72[1]
Decision latitude (9 items)	.5109	N/A
Decision latitude (8 items)*	.6487	N/A
Coworker support (4 items)	.7453	.80[1]
Supervisor support (3 items)	.8280	.86[1]
Effort (6 items)	.8144	>.70[2]
Reward (11 items)	.8897	>.70[2]

* Excluding item: On my job, I have very little freedom to decide how I do my work.[b.]

[1] JCQ Center, 2008

[2] Siegrist, 2006

Description of the Sample

Shoulder pain prevalence. The sample was comprised of 493 room cleaners. In the prior 4 weeks, 8% reported no shoulder pain, 5% reported very mild, 10% mild, 22% moderate, 27% severe, and 29% reported very severe shoulder pain. Of those with severe/very severe shoulder pain, 178 (67%) also reported severe/very severe neck pain (Spearman's rank correlation= 0.58, p=0.000).

Characteristics of the Sample by Shoulder Pain

Socio-demographic factors and shoulder pain. Table 5 shows the distribution of socio-demographic, behavioral and anthropometric factors for the total analytic sample and by shoulder pain level, dichotomized into none, very mild, mild or moderate vs. severe or very severe pain (called severe shoulder pain for this discussion). The last column in Table 5 shows *p* values for chi-square and *t*-tests comparing proportion and means of covariates by pain level. Nearly all (98%) were female (data not shown), with an average age of 41.18 years (SD 9.67). Sixty-nine percent were married or partnered. Latinas comprised 78% of the sample. Being born outside of the USA was reported by 85% of room cleaners. The mean number of years of education was 9.22 (SD 3.59). Caregiving responsibilities at home ranged from 0-9 children or elders needing care, with the mean number being 0.99 (SD 1.29), and the median 1.

Married/partnered room cleaners had a significantly higher prevalence of severe shoulder pain (p=0.008). Being of Latina ethnicity (p=0.001) and being born outside of the USA (p=0.015) were factors with a higher prevalence of severe shoulder pain, as was fewer years of education (p=0.003). Shoulder pain severity did not differ by caregiving demands at home (p=0.821).

Behavioral factors and shoulder pain. Thirteen percent of the sample currently smoked. Alcohol use ranged from 0-100 drinks per month, with 2.24 drinks on average consumed per month (SD 9.1, median 0). Shoulder pain severity did not vary by smoking and alcohol use.

Anthropometric factors and shoulder pain. Weight ranged from 41 to 132 kg (90-291 lbs), with a mean weight of 69.04 kilograms (SD 14.07) (mean = 152 lbs [SD = 31 lbs]). Height ranged from 135 to 198 cm (53 inches to 77 inches), with a mean height of 156.66 cm (SD 8.00) (mean=62 inches [SD 3.15 inches]). Shoulder pain severity did not differ by weight. However, shorter height was significantly correlated with severe shoulder pain (Spearman's rho = -0.11, p=0.012).

Table 5: Socio-Demographic, Behavioral and Anthropometric Factors by Shoulder Pain for Hotel Room Cleaners

Factors	Total Sample N=493	None, Very Mild, Mild or Moderate Pain n=219 (44%)	Severe or Very Severe Pain n=274 (56%)	*p* value
Age				0.938
Mean (SD)	41.18 (9.67)	41.22 (10.43)	41.15 (9.04)	
Median	41	40	41	
Range	20-66	20-66	20-66	
Marital status (%)				**0.036**
Married	319 (65)	127 (40)	192 (60)	
Partnered	22 (4)	11 (50)	11 (50)	
Single	56 (11)	29 (52)	27 (48)	
Separated	30 (6)	21 (70)	9 (30)	
Divorced	47 (10)	23 (49)	24 (51)	
Widowed	14 (3)	5 (36)	9 (64)	
Not stated	5 (1)	3 (60)	2 (40)	
Married/partnered	341(69)	138(40)	203(60)	**0.008**
All other marital status	152(31)	81(53)	71(47)	
Ethnicity (%)				**0.018**
African Am.	20 (4)	14 (70)	6 (30)	
Native Am.	4 (1)	2 (50)	2 (50)	
Latino	386 (78)	157 (41)	229 (59)	
Filipino	24 (5)	13 (54)	11 (46)	
Asian/PI	17 (3)	13 (76)	4 (24)	
White	24 (5)	13 (54)	11 (46)	
Other	14 (3)	5 (36)	9 (64)	
Not stated	4(1)	2 (50)	2 (50)	
Latina	386 (78)	157 (41)	229 (59)	**0.001**
All other ethnicities	107 (22)	62(58)	45(42)	
USA Born (%)				**0.015**
Yes	75 (15)	43 (57)	32 (43)	
No	418 (85)	176 (42)	242 (58)	
Education (yrs)				**0.003**
Mean	9.22 (3.59)	9.76 (3.45)	8.79 (3.65)	
Median	9	10	9	
Range	0-18	0-18	0-18	
Caregiving at home[a.]				0.821
Mean (SD)	0.99 (1.29)	0.98 (1.36)	1.00 (1.23)	
Median	1	0	1	
Range	0-9	0-9	0-6	

Factors	Total Sample N=493	None, Very Mild, Mild or Moderate Pain n=219 (44%)	Severe or Very Severe Pain n=274 (56%)	*p* value
Current Smoking (%)				0.377
No	427 (87)	193 (45)	234 (55)	
Yes	66 (13)	26 (39)	40 (61)	
Current Alcohol (drinks/month)				0.460
Mean (SD)	2.24 (9.19)	2.58 (8.87)	1.96 (9.45)	
Median	0	0	0	
Range	0-100	0-80	0-100	
Weight (kg)				0.827
Mean (SD)	69.04(14.07)	68.89 (14.96)	69.16 (13.34)	
Median	67.00	67	67	
Range	41-132	43-132	41-110	
Height (cm)				**0.012**
Mean (SD)	156.66(8.00)	157.68 (8.54)	155.84 (7.46)	
Median	156	157	155.5	
Range	135-198	137-198	135-191	

a. Caregiving at home is the number of persons currently living in the home needing childcare, eldercare, and/or disability care.

Hotel and shoulder pain. Table 6 lists the distribution of the sample by hotel, and compares this variable by shoulder pain level. There were no significant differences in severe shoulder pain prevalence amongst the hotels (p=0.279). However, there were differences in job strain (chi square = 11.74, p=0.019), iso-strain (chi square 23.70, p=0.000), and ERI (chi square = 9.30, p=0.054) between hotels (data not shown).

Table 6: Hotel by Shoulder Pain for Hotel Room Cleaners

Factors	**Total Sample** n=493	**None, Very Mild, Mild or Moderate Pain** n=219 (44%)	**Severe or Very Severe Pain** n=274 (56%)	***p* value**
Hotel (%)				0.279
A	140 (28)	66 (47)	74 (53)	
B	108 (22)	40 (37)	68 (63)	
C	112 (23)	57 (51)	55 (49)	
D	86 (17)	37 (43)	49 (57)	
E	47 (10)	19 (40)	28 (60)	

Biomechanical work factors and shoulder pain. Table 7 lists the biomechanical work factors for the sample, and compares all variables by shoulder pain level. Overall, the mean number of years working as a room cleaner was 7.74 (SD 5.41), the average number of hours worked per week was 40.26 (SD 11.00), and the number of beds made per day averaged 19.35 (SD 6.72). The physical workload index ranged from 2.6 to 399.36, with a mean of 141.40 (SD 68.16). The work intensification index, reflecting an increased physical workload as compared to 5 years ago, ranged from 26-78, with a mean 57.17 (SD 9.02), and the ergonomic index ranged from 11-44, with a mean of 28.65 (SD 7.58).

Years of work, number of hours worked per week, and the number of beds made per day did not significantly vary by shoulder pain severity. However, higher physical workload (Spearman's rho=0.26, p=0.000), greater work intensification as compared to 5 years ago (Spearman's rho=0.25, p=0.000), and a greater number of ergonomic problems (Spearman's rho=0.25, p=0.000) were each individually correlated with severe shoulder pain.

Table 7: Biomechanical Work Factors by Shoulder Pain for Hotel Room Cleaners

Factors	**Total Sample** n=493	**None, Very Mild, Mild or Moderate Pain** n=219 (44%)	**Severe or Very Severe Pain** n=274 (56%)	***p* value**
Years of Work[a.]				0.251
Mean (SD)	7.74 (5.41)	7.42 (5.65)	7.99 (5.21)	
Median	7	6	7	
Range	0.5-32	0.67-32	0.50-30	
Hours Worked/Week				0.300
Mean (SD)	40.26 (11.00)	40.82 (9.90)	39.81 (11.81)	
Median	40	40	40	
Range	5-80	8-80	5-80	
Beds Made/Day				0.102
Mean (SD)	19.35 (6.72)	18.79 (6.66)	19.79 (6.75)	
Median	19	18	19	
Range	3-40	4-36	3-40	
Physical workload index [b.]				**0.000**
Mean (SD)	141.40 (68.16)	123.33 (61.11)	155.83 (70.14)	
Median	135.93	114.72	153.30	
Range	2.6-399.36	14.46-352.2	2.6-399.36	
Physical workload intensification compared to 5 years ago [c.]				**0.000**
Mean (SD)	57.17 (9.02)	54.65 (8.50)	59.18 (8.94)	
Median	56.16	54	59.14	
Range	26-78	26-78	38-78	
Ergonomic Index[d.]				**0.000**
Mean (SD)	28.65 (7.58)	26.50 (7.37)	30.36 (7.31)	
Median	28	25	30	
Range	11-44	11-44	13-44	

[a.] Years worked as a hotel room cleaner.
[b.] A higher score on the Physical workload index indicates more physical work demands.
[c.] A higher score on Physical workload intensification indicates greater intensification of physical workload as compared to 5 years ago.
[d.] A higher score on the Ergonomic Index indicates greater ergonomic problems.

Psychosocial work factors and shoulder pain. Table 8 lists the psychosocial work factors, the primary independent variables in this analysis, and compares each by shoulder pain level. Job strain, iso-strain and effort-reward imbalance (ERI) and the respective subscales are presented.

For the subscales of job strain and iso-strain, psychological demand and decision latitude scores did not vary by shoulder pain severity. However, those with severe shoulder pain had significantly lower mean social support scores, specifically supervisor support (p=0.006). Per median sample splits, overall, 35% (n=173) experienced job strain and 23% (n=113) experienced iso-strain. Job strain scores, analyzed as both a ratio and as a sample median split, did not vary by shoulder pain severity. Likewise, there were no significant differences in iso-strain scores, analyzed as both a ratio and as a sample median split, by shoulder pain severity.

For the subscales of ERI, those with severe shoulder pain had higher effort scores (generated using the 6-item scale), with a mean score of 22.09 (SD 5.37, range 6-30) as compared to a mean score of 18.31 (SD 5.60, p=0.000) for those with none to moderate shoulder pain. When re-tested with a 5-item effort score (i.e., removing the one physical effort item included in this subscale), this significant difference was maintained: those with severe shoulder pain had higher effort scores (mean 17.74 [SD 4.52], range 5-25), as compared to those with none to moderate shoulder pain (mean 14.66 [SD 4.62], p=0.000, data not shown). For reward, those with severe shoulder pain had lower reward scores (p=0.000). Overall, 54% (n=268) of the sample experienced ERI. Those with higher ERI scores had a significantly higher prevalence of severe shoulder pain (p=0.000).

Moderate correlations were demonstrated between job strain and ERI (Spearman's rho= 0.20, p=0.000), and between iso-strain and ERI (Spearman's rho=0.27, p=0.000). Twenty-four percent (n=118) of the sample experienced both job strain and ERI; 18% (n=89) experienced both iso-strain and ERI (data not shown).

Table 8: Psychosocial Work Factors by Shoulder Pain for Hotel Room Cleaners

Factors	**Total Sample** **n=493**	**None, Very Mild, Mild or Moderate Pain** **n=219 (44%)**	**Severe or Very Severe Pain** **n=274 (56%)**	***p* value**
Psychological Demand				0.243
Mean (SD)	37.08 (7.00)	36.67 (6.95)	37.41 (7.03)	
Median	36	36	38	
Range	18-48	18-48	20-48	
Decision Latitude				0.103
Mean (SD)	56.13 (9.92)	56.95 (9.79)	55.48 (9.99)	
Median	56	58	54	
Range	26-88	26-88	32-86	
Coworker Support				0.705
Mean (SD)	10.86 (2.47)	10.90 (2.20)	10.82 (2.67)	
Median	11	11	11	
Range	4-16	4-16	4-16	
Supervisor Support				**0.006**
Mean (SD)	9.34 (3.40)	9.81 (3.15)	8.96 (3.55)	
Median	9.33	10.67	8	
Range	4-16	4-16	4-16	
Total Support				**0.033**
Mean (SD)	20.20 (4.92)	20.72 (4.42)	19.78 (5.26)	
Median	20	21	20	
Range	8-32	8-32	8-32	
Job strain ratio [a.]				0.133
Mean (SD)	0.69 (0.22)	0.67 (0.22)	0.70 (.22)	
Median	0.64	0.63	0.66	
Range	0.26-1.69	0.26-1.69	0.30-1.5	
Job strain-median split [b.] (%)				0.055
No	320 (65)	148 (46)	172 (54)	
Yes	173 (35)	71 (41)	102 (59)	

Factors	Total Sample n=493	None, Very Mild, Mild or Moderate Pain n=219 (44%)	Severe or Very Severe Pain n=274 (56%)	*p* value
Iso-strain ratio[c]				0.055
Mean (SD)	0.50 (0.15)	0.49 (0.15)	0.52 (0.16)	
Median	0.48	0.46	0.49	
Range	0.2-1.2	0.2-1.04	0.23-1.2	
Iso-strain-median split [d.] (%)				0.121
No	380 (77)	176 (46)	204 (54)	
Yes	113 (23)	43 (38)	750 (62)	
Effort				**0.000**
Mean	20.41 (5.78)	18.31 (5.60)	22.09 (5.37)	
Median	21	18	23	
Range	6-30	6-30	6-30	
Reward				**0.000**
Mean	35.61 (12.14)	39.73 (10.87)	32.32 (12.11)	
Median	37	41	33	
Range	11-55	11-55	11-55	
Effort/reward imbalance (ERI) ratio[e.]				**0.000**
Mean (SD)	1.33 (0.95)	1.03 (0.77)	1.58 (1.01)	
Median	1.05	0.82	1.29	
Range	0.2-5.00	0.20-5.00	0.20-5.00	
ERI >=1.00 (%)				**0.000**
No	225 (46)	141 (63)	84 (37)	
Yes	268 (54)	78 (29)	190 (71)	

[a] Job strain ratio: psychological demand divided by decision latitude.
[b] Job strain categories determined by sample median splits: psychological demand score>=36 in combination with a decision latitude score <=56.
[c] Iso-strain ratio: psychological demand divided by (decision latitude + total support).
[d] Iso-strain categories determined by sample median splits: psychological demand score>=36, a decision latitude score <=56, in combination with total support score <=20.
[e.] Effort-reward imbalance ratio: extrinsic effort divided by (reward x multiplier)

Characteristics of the Sample by Job Strain, Iso-strain and ERI

Socio-demographic, behavioral, anthropometric, biomechanical, and organizational factors and job strain. Table 9 lists the socio-demographic, behavioral, anthropometric, biomechanical, and organizational factors for the sample, and compares all variables by job strain. As seen previously (Table 8), the prevalence of severe shoulder pain was not significantly higher for those with job strain. However, it may be useful to explore the sample with respect to job strain. Those with job strain were significantly younger (p=0.000), born in the USA (p=0.002), current smokers (p=0.014), and of lighter weight (p=0.046). To further explore the relationship of ethnicity and job strain, Latinas were compared to those of all other ethnicities, but this did not yield significant results (data not shown, p=0.575).

Job strain also varied significantly by employer. Room cleaners from hotels A and D reported more (41-43%) job strain, compared to 26-35% of those from other hotels. Years worked as a room cleaner, number of hours worked per week, and the number of beds made per day did not significantly differ for those with job strain. Those with job strain had significantly higher mean physical workload scores, higher work intensification scores, and higher ergonomic scores (p=0.000), when compared to those without job strain.

Table 9: Job Strain and Shoulder Pain, Socio-Demographic, Behavioral, Anthropometric, Biomechanical and Organizational Factors for Hotel Room Cleaners

Factors	**Total** n=493	**No Job Strain** n=320 (65%)	**Job Strain** n=173 (35%)	***p* value**
Shoulder Pain				
Shoulder Pain (%)				0.267
None to Moderate	219 (44)	148 (68)	71 (32)	
Severe	274 (56)	172 (63)	102 (37)	
Socio-demographic, Behavioral, and Anthropometric Factors				
Age				**0.000**
Mean (SD)	41.18 (9.67)	42.31 (9.39)	39.09 (9.86)	
Median	41	42	37	
Range	20-66	22-66	20-63	
Marital status (%)				0.873
Married	319 (65)	201 (63)	118 (37)	
Partnered	22 (4)	16 (73)	6 (27)	
Single	56 (11)	39 (70)	17 (30)	
Separated	30 (6)	19 (63)	11 (37)	
Divorced	47 (10)	31 (66)	16 (34)	
Widowed	14 (3)	10 (71)	4 (29)	
Not stated	5 (1)	4 (80)	1 (20)	
Ethnicity (%)				**0.001**
African Am.	20 (4)	14 (70)	6 (30)	
Native Am.	4 (1)	3 (75)	1 (25)	
Latino	386 (78)	253 (66)	133 (34)	
Filipino	24 (5)	23 (96)	1 (4)	
Asian/PI	17 (3)	10 (59)	7 (41)	
White	24 (5)	7 (29)	17 (71)	
Other	14 (3)	8 (57)	6 (43)	
Not stated	4(1)	2 (50)	2 (50)	
USA Born (%)				**0.002**
Yes	75 (15)	37 (49)	38 (51)	
No	418 (85)	283 (68)	135 (32)	
Education (yrs)				0.215
Mean	9.22 (3.59)	9.08 (3.65)	9.49 (3.47)	
Median	9	9	10	
Range	0-18	0-18	0-18	
Caregiving at home[a.]				0.854
Mean (SD)	0.99 (1.29)	0.98 (1.36)	1.01(1.16)	
Median	1	0	1	
Range	0-9	0-9	0-5	

Factors	**Total** n=493	**No Job Strain** n=320 (65%)	**Job Strain** n=173 (35%)	***p* value**
Current Smoking(%)				**0.014**
No	427 (87)	286 (67)	141 (33)	
Yes	66 (13)	34 (52)	32 (48)	
Current Alcohol (drinks/month)				0.139
Mean (SD)	2.24 (9.19)	1.71 (6.80)	3.22 (12.42)	
Median	0	0	0	
Range	0-100	0-80	0-100	
Weight (kg)				**0.046**
Mean (SD)	69.04 (14.07)	69.93 (14.69)	67.39 (12.74)	
Median	67.00	68	66	
Range	41-132	41-132	43-115	
Height (cm)				0.193
Mean (SD)	156.66 (8.00)	156.32 (8.00)	157.30 (8.01)	
Median	156	156	156	
Range	135-198	137-198	135-193	
Biomechanical and Organizational Factors				
Hotel (%)				**0.019**
A	140 (28)	82 (59)	58 (41)	
B	108 (22)	70 (65)	38 (35)	
C	112 (23)	84 (75)	28 (25)	
D	86 (17)	49 (57)	37 (43)	
E	47 (10)	35 (74)	12 (26)	
Years of Work[b.]				0.234
Mean (SD)	7.74 (5.41)	7.95 (5.60)	7.34 (5.03)	
Median	7	7	6.6	
Range	0.5-32	0.5-32	0.583-30	
Hours Worked/Week				0.078
Mean (SD)	40.26 (11.00)	39.62 (11.00)	41.45 (10.94)	
Median	40	40	40	
Range	5-80	8-80	5-80	
Beds Made/Day				0.701
Mean (SD)	19.35 (6.72)	19.43 (6.95)	19.19 (6.30)	
Median	19	18	19	
Range	3-40	3-40	4-33	

Factors	Total n=493	No Job Strain n=320 (65%)	Job Strain n=173 (35%)	*p* value
Physical workload index [c]				**0.011**
Mean (SD)	141.40(68.16)	135.64(68.10)	152.05(67.17)	
Median	135.93	133.93	146.9	
Range	2.6-399.36	2.6-376.5	4.75-399.36	
Physical workload intensification compared to 5 years ago [d.]				**0.002**
Mean (SD)	57.17 (9.02)	56.23 (9.17)	58.90 (8.51)	
Median	56.16	55.2	59	
Range	26-78	26-78	40-78	
Ergonomic Index[e.]				**0.002**
Mean (SD)	28.65 (7.58)	27.90 (7.86)	30.02 (6.84)	
Median	28	27	30	
Range	11-44	11-44	15-44	

[a.] Caregiving at home is the number of persons currently living in the home needing childcare, eldercare, and/or disability care.
[b.] Years of work were defined as years worked as a hotel room cleaner.
[c.] A higher score on the physical workload index indicates more physical work demands.
[d.] A higher score on physical workload intensification indicates greater intensification of physical workload as compared to 5 years ago.
[e.] A higher score on the ergonomic index indicates greater ergonomic problems.

Socio-demographic, behavioral, anthropometric, biomechanical, and organizational factors and iso-strain. Table 10 lists the socio-demographic, behavioral, anthropometric, biomechanical, and organizational factors for the sample, and compares all variables by the second main psychosocial variable, iso-strain. As seen in Table 10, the prevalence of severe shoulder pain was not significantly higher for those with iso-strain. As with job strain, those with iso-strain were significantly younger (p=0.000) and born in the USA (p=0.003). To further explore the relationship of ethnicity and iso-strain, Latinas were compared to all other ethnicities; as with job strain, the prevalence of iso-strain did not vary by ethnicity (data not shown, p=0.891).

Iso-strain prevalence varied significantly between hotels. Again, room cleaners from hotels A and D had the highest prevalence of iso-strain (32-33%) compared to 10-19% for room cleaners from the other hotels. The number of years worked as a room cleaner, hours worked per week, and beds made per day did not vary for those with iso-strain. However, as seen with job strain, those with iso-strain had significantly higher mean physical workload (p=0.005), work intensification (p=0.000), and ergonomic index scores (0.000).

Table 10: Iso-strain and Shoulder Pain, Socio-Demographic, Behavioral, Anthropometric, Biomechanical and Organizational Factors for Hotel Room Cleaners

Factors	Total n=493	No Iso-strain n=380 (77%)	Iso-strain n=113 (23%)	*p* value
Shoulder Pain				
Shoulder Pain (%)				0.121
None to Moderate	219 (44)	176 (80)	43 (20)	
Severe	274 (56)	204 (74)	70 (26)	
Socio-demographic, Behavioral, and Anthropometric Factors				
Age				**0.000**
Mean (SD)	41.18 (9.67)	42.22 (9.55)	37.67 (9.29)	
Median	41	42	36	
Range	20-66	22-66	20-61	
Marital status (%)				0.338
Married	319 (65)	237 (74)	82 (26)	
Partnered	22 (4)	19 (86)	3 (14)	
Single	56 (11)	46 (82)	10 (18)	
Separated	30 (6)	23 (77)	7 (23)	
Divorced	47 (10)	37 (79)	10 (21)	
Widowed	14 (3)	13(93)	1 (7)	
Not stated	5 (1)	5 (100)	0 (0)	
Ethnicity (%)				**0.044**
African Am.	20 (4)	16 (80)	4 (20)	
Native Am.	4 (1)	3 (75)	1 (25)	
Latino	386 (78)	297 (77)	89 (23)	
Filipino	24 (5)	24 (100)	0 (0)	
Asian/PI	17 (3)	13 (76)	4 (24)	
White	24 (5)	13 (54)	11 (46)	
Other	14 (3)	11 (79)	3 (21)	
Not stated	4(1)	3 (75)	1 (25)	
USA Born (%)				**0.003**
Yes	75 (15)	48 (64)	27 (36)	
No	418 (85)	332 (79)	86 (21)	
Education (yrs)				0.237
Mean	9.22 (3.59)	9.12 (3.61)	9.58 (3.51)	
Median	9	9	10	
Range	0-18	0-18	0-18	
Caregiving at home[a.]				0.656
Mean (SD)	0.99 (1.29)	0.98 (1.34)	1.04 (1.13)	
Median	1	0	1	
Range	0-9	0-9	0-5	

Factors	Total n=493	No Iso-strain n=380 (77%)	Iso-strain n=113 (23%)	*p* value
Current Smoking(%)				0.366
No	427 (87)	332 (78)	95 (22)	
Yes	66 (13)	48 (73)	18 (27)	
Current Alcohol (drinks/month)				0.742
Mean (SD)	2.24 (9.19)	2.14 (7.89)	2.56 (12.67)	
Median	0	0	0	
Range	0-100	0-80	0-100	
Weight (kg)				0.775
Mean (SD)	69.04 (14.07)	69.14 (14.25)	68.71 (13.50)	
Median	67.00	67	67	
Range	41-132	41-132	45-115	
Height (cm)				0.600
Mean (SD)	156.66 (8.00)	156.56 (8.17)	157.01 (7.46)	
Median	156	156	156	
Range	135-198	137-198	135-178	
Biomechanical and Organizational Factors				
Hotel (%)				**0.000**
A	140 (28)	95 (68)	45 (32)	
B	108 (22)	88 (81)	20 (19)	
C	112 (23)	101 (90)	11 (10)	
D	86 (17)	58 (67)	28 (33)	
E	47 (10)	38 (81)	9 (19)	
Years of Work[b.]				0.632
Mean (SD)	7.74 (5.41)	7.80 (5.45)	7.52 (5.28)	
Median	7	7	7	
Range	0.5-32	0.5-32	0.583-30	
Hours Worked/Week				0.677
Mean (SD)	40.26 (11.00)	40.14 (11.34)	40.64 (9.84)	
Median	40	40	40	
Range	5-80	8-80	5-80	
Beds Made/Day				0.733
Mean (SD)	19.35 (6.72)	19.41 (6.82)	19.16 (6.39)	
Median	19	18	19	
Range	3-40	3-40	5-32	
Physical workload index [c]				**0.005**
Mean (SD)	141.40 (68.16)	136.66 (67.77)	157.31 (67.35)	
Median	135.93	133.6	153.2	
Range	2.6-399.36	2.6-376.5	4.75-399.36	

Factors	Total n=493	No Iso-strain n=380 (77%)	Iso-strain n=113 (23%)	*p* value
Physical workload intensification compared to 5 years ago [d.]				**0.000**
Mean (SD)	57.17 (9.02)	56.04 (8.99)	60.96 (8.09)	
Median	56.16	55.12	61.75	
Range	26-78	26-78	41-77	
Ergonomic Index[e.]				**0.000**
Mean (SD)	28.65 (7.58)	27.81 (7.66)	31.46 (6.58)	
Median	28	27	31	
Range	11-44	11-44	15-44	

[a.] Caregiving at home is the number of persons currently living in the home needing childcare, eldercare, and/or disability care.
[b.] Years of work were defined as years worked as a hotel room cleaner.
[c.] A higher score on the physical workload index indicates more physical work demands.
[d.] A higher score on physical workload intensification indicates greater intensification of physical workload as compared to 5 years ago.
[e.] A higher score on the ergonomic index indicates greater ergonomic problems.

Socio-demographic, behavioral, anthropometric, biomechanical, and organizational factors and Effort-Reward Imbalance. Table 11 lists the socio-demographic, behavioral, anthropometric, biomechanical, and organizational factors for the sample, and compares all variables by ERI, the third psychosocial variable of interest in this dissertation. In every formulation of ERI as seen in Table 8, those with severe shoulder pain had a significantly higher prevalence of ERI. Sixty-nine percent of those with severe shoulder pain (n=190) reported ERI (p=0.000). More than 50% of those married, separated or divorced reported ERI. Lower weight was significantly associated with ERI (p=0.044).

Although ERI did not vary significantly between hotels, 67% (n=58) of room cleaners from Hotel D reported ERI, as compared to a low of 48% in Hotel B (p=0.054). The number of years worked as a room cleaner, hours worked per week, and beds made per day did not vary for those with ERI. Those with ERI had higher mean physical workload (p=0.000), work intensification (p=0.000), and ergonomic index scores (p=0.000), as compared to those without ERI.

Table 11: Effort-Reward Imbalance (ERI) and Shoulder Pain, Socio-Demographic, Behavioral, Anthropometric, Biomechanical, and Organizational Factors for Hotel Room Cleaners

Factors	**Total** **n=493**	**No ERI** **n=225 (46%)**	**ERI** **n=268 (54%)**	***p* value**
Shoulder Pain				
Shoulder Pain (%)				**0.000**
None to Moderate	219 (44)	141 (64)	78 (36)	
Severe	274 (56)	84 (31)	190 (69)	
Socio-demographic, Behavioral, and Anthropometric Factors				
Age				0.141
Mean (SD)	41.18 (9.67)	41.88 (9.64)	40.59 (9.68)	
Median	41	43	40	
Range	20-66	20-66	20-66	
Marital status (%)				**0.026**
Married	319 (65)	130 (41)	189 (59)	
Partnered	22 (4)	15 (68)	7 (32)	
Single	56 (11)	31 (55)	25 (45)	
Separated	30 (6)	15 (50)	15 (50)	
Divorced	47 (10)	21 (45)	26 (55)	
Widowed	14 (3)	9 (64)	5 (36)	
Not stated	5 (1)	4 (80)	1 (20)	
Ethnicity (%)				0.533
African Am.	20 (4)	12 (60)	8 (40)	
Native Am.	4 (1)	1 (25)	3 (75)	
Latino	386 (78)	168 (44)	218 (56)	
Filipino	24 (5)	14 (58)	10 (42)	
Asian/PI	17 (3)	10 (59)	7 (41)	
White	24 (5)	12 (50)	12 (50)	
Other	14 (3)	6 (43)	8 (57)	
Not stated	4(1)	2 (50)	2 (50)	
USA Born (%)				0.485
Yes	75 (15)	37 (49)	38 (51)	
No	418 (85)	188 (45)	230 (55)	
Education (yrs)				0.442
Mean	9.22 (3.59)	9.36 (3.75)	9.11 (3.45)	
Median	9	10	9	
Range	0-18	0-18	0-18	
Caregiving at home[a.]				0.288
Mean (SD)	0.99 (1.29)	0.92 (1.28)	1.05 (1.30)	
Median	1	0	1	
Range	0-9	0-8	0-9	

Factors	**Total** n=493	**No ERI** n=225 (46%)	**ERI** n=268 (54%)	***p* value**
Current Smoking(%)				0.618
No	427 (87)	193 (45)	234 (55)	
Yes	66 (13)	32 (48)	34 (52)	
Current Alcohol (drinks/month)				0.553
Mean (SD)	2.24 (9.19)	2.51 (10.33)	2.01(8.13)	
Median	0	0	0	
Range	0-100	0-87	0-100	
Weight (kg)				**0.044**
Mean (SD)	69.04 (14.07)	70.46 (15.40)	67.85 (12.76)	
Median	67.00	68	66	
Range	41-132	41-132	43-118	
Height (cm)				0.711
Mean (SD)	156.66 (8.00)	156.81 (8.57)	156.54 (7.52)	
Median	156	157	156	
Range	135-198	137-198	135-191	
Biomechanical and Organizational Factors				
Hotel (%)				0.054
A	140 (28)	61 (44)	79 (56)	
B	108 (22)	56 (52)	52 (48)	
C	112 (23)	57 (51)	55 (49)	
D	86 (17)	28 (33)	58 (67)	
E	47 (10)	23 (49)	24 (51)	
Years of Work[b.]				0.632
Mean (SD)	7.74 (5.41)	7.61 (5.36)	7.84 (5.46)	
Median	7	6.5	7	
Range	0.5-32	0.75-32	0.5-30	
Hours Worked/Week				0.712
Mean (SD)	40.26 (11.00)	40.46 (10.72)	40.09 (11.25)	
Median	40	40	40	
Range	5-80	8-80	5-80	
Beds Made/Day				0.195
Mean (SD)	19.35 (6.72)	18.92 (7.08)	19.71 (6.40)	
Median	19	18	19	
Range	3-40	3-35	4-40	

Factors	Total n=493	No ERI n=225 (46%)	ERI n=268 (54%)	*p* value
Physical workload index [c]				**0.000**
Mean (SD)	141.40(68.16)	122.53(66.13)	157.23(65.88)	
Median	135.93	112.7	152.9	
Range	2.6-399.36	2.6-337.1	9.94-399.36	
Physical workload intensification compared to 5 years ago [d.]				**0.000**
Mean (SD)	57.17 (9.02)	53.96 (8.86)	59.86 (8.26)	
Median	56.16	53	60	
Range	26-78	26-78	37-78	
Ergonomic Index [e.]				**0.000**
Mean (SD)	28.65 (7.58)	25.61 (7.40)	31.20 (6.76)	
Median	28	25	31	
Range	11-44	11-44	13-44	

[a.] Caregiving at home is the number of persons currently living in the home needing childcare, eldercare, and/or disability care.
[b.] Years of work were defined as years worked as a hotel room cleaner.
[c.] A higher score on the physical workload index indicates more physical work demands.
[d.] A higher score on physical workload intensification indicates greater intensification of physical workload as compared to 5 years ago.
[e.] A higher score on the ergonomic index indicates greater ergonomic problems.

Logistic regression modeling of the relationship of psychosocial work factors and shoulder pain. In order to examine the relationships between each of the psychosocial work factors and severe shoulder pain, separate multiple regression models were built to account for different sets of confounding variables. Tables 12, 13, 14, and 15 present four models for each of the three psychosocial work factors and their respective subscales. The relationships of the psychosocial work factors on shoulder pain were analyzed by logistic regression. Model 1 adjusted for age. For Model 2, for job strain and iso-strain, and their respective subscales, the socio-demographic, behavioral, and anthropometric factors included ethnicity (Latinos versus all others), born in/outside of the USA, marital status (married/partnered versus all others), years of education, caregiving at home, current smoking, current alcohol, weight, and height. For ERI, and its respective subscales, the socio-demographic, behavioral, and anthropometric factors added at Model 2 included years of education, caregiving at home, current smoking, current alcohol, and height. The factors added at Models 3 and 4 were the same for job strain, iso-strain and ERI and were based on a priori assumptions described in the Methods section.

Psychological demand, decision latitude, and social support. Higher psychological demands were not associated with severe shoulder pain in this sample in any of the four models (Table 12). In Model 4, those with higher psychological demands had a higher odds of having severe shoulder pain, but this relationship was not significant (AOR 1.02, 95% CI 0.99-1.05, p=0.269). For decision latitude, higher scores were initially shown as protective in Models 1 and 2; however, this relationship was not maintained in Models 3 and 4. Likewise, for coworker support, higher scores were initially shown as protective, but this relationship was not maintained in Models 3 and 4. For supervisor support, greater perceived support from supervisors was significantly associated with lower prevalence of severe shoulder pain in Models 1 and 2. This relationship was, however, not maintained after adjusting for biomechanical work factors (Model 3) and hotel (Model 4). In summary, psychological demand, decision latitude and coworker support were not associated with severe shoulder pain, after adjusting for socio-demographic, behavioral, anthropometric, biomechanical and hotel factors. Although higher mean supervisor support and higher total social support scores were significantly associated with a lower prevalence of severe shoulder pain, this relationship was not maintained in Models 3 and 4, due to the confounding effects of biomechanical and hotel factors.

Table 12: Relationship of Psychological Demand, Decision Latitude, Supervisor Support, Coworker Support, and Total Support to Shoulder Pain (Severe or Very Severe Compared to None, Very Mild, Mild or Moderate) among 493 Hotel Room Cleaners by Logistic Regression Analysis[a]

Psychosocial Job Factor	**OR**	**95% CI**	***p value***
Psychological demand			
Model 1	1.01	0.99-1.04	0.243
Model 2	1.03	0.99-1.05	0.061
Model 3	1.02	0.99-1.05	0.226
Model 4	1.02	0.99-1.05	0.269
Decision Latitude (higher scores protective)			
Model 1	0.98	0.97-1.00	0.103
Model 2	0.98	0.97-1.00	0.121
Model 3	1.00	0.98-1.02	0.956
Model 4	1.00	0.98-1.02	0.875
Coworker support (higher scores protective)			
Model 1	0.99	0.92-1.06	0.717
Model 2	0.98	0.90-1.05	0.533
Model 3	1.05	0.96-1.14	0.278
Model 4	1.06	0.97-1.16	0.171
Supervisor support (higher scores protective)			
Model 1	0.93	0.88-0.98	**0.006**
Model 2	0.93	0.88-0.99	**0.014**
Model 3	1.00	0.94-1.06	0.986
Model 4	1.01	0.95-1.08	0.748
Total support (higher scores protective)			
Model 1	0.96	0.92-1.00	**0.034**
Model 2	0.96	0.92-1.00	**0.042**
Model 3	1.01	0.97-1.06	0.582
Model 4	1.02	0.98-1.07	0.341

[a] Logistic regression analysis on shoulder pain included the following variables:
Model 1: psychosocial factor and age
Model 2: Model 1 plus socio-demographic, behavioral and anthropometric factors: ethnicity (Latinos versus all others), born in/outside of the USA, marital status (married/partnered versus all others), years of education, caregiving at home, current smoking, current alcohol, weight, and height
Model 3: Model 2 plus biomechanical factors: number of years as a hotel room cleaner, number of hours worked/week, number of beds made/day, physical workload index, work intensification index, and ergonomic index
Model 4: Model 3 plus hotel

Job strain. As seen in Table 13, job strain (analyzed as a ratio) was significantly related to severe shoulder pain in Model 2 (AOR 2.52, 95% CI 1.02-6.24, p=0.045). However, after adjusting for biomechanical work factors in Model 3, the effect measure dropped from an AOR of 2.52 to an AOR of 1.44, losing statistical significance. This decrease in the effect measure demonstrates the importance of biomechanical factors and their confounding effect on WRSP. A decrease in the effect measure with the addition of biomechanical factors to the model was also observed when job strain was analyzed as a median split. When job strain was analyzed as quartiles, a dose-response relationship was seen in Models 1 and 2, i.e., a higher effect measure was seen at each quartile level. In Models 3 and 4, however, this quartile pattern was not observed.

Table 13: Relationship of Job Strain to Shoulder Pain (Severe or Very Severe Compared to None, Very Mild, Mild or Moderate) among 493 Hotel Room Cleaners by Logistic Regression Analysis[a]

Psychosocial Job Factor	**OR**	**95% CI**	***p value***
Job Strain ratio			
Model 1	1.89	0.82-4.36	0.133
Model 2	2.52	1.02-6.24	**0.045**
Model 3	1.44	0.55-3.77	0.462
Model 4	1.32	0.49-3.51	0.583
Job Strain ratio in quartiles			
Model 1			
Lowest	Reference		
Second	1.10	0.66-1.84	0.701
Third	1.29	0.78-2.12	0.317
Highest	1.50	0.89-2.51	0.126
Model 2			
Lowest	Reference		
Second	1.10	0.65-1.87	0.729
Third	1.39	0.82-2.33	0.219
Highest	1.70	0.98-2.95	0.058
Model 3			
Lowest	Reference		
Second	0.96	0.54-1.69	0.884
Third	1.21	0.69-2.12	0.496
Highest	1.20	0.67-2.18	0.538
Model 4			
Lowest	Reference		
Second	0.93	0.52-1.66	0.808
Third	1.18	0.66-2.10	0.578
Highest	1.10	0.60-2.03	0.756
Job Strain-sample median split			
Model 1	1.24	0.85-1.81	0.266
Model 2	1.33	0.89-1.99	0.163
Model 3	1.12	0.73-1.72	0.613
Model 4	1.05	0.67-1.62	0.839

[a] Logistic regression analysis on shoulder pain included the following variables:
Model 1: psychosocial factor and age
Model 2: Model 1 plus socio-demographic factors: ethnicity (categorical, Latinos versus all others), born in/outside of the USA, marital status (married/partnered versus all others), years of education, caregiving at home, current smoking, current alcohol, weight, and height
Model 3: Model 2 plus biomechanical factors: number of years as a hotel room cleaner, number of hours worked/week, number of beds made/day, physical workload index, work intensification index, and ergonomic index
Model 4: Model 3 plus hotel

Iso-strain. In Table 14, iso-strain, analyzed as a ratio, was significantly related to severe shoulder pain in Model 2, with a much higher effect measure than was observed with job strain. This significant relationship was not maintained, however, after adjusting for biomechanical work factors and hotel in Models 3 and 4. The confounding effects of biomechanical factors were strongly demonstrated by a drop in the AOR of 4.92 in Model 2, to an AOR of 1.70 in Model 3. Further confounding by hotel lowered the effect measure to an AOR of 1.45. Analyzing iso-strain as a median split demonstrated much more modest effect measures, with confounding observed in both Models 3 and 4 after the addition of the biomechanical and hotel factors. Analyzing quartiles of iso-strain showed the confounding effects of the biomechanical factors: in Model 2, room cleaners in the highest quartile of iso-strain had 1.83 times the odds of reporting severe shoulder pain (95% CI 1.06-3.17, p=0.031). Once biomechanical factors were added in Model 3, room cleaners in the highest quartile of iso-strain had 1.19 times the odds of reporting severe shoulder pain, a finding that was no longer significant. Adding hotel in Model 4 further dampened the effect measure to an AOR of 1.06.

Table 14: Relationship of Iso-Strain to Shoulder Pain (Severe or Very Severe Compared to None, Very Mild, Mild or Moderate) among 493 Hotel Room Cleaners by Logistic Regression Analysis[a]

Psychosocial Job Factor	**OR**	**95% CI**	***p value***
Iso-strain ratio[b.]			
Model 1	3.26	0.98-10.85	0.054
Model 2	4.92	1.34-18.06	**0.016**
Model 3	1.70	0.42-6.88	0.454
Model 4	1.45	0.35-6.04	0.611
Iso-strain ratio by quartiles			
Model 1			
Lowest	Reference		
Second	1.23	0.73-2.05	0.434
Third	1.64	0.99-2.71	0.054
Highest	1.56	0.93-2.62	0.089
Model 2			
Lowest	Reference		
Second	1.20	0.70-2.06	0.498
Third	1.82	1.07-3.10	**0.026**
Highest	1.83	1.06-3.17	**0.031**
Model 3			
Lowest	Reference		
Second	1.13	0.64-1.99	0.679
Third	1.53	0.87-2.68	0.141
Highest	1.19	0.66-2.17	0.565
Model 4			
Lowest	Reference		
Second	1.06	0.59-1.89	0.848
Third	1.51	0.85-2.71	0.162
Highest	1.06	0.57-1.98	0.858
Iso-strain-sample median split			
Model 1	1.42	0.91-2.20	0.118
Model 2	1.49	0.94-2.36	0.087
Model 3	1.08	0.66-1.78	0.753
Model 4	0.99	0.59-1.66	0.983

[a] Logistic regression analysis on shoulder pain included the following variables:
Model 1: psychosocial factor and age
Model 2: Model 1 plus socio-demographic factors: ethnicity (categorical, Latinos versus all others), born in/outside of the USA, marital status (married/partnered versus all others), years of education, caregiving at home, current smoking, current alcohol, weight, and height
Model 3: Model 2 plus biomechanical factors: number of years as a hotel room cleaner, number of hours worked/week, number of beds made/day, physical workload index, work intensification index, and ergonomic index
Model 4: Model 3 plus hotel
[b.] Iso-strain ratio: psychological demand divided by (decision latitude + total support)

Effort-Reward Imbalance. In contrast to the other psychosocial factors, and as seen in Table 15, both component factors, the ERI ratio, and the categorical variable of ERI were significantly associated with severe shoulder pain. Room cleaners reporting higher effort scores had a significantly higher prevalence of severe shoulder pain in all four models. Likewise, higher rewards were associated with a significantly lower prevalence of severe shoulder pain in all four models. Those with a higher ERI ratio had 1.7 times the odds of reporting severe shoulder pain in Model 4 (95% CI 1.30-2.26, p=0.000). Those in the highest quartiles of ERI were 5.5 times as likely to report severe shoulder pain, when compared to those in the lowest quartile of ERI (reference group), in the fully adjusted Model 4 (AOR 5.50, 95% CI 2.79-10.86, p=0.000). Those with an ERI score of 1.0 or higher had 3 times the odds of reporting severe shoulder pain in the fully adjusted Model 4 (OR 2.98, 95% CI 1.93-4.59, p=0.000). Confounding by biomechanical factors was observed in the regression of the ERI ratio (AOR 2.20 in Model 2 decreased to AOR 1.68 in Model 3), and the regression of the categorical variable of ERI (AOR 4.22 in Model 2 decreased to 2.94 in Model 3). There was minimal confounding observed by the addition of the hotel factor in Model 4. Evaluation of ERI quartiles additionally demonstrates selective confounding by biomechanical factors alone.

Table 15: Relationship of Effort-Reward Imbalance to Shoulder Pain (Severe or Very Severe Compared to None, Very Mild, Mild or Moderate) among 493 Hotel Room Cleaners by Logistic Regression Analysis[a]

Psychosocial Job Factor	**OR**	**95% CI**	***p value***
Effort			
Model 1	1.14	1.09-1.17	**0.000**
Model 2	1.14	1.09-1.18	**0.000**
Model 3	1.10	1.06-1.14	**0.000**
Model 4	1.11	1.06-1.15	**0.000**
Reward (higher scores protective)			
Model 1	0.95	0.93-0.96	**0.000**
Model 2	0.95	0.93-0.96	**0.000**
Model 3	0.96	0.95-0.98	**0.000**
Model 4	0.96	0.94-0.98	**0.000**
Effort Reward Imbalance ratio			
Model 1	2.21	1.70-2.87	**0.000**
Model 2	2.20	1.69-2.86	**0.000**
Model 3	1.68	1.28-2.20	**0.000**
Model 4	1.71	1.30-2.26	**0.000**
Effort Reward Imbalance ratio in quartiles			
Model 1			
Lowest	Reference		
Second	2.24	1.30-3.84	**0.003**
Third	4.62	2.66-8.04	**0.000**
Highest	8.76	4.88-15.74	**0.000**
Model 2			
Lowest	Reference		
Second	2.24	1.29-3.91	**0.004**
Third	4.86	2.76-8.58	**0.000**
Highest	9.00	4.94-16.40	**0.000**
Model 3			
Lowest	Reference		
Second	1.75	0.98-3.14	0.059
Third	3.44	1.88-6.30	**0.000**
Highest	5.14	2.65-9.96	**0.000**
Model 4			
Lowest	Reference		
Second	1.76	0.98-3.19	0.060
Third	3.39	1.82-6.31	**0.000**
Highest	5.50	2.79-10.86	**0.000**

Effort Reward Imbalance, as defined by any score greater than 1.0			
Model 1	4.11	2.82-6.01	**0.000**
Model 2	4.22	2.87-6.22	**0.000**
Model 3	2.94	1.94-4.48	**0.000**
Model 4	2.98	1.93-4.59	**0.000**

[a] Logistic regression analysis on shoulder pain included the following variables:
Model 1: psychosocial factor and age
Model 2: Model 1 plus socio-demographic factors: years of education, caregiving at home, current smoking, current alcohol, and height
Model 3: Model 2 plus biomechanical factors: number of years as a hotel room cleaner, number of hours worked/week, number of beds made/day, physical workload index, work intensification index, and ergonomic index
Model 4: Model 3 plus hotel

In summary, job strain and iso-strain were not significantly related to severe shoulder pain in this sample of 493 room cleaners, controlling for important socio-demographic, behavioral, anthropometric, biomechanical and organizational factors. However, ERI and its respective subscales showed significant relationships with severe shoulder pain in all Models.

Socio-demographic, Behavioral, Anthropometric, Biomechanical, and Organizational Factors and Shoulder Pain by Psychosocial Work Factor: Model 4

Tables 16, 17, and 18 show the details of Model 4 for the ratios of job strain, iso-strain and ERI, including the AOR for the socio-demographic, behavioral, anthropometric, biomechanical and organizational factors. Additionally, to aid in the discussion of findings, these models were analyzed with quartile measures for two significant biomechanical factors: physical workload index and ergonomic index. Because of the quartile variables and additional degrees of freedom, the AOR for the ratio psychosocial variables differ from those seen for Model 4 in Tables 13, 14, and 15.

Job strain: Model 4. In Model 4, as seen in Table 16, job strain was associated with severe shoulder pain, but this relationship did not reach statistical significance at alpha=0.05 (AOR = 1.20, 95% CI, 0.44-3.26, p = 0.726). However, marital status, current smoking, and two biomechanical factors, physical workload and a greater number of ergonomic problems, were significantly associated with severe shoulder pain, after adjusting for other factors in the model including job strain. Fewer years of education and shorter height demonstrated observed associations with severe shoulder pain, although these factors did not reach statistical significance at alpha=0.05.

Model 4, as seen in Table 16, discerns the significant factors associated with severe shoulder pain, adjusting for job strain. Room cleaners who were married/partnered were 1.6 times as likely to report severe shoulder pain, when compared to those who were single, widowed, divorced, or separated, after adjusting for all other factors in Model 4 (AOR 1.61, 95% CI 1.02-2.55, p=0.041). Room cleaners who were current smokers were 2.3 times as likely to report severe shoulder pain, when compared to those who were not current smokers, after adjusting for other factors in model 4, including job strain (AOR 2.35, 95% CI 1.22-4.53, p=0.010). And, room cleaners who reported a greater physical workload and a greater number of ergonomic problems were significantly more likely to report severe shoulder pain, after adjusting for other factors including job strain. The two biomechanical factors were analyzed as quartiles in this analysis. Room cleaners in the highest quartile of physical workload were 2.5 times as likely to report severe shoulder pain (AOR 2.51, 95% CI 1.28-4.95, p=0.008), when compared to the lowest quartile of physical workload. Room cleaners in the highest quartile of ergonomic problems were 3.8 times as likely to report severe shoulder pain, when compared to those in the lowest quartile of ergonomic problems (AOR 3.78, 95% CI 1.92-7.42, p=0.000), after adjusting for all other factors in the model, including job strain.

Table 16: Job Strain and Model 4 Factors on Shoulder Pain (Severe or Very Severe Compared to None, Very Mild, Mild or Moderate) among 493 Hotel Room Cleaners by Logistic Regression Analysis

Factor	**OR**	**95% CI**	***p value***
Job strain (ratio)	1.20	0.44-3.26	0.726
Age	1.01	0.98-1.03	0.614
Latinas vs. all other ethnicities	1.29	0.73-2.30	0.379
Born in/out of USA	1.62	0.84-3.11	0.150
Married/partnered vs. all others	1.61	1.02-2.55	**0.041**
Years of Education	0.95	0.90-1.01	0.114
Caregiving at home	0.95	0.80-1.12	0.544
Current smoking	2.35	1.22-4.53	**0.010**
Current alcohol use	0.99	0.96-1.01	0.305
Weight	1.01	0.99-1.02	0.376
Height	0.97	0.95-1.00	0.075
Years worked	1.03	0.99-1.07	0.156
Hours worked per week	0.99	0.98-1.01	0.581
Number of beds/day	1.01	0.98-1.04	0.588
Physical workload index: Lowest	reference		
Second	1.05	0.60-1.85	0.857
Third	1.59	0.89-2.84	0.120
Highest	2.51	1.28-4.95	**0.008**
Work intensification index	1.02	0.99-1.05	0.105
Ergonomic index Lowest	reference		
Second	2.27	1.29-4.00	**0.004**
Third	2.15	1.19-3.87	**0.011**
Highest	3.78	1.92-7.42	**0.000**
Hotel A	reference		
B	1.73	0.92-3.27	0.090
C	0.68	0.38-1.23	0.206
D	1.32	0.71-2.45	0.376
E	1.31	0.57-3.01	0.521

Iso-Strain: Model 4. In this fully adjusted Model 4 as displayed in Table 17, iso-strain was associated with severe shoulder pain, although this relationship did not reach statistical significance at alpha=0.05 (AOR 1.27, 95% CI 0.29-5.47, p=0.751). Similar to that seen for the full model investigating job strain, marital status, current smoking, physical workload and ergonomic problems remained significantly associated with severe shoulder pain, after adjusting for other factors in the model including iso-strain. Two biomechanical factors were analyzed as quartiles in this analysis. Room cleaners in the highest quartile of physical workload were 2.5 times as likely to report severe shoulder pain (AOR 2.51, 95% CI 1.27-4.95, p=0.008), when compared to the lowest quartile of physical workload, after adjusting for other factors in the model, including iso-strain. Room cleaners in the highest quartile of ergonomic problems were 3.8 times as likely to report severe shoulder pain, when compared to those in the lowest quartile of ergonomic problems (AOR 3.77, 95% CI 1.91-7.41, p=0.000), after adjusting for other factors in the model, including iso-strain.

Table 17: Iso-strain and Model 4 Factors on Shoulder Pain (Severe or Very Severe Compared to None, Very Mild, Mild or Moderate) among 493 Hotel Room Cleaners by Logistic Regression Analysis

Factor	**OR**	**95% CI**	***p value***
Iso-strain (ratio)	1.27	0.29-5.47	0.751
Age	1.01	0.98-1.03	0.611
Latinas vs. all other ethnicities	1.30	0.73-2.29	0.384
Born in/outside of USA	1.61	0.84-3.11	0.152
Married/partnered vs. all others	1.61	1.02-2.55	**0.041**
Years of Education	0.95	0.90-1.01	0.113
Caregiving at home	0.95	0.80-1.12	0.545
Current smoking	2.37	1.23-4.54	**0.010**
Current alcohol use	0.99	0.96-1.01	0.311
Weight	1.01	0.99-1.02	0.381
Height	0.97	0.95-1.00	0.076
Years worked	1.03	0.99-1.07	0.155
Hours worked per week	0.99	0.98-1.01	0.582
Number of beds/day	1.01	0.98-1.04	0.586
Physical workload index Lowest	reference		
Second	1.05	0.60-1.85	0.860
Third	1.59	0.88-2.84	0.121
Highest	2.51	1.27-4.95	**0.008**
Work intensification index	1.02	1.00-1.05	0.105
Ergonomic index Lowest	reference		
Second	2.27	1.29-4.00	**0.004**
Third	2.14	1.18-3.88	**0.012**
Highest	3.77	1.91-7.41	**0.000**
Hotel A	reference		
B	1.74	0.92-3.28	0.089
C	0.68	0.38-1.24	0.210
D	1.32	0.71-2.44	0.380
E	1.31	0.57-3.01	0.522

Effort-Reward Imbalance: Model 4. In this fully adjusted Model 4 as displayed in Table 18, ERI was associated with severe shoulder pain (p=0.000). In addition, fewer years of education, current smoking, a higher physical workload index, a greater number of ergonomic problems, and hotel were significantly associated with severe shoulder pain, after adjusting for other factors in the model including ERI. Shorter height was associated with severe shoulder pain in this model, but did not reach statistical significance at alpha = 0.05 (AOR 0.98, 95% CI 0.95-1.00, p=0.066). A subsequent analysis was conducted of ERI and Model 4, of those in the lowest 10% of height (i.e. less than 147 cm, 4'10 inches tall). In this regression, those in this category were 1.54 times as likely to report severe shoulder pain than those in the taller height categories, after controlling for all other Model 4 factors, including ERI (AOR 1.54, 95% CI 0.83-2.84, p=0.167) (data not shown). No additional socio-demographic, behavioral, anthropometric or biomechanical factors were related to ERI and severe shoulder pain.

Model 4 identifies factors independently influencing severe shoulder pain in addition to and in the presence of ERI. More years of education protected against severe shoulder pain, after adjusting for all other factors in Model 4 including ERI (AOR 0.93 for each additional year of education, 95% CI 0.88-0.99, p=0.021). Room cleaners who were current smokers were twice as likely to report severe shoulder pain, when compared to those who were not current smokers, after adjusting for other factors in model 4, including ERI (AOR 1.96, 95% CI 1.05-3.67, p=0.036). Room cleaners who reported a greater physical workload and a greater number of ergonomic problems were significantly more likely to report severe shoulder pain. Room cleaners in the highest quartile of physical workload were twice as likely to report severe shoulder pain (AOR 2.23, 95% CI 1.14-4.38, p=0.019), when compared to room cleaners in the lowest quartile of physical workload. Room cleaners in the highest quartile of ergonomic problems were over 2.5 times as likely to report severe shoulder pain, when compared to those in the lowest quartile of ergonomic problems (AOR 2.58, 95% CI 1.29-5.16, p=0.007), after adjusting for Model 4 factors including ERI. This model also demonstrated significant differences between Hotel B and Hotel A, but there could be additional inter-hotel differences. Further evaluation into differences between hotels is indicated.

Table 18: Effort-Reward Imbalance and Model 4 Factors on Shoulder Pain (Severe or Very Severe Compared to None, Very Mild, Mild or Moderate) among 493 Hotel Room Cleaners by Logistic Regression Analysis

Factor	**OR**	**95% CI**	***p value***
ERI (ratio)	1.71	1.30-2.25	**0.000**
Age	1.00	0.98-1.03	0.754
Years of Education	0.93	0.88-0.99	**0.021**
Caregiving at home	0.96	0.81-1.13	0.600
Current smoking	1.96	1.05-3.67	**0.036**
Current alcohol use	0.99	0.97-1.01	0.381
Height	0.97	0.95-1.00	0.058
Years worked	1.02	0.98-1.06	0.397
Hours worked per week	0.99	0.97-1.01	0.435
Number of beds/day	1.00	0.97-1.04	0.772
Physical workload index Lowest	reference		
Second	0.99	0.56-1.73	0.962
Third	1.41	0.79-2.53	0.243
Highest	2.23	1.14-4.38	**0.019**
Work intensification index	1.02	0.99-1.05	0.140
Ergonomic index Lowest	reference		
Second	1.87	1.07-3.26	**0.028**
Third	1.79	0.99-3.23	0.053
Highest	2.58	1.29-5.16	**0.007**
Hotel A	reference		
B	2.31	1.21-4.38	**0.011**
C	0.83	0.45-1.50	0.529
D	1.42	0.77-2.63	0.258
E	1.39	0.61-3.15	0.612

CHAPTER V

Discussion

Synthesis And Discussion Of Findings

This study identified important socio-demographic, behavioral, anthropometric, biomechanical and organizational factors associated with severe shoulder pain in this cross-sectional sample of hotel room cleaners from five unionized casino hotels in Las Vegas. The study sample of 493 included primarily female, Latina, immigrant, married, hotel room cleaners, who, on average, had worked as room cleaners for almost eight years, making 19 beds per day. They worked in five different hotels, including an all-suites hotel, a tourist/family hotel, and a business/conference hotel.

This study documented a 1-month period prevalence of self-reported severe shoulder pain of 56% in this sample. This prevalence is similar to the Krause et al. findings of other body regions in this same sample of hotel room cleaners (47% overall bodily pain, 43% neck, 59% upper back and 63% lower back) (2005). This 1-month prevalence is similar to that of Andersen et al. who observed a neck/shoulder 12-month prevalence of 49% in cleaning personnel (2007). However, this 1-month prevalence is higher than the 31% 1-month prevalence observed in Mexican American custodians in a University setting (Flores & Deal, 2003).

Of the socio-demographic factors explored in bivariate analyses, a higher prevalence of severe shoulder pain was observed in hotel room cleaners who were married/partnered, of Latina ethnicity, born outside of the USA, and had fewer years of education. Although few researchers in the published literature have explored the associations between marital status, ethnicity, and immigrant status and WRSP, being married or partnered may represent additional domestic responsibilities that could contribute to severe shoulder pain. Being of Latina ethnicity may be a proxy measure for shorter height (Spearman's rho: -0.1780, p=0.0001). Being born outside of the USA may represent a wide range of factors that could contribute to WRSP, ranging from variations in self-report of shoulder pain symptoms to the need to work a second job. Fewer years of education and its association with severe shoulder pain is consistent with the literature (Andersen, Haahr, & Frost, 2007; Miranda, Viikari-Juntura, Heistaro, Heliovaara, & Riihimaki, 2005; Ostergren et al., 2005). The type of work available to those with fewer years of education may include those jobs with greater physical demands, typically classified as "manual" labor. However, in the multivariate analyses for ERI, education remained an important factor, even after adjusting for physical workload, workload intensification and ergonomic indices.

There was a higher prevalence of severe shoulder pain for room cleaners of shorter height. Height was not found to be associated with shoulder pain in one study of male paint production workers whose height averaged 174 cm (SD 5.9) (68.5 inches=5'7") (Carnide, Veloso, Gamboa, Caldeira, & Fragoso, 2006). The sample in this study was primarily female with an average height of 157 cm (SD 8.0) (62 inches = 5'1-1/2"). Being of shorter height may require more frequent awkward postures to perform cleaning work tasks, thereby posing risks for WRSP.

Higher prevalence of shoulder pain was seen with higher physical workload, work intensification and higher ergonomic indices. These higher indices may equate to a summed exposure to repetition, awkward postures, and force. All three biomechanical factors are well-established contributors to WRSP (Andersen, Haahr, & Frost, 2007;

Andersen et al., 2003; Harkness, Macfarlane, Nahit, Silman, & McBeth, 2003; Leclerc, Chastang, Niedhammer, Landre, & Roquelaure, 2004; Miranda, Viikari-Juntura, Heistaro, Heliovaara, & Riihimaki, 2005; Punnett, Gold, Katz, Gore, & Wegman, 2004; Svendsen, Bonde, Mathiassen, Stengaard-Pedersen, & Frich, 2004) .

The first research question addressed differences in job strain, iso-strain and ERI between room cleaners with and without WRSP. Lower supervisor support and lower total support scores varied significantly by shoulder pain severity. However, there were no significant differences in psychological demand, decision latitude, coworker support, job strain and iso-strain between those with severe shoulder pain when compared to those with none to moderate shoulder pain. However, consistent and significant findings were observed for effort-reward imbalance in that higher effort, lower rewards and ERI (scored both as a ratio and dichotomously) were all significantly different for those with severe shoulder pain. A further discussion of these psychosocial work factors and their subscales will be included later in this paper.

The second research question assessed whether there were significant differences in job strain, iso-strain and ERI across selected socio-demographic, behavioral, anthropometric, biomechanical, and hotel factors. Severe shoulder pain prevalence did not significantly vary for those with job strain. Those with job strain were significantly younger, *not* of Latina ethnicity, and born in the USA. Those with job strain were more often current smokers, and weighed significantly less than those without job strain. Job strain varied significantly between hotels: 41% of Hotel A room cleaners and 43% of Hotel D room cleaners reported job strain, compared to 25% to 26% in Hotels C and E respectively. Those with job strain had significantly higher physical workload, work intensification and ergonomic indices.

Iso-strain showed similar findings. Severe shoulder pain prevalence did not vary significantly for those with iso-strain. Room cleaners of younger age, *not* of Latina ethnicity, who were USA-born, or who worked at Hotels A and D, had higher prevalence of iso-strain. As with job strain, higher physical workload, work intensification, and ergonomic index scores were significantly higher for those with iso-strain.

ERI scores, as noted earlier and in contrast to job strain and iso-strain, were significantly different for those with severe shoulder pain in the bivariate analysis. Also in contrast to job strain and iso-strain, those married or divorced were more likely to report ERI. Similar to job strain, but not for iso-strain, those with ERI weighed 2.6 kilograms less, on average, than those without ERI. As observed in both job strain and iso-strain, hotel D ranked first in ERI: 67% of room cleaners in Hotel D reported ERI, with hotel A ranking second with 56% reporting ERI, although ERI differences between hotel were not statistically significant. Number of hours worked per week, number of years as a room cleaner, and number of beds made/day did not vary with ERI. Similar to job strain and iso-strain, those with ERI reported significantly higher physical workload, work intensification and ergonomic indices.

The final research question explored the relationships between job strain, iso-strain and ERI on severe shoulder pain, after adjusting for socio-demographic, behavioral, anthropometric, biomechanical, and hotel factors. The subscales for job strain, iso-strain and ERI were separately analyzed for this research question. For psychological demand and decision latitude, there were no significant relationships with severe shoulder pain in the fully adjusted models. Likewise, for job strain evaluated as a ratio, in quartiles, and as a sample median split, there were null findings in the fully adjusted final model. However, in this final model, married/partnered status, current smoking, and higher physical workload and ergonomic indices were associated with severe shoulder pain, after controlling for job strain and the other factors.

For coworker support, supervisor support and total support, there were no significant relationships with severe shoulder pain in the fully adjusted models. Likewise, for iso-strain evaluated as a ratio, in quartiles, and as a sample median split, there were null findings in the fully adjusted final model. However, as seen in job strain, married/partnered status, current smoking, and higher physical workload and ergonomic indices were associated with severe shoulder pain, after controlling for iso-strain, and the other factors in the final model. Current smoking as an important factor for WRSP is consistent with the literature on WRSP (Andersen, Haahr, & Frost, 2007; Fredriksson et al., 2000; Svendsen, Bonde, Mathiassen, Stengaard-Pedersen, & Frich, 2004).

In contrast to job strain and iso-strain and its subscales, ERI and its subscales were all significantly associated with severe shoulder pain in the fully adjusted model. Higher effort, lower rewards, ERI as a ratio, ERI in quartiles, and ERI as a categorical variable all maintained significance in the fully adjusted models. In addition, fewer years of education were significantly associated with more severe shoulder pain (i.e. more education was protective). Smoking, as seen in job strain and iso-strain, continued to be associated with severe shoulder pain. Higher physical workload and ergonomic indices continued to be associated with severe shoulder pain. Unique to ERI, the organizational factor of hotel was significantly associated with severe shoulder pain, after controlling for other variables in the final model. Workers in Hotel D, an upscale, all-suites hotel, had the highest prevalence of ERI. As was seen in the prior analyses, Hotel D ranked first in job strain and iso-strain. There were no significant differences in severe shoulder pain by hotel.

Further Discussion of Results

In the fully adjusted models, job strain, iso-strain, and the subscales of psychological demand, decision latitude, and total support were not associated with severe shoulder pain. These null findings are consistent with findings from other well-designed studies (Andersen, Haahr, & Frost, 2007; Harkness, Macfarlane, Nahit, Silman, & McBeth, 2003; Leroyer et al., 2006; Miranda, Viikari-Juntura, Heistaro, Heliovaara, & Riihimaki, 2005; Svendsen, Bonde, Mathiassen, Stengaard-Pedersen, & Frich, 2004). In Karasek's early research on the JD-C Model, using national employment data from the Quality of Employment (QES) surveys from the 1970s, janitorial work was identified as "passive," i.e., those occupations characterized by low psychological demand and low decision latitude (Karasek & Theorell, 1990). Although it is difficult to compare 2002 job strain scores in one relatively homogeneous sample of hotel room cleaners to earlier population-based norms, this sample of room cleaners had, on average, higher psychological demand scores, lower decision latitude scores, and lower coworker and supervisor support scores than the QES and the New England Medical Center (NEMC) data collected from 16 large employers in 1994 (Karasek et al., 1998). For example, for women, the QES mean scores for psychological demand (using the 5 item tool) was 30.9 (SD 7.0); in the NEMC study, the mean for women for psychological demand was 34.8 (SD 7.5) (Karasek et al., 1998). In this room cleaner sample, the mean for psychological demand was 37.08 (SD 7.00), statistically significantly higher when compared to these national norms (p=0.000). For decision latitude, for women, the QES data mean was 65.7 (SD 15.8) (Job Content Questionnaire Center, 2008); with a mean of 65.9 (SD14.4) observed in the NEMC study (Karasek et al., 1998). This sample of room cleaners had a mean of 56.13 (SD 9.92) for decision latitude, significantly lower than both national norms (p=0.000). Coworker support scores for the QES data averaged 13.2 (SD 2.6), with supervisor support scores averaging 12.8 (SD 3.1) (Karasek et al., 1998). In the NEMC data, coworker support scores, on average, were 12.4 (SD 2.5), and supervisor support scores, on average, were 12.4 (SD 3.2) (Karasek et al., 1998). This hotel room cleaner sample had, on average, a coworker support score of 10.86 (SD 2.47) and a supervisor support score of 9.34 (SD 3.40), both scores significantly lower than the national norms (p=0.000). Therefore, per these national norms for women, in contrast to the classification of janitors as passive jobs, hotel room cleaning jobs would be classified as high strain jobs, i.e., those with high psychological demands above the national norms, with decision latitude scores below the national norm. Likewise, these jobs would meet the criteria for iso-strain, based on national norms for coworker and supervisor support for women.

Null findings were demonstrated in the fully adjusted models for both job strain and iso-strain. The reliability of the decision latitude subscale did not perform well, specifically due to one item, and this could be a factor in the null findings. Sample median splits were used in this regression analysis, comparing those above the median within this homogenous group, against those below the median. A ratio of psychological demand divided by decision latitude was additionally used in this analysis, which is one of the four methods accepted for the JD-C Model (Job Content Questionnaire Center, 2008). Null findings were found with this job strain formulation as well. Of interest, in bivariate analyses, job strain and iso-strain were both significantly associated with *not* being Latina, and being USA born. Therefore, the JD-C Model may not be a culturally appropriate tool to assess job strain in this Latina, immigrant sample of hotel room cleaners. The literature examining the JD-C Model with immigrant workers is very limited. In a recent cross-sectional study of immigrant farm workers, the researchers concluded that the JD-C model did not adequately capture the demands of what was also viewed as a "passive" job, and that the model may need refining to address the current work stressors facing immigrant workers (Grzywacz, Quandt, & Arcury, 2008).

In contrast, there were significant findings for effort, reward, ERI as a ratio, ERI in quartiles, and ERI as a categorical variable, and its relationship with severe shoulder pain, adjusting for all factors in the final model. These findings are similar to the Gillen et al. study of hospital workers, in which they observed a higher odds of neck/shoulder injury claims associated with ERI, but not with job strain, in their fully adjusted models (Gillen et al., 2007).

The ERI Model is postulated to capture the balance between efforts expended at work, in exchange for rewards. This model additionally captures the degree of distress caused by high effort (if experienced) and/or low reward (if experienced). The ERI Model therefore captures more of the subjective impact of high effort and low rewards at work. In this study, ERI was the only psychosocial work factor that was significantly associated with WRSP, after adjusting for age, years of education, caregiving at home, current smoking, current alcohol, height, years worked as a hotel room cleaner, hours worked per week, number of beds made per day, the physical workload, work intensification and ergonomic indices, and hotel. Of interest, when adding job strain as an additional factor to Model 4 for ERI, the point estimate remained unchanged (data not shown), adding further strength to the findings regarding the ERI scale. This study adds to the growing consensus that the JD-C Model and the ERI Model are distinct constructs that test different occupational stress domains (Calnan, Wadsworth, May, Smith, & Wainwright, 2004; Karasek, Siegrist, & Theorell, 1998; Tsutsumi & Kawakami, 2004).

Fewer years of education, current smoking, higher physical workload and ergonomic indices, and hotel were each important factors for WRSP, potentially amenable to prevention efforts. Shorter height remains a factor for further study. This analysis also demonstrated a significant relationship amongst the hotels and severe shoulder pain, adjusting for ERI and other factors in the model. Hotel D, an all-suites hotel, was the primary hotel of interest, ranking first in prevalence of ERI, followed by Hotel A, a large upscale tourist hotel. All hotels were unionized, a stabilizing factor within the analysis. Future inquiry into hotel factors and their potential relationship to WRSP is indicated so as to further explore prevention opportunities at the organizational level.

Significance

This is the first study exploring psychosocial work factors and WRSP in hotel room cleaners. Prior studies have explored the relationships between psychosocial work factors and WRSP in other occupational groups, but suffered from methodological concerns, specifically not controlling for the confounding effects of biomechanical factors. This study documented the large confounding effect by biomechanical factors, as demonstrated by less robust point estimates for each psychosocial work factor after the addition of the six biomechanical factors (Model 3).

In fully adjusted models, job strain and iso-strain did not have a significant relationship with WRSP in this primarily Latina immigrant sample. Therefore, this study does not confirm any relationship between job strain and iso-strain and WRSP. Further testing of the JD-C Model with immigrant workers is needed to determine if the JD-C model is a valid and reliable measure of occupational stress in immigrant workers.

This study and that of Gillen et al. (2007) are the only studies to date that confirm a relationship between ERI and WRSP, adjusting for significant individual and workplace factors. This is the first study to explore ERI in relationship to WRSP in hotel room cleaners, a large occupational group with a high prevalence of WRSP. Furthermore, this is the first study to explore ERI in a primarily immigrant Latina sample. Replication of this study will add to what is known about psychosocial work factors affecting hotel room cleaners, and potential relationships with WRSP.

Strengths

A major strength of this study was the comprehensive assessment of biomechanical demands of hotel room cleaning. This comprehensive assessment thoroughly controlled for confounding, a major methodological weakness noted by Bongers et al. (2002, 2006) and van der Windt et al. (2000) in their systematic reviews. Residual confounding was also minimized by the use of six factors, three of which were composite self-report indices. Although there was neither direct observation nor ergonomic objective assessment of hotel room cleaning work for the original study, the self-report measures were generated and pilot tested using focus groups of hotel room cleaners, adding to the validity of the indices. For hotel room cleaning, there are many non-routinized tasks that vary, based on, for example, the condition of the hotel room or the staffing patterns of any given shift. The measures used in this study arose from actual worker descriptions of the work, with measures of frequency of each task, a well-respected and efficient composite measurement approach for non-routinized work (National Research Council & The Institute of Medicine, 2001). Several studies have validated such composite self-report measures of exposure against the "gold standard" of direct observation (Pope, Silman, Cherry, Pritchard, & Macfarlane, 1998; Stock, Fernandes, Delisle, & Vezina, 2005), lending support to the findings reported here.

Limitations

This study observed important psychosocial work factors, in addition to individual and workplace factors, influencing WRSP in hotel room cleaners. However, there are limitations to discuss. As a noted limitation of cross-sectional survey design, because both the exposure and outcome are collected simultaneously, it is not possible to determine causation or temporal precedence. One therefore cannot make any conclusions related to causality: ERI could be a causal factor for severe shoulder pain, shoulder pain could be a causal factor for ERI, or other unmeasured factors could cause shoulder pain and these results may represent simply the co-occurrence of both.

An additional concern with cross-sectional design is potential selection bias, only sampling those room cleaners who were at the workplace on the study days. This sample may be healthier, and therefore not be reflective of those who may have left the workplace because of job strain, iso-strain, ERI or WRSP. The original survey sampled 74% of the available and eligible room cleaners, and the analytic sample consisted of

52% of the original survey participants. Although an analysis of non-responders was not done in the original survey, a participation rate of 74% is considered very high (Hulley, 2001; NIOSH, 1997). This successful participation rate may have been due in large part to the use of participatory community research strategies, partnering with the union, using hotel room cleaners on an advisory board, and engaging in active dialogue about questionnaire development (Lee & Krause, 2002). Interviewers were students or room cleaners recruited from non-participating hotels, and represented the Hispanic and Serbo-Croatian populations. This additional measure may have contributed to their high participation rate.

To evaluate if the list-wise deletion used for the analytic sample introduced significant selection bias, a mean replacement was done for any missing covariate data, excluding the outcome and three psychosocial work factors. Model 4 was re-tested for the job strain ratio, the iso-strain ratio and the ERI ratio using this larger sample. For job strain, the list-wise deletion of observations used in this analysis introduced a small but conservative bias with a reduction of an AOR of 1.42 (n=852) to an AOR of 1.32 (n=493). For iso-strain, a moderate conservative bias was introduced through the list-wise deletion of observations, with reduction of an AOR of 2.18 (n=835) to an AOR 1.45 (n=493). For ERI, there was minimal bias introduced using the smaller analytic sample: the AOR was 1.76 (n=890) as compared to AOR 1.71 (n=493).

There may be limitations in regards to the questionnaire used in the original survey. The original questionnaire was used in three languages: English, Spanish and Serbo-Croatian. The experience of work stress and pain is embedded within varying cultures—asking about work stress and pain may be interpreted differently across cultures (Ong & Seymour, 2004; Portenoy, Ugarte, Fuller, & Haas, 2004).

The measures in the study were primarily self-report of both the exposure and the outcome. Using self-report for the independent variables and for the outcome runs the risk of common method variance (or common instrument bias), sensitive to negative affectivity, for example. Although self-report symptom surveys are viewed by some as a weakness in occupational health research (Punnett & Wegman, 2004), self-report of symptoms does provide important data from the worker perspective (Von Korff, Jensen, & Karoly, 2000).

There may have been residual confounding due to inadequate assessment of physical activity related to housework, sports and other high demand leisure activities, or having a second job that may contribute additional biomechanical and psychosocial risk factors for WRSP. Likewise, the hotel variable may have been an inadequate proxy measure of organizational factors important to WRSP.

Clinical Implications for Occupational Health Nurses

This study illustrates the importance of psychosocial work factors and selected socio-demographic, behavioral, anthropometric, biomechanical and organizational factors in relationship to WRSP for hotel room cleaners from unionized casino hotels in Las Vegas. ERI was the psychosocial work factor that maintained a significant relationship with WRSP, after adjusting for relevant factors, including biomechanical demands. Occupational health nurses (OHNs) need to be more aware of psychosocial work factors that are associated with WRSP and other adverse health outcomes. Primary prevention measures may include the design of healthy organizations and work groups, where there is recognition of the important balance between efforts in exchange for rewards, to include esteem, job security with opportunities for promotion, and salary. For example, OHNs may be able to influence supervisor training to include fairness and respectful communication at work, items included in the reward subscale of the ERI. OHNs can also expand their participation in research related to psychosocial work factors and adverse health outcomes.

Other factors associated with WRSP, that may be responsive to prevention efforts, include the important roles of education and smoking cessation. OHNs could encourage additional worker education (continuing education, and/or additional vocational training) to potentially expand job opportunities outside of the hotel environment, or provide opportunities for greater task variety and/or job enlargement within current hotel work. The role of education in the prevention of WRSP needs further exploration to determine, for example, if educational interventions expand perceived job opportunities, or if added task variety through educational interventions alters ERI and associations with WRSP. This study documented the independent relationship between current smoking and WRSP. Smoking cessation programs at worksites continue to be an important prevention opportunity for OHNs (Caplan, 1995; Lusk, 1997).

Biomechanical demands, as represented by the physical workload and ergonomic indices, remain an important factor in WRSP. This study underscores the continuing importance to alter external loads through ergonomic interventions to reduce repetition, awkward postures and force involved in cleaning work (Kumar, Chaikumarn, & Lundberg, 2005). Although shorter height as an important WRSP factor did not reach significance at an alpha of 0.05, there still may be WRSP risk related to shorter height.

OHNs could explore if those of shorter height are using compensatory mechanisms at work that mitigate WRSP risk. Likewise, workers who are of shorter height may require creative ergonomic interventions at work. Since ergonomic interventions are often done by OHNs, this may become an important area of focus for them (Conrad, Lavender, Reichelt, & Meyer, 2000; Grayson, Dale, Bohr, Wolf, & Evanoff, 2005).

Implications for Future Research

Future research is needed to replicate these findings and to ascertain in more detail the factors associated with WRSP. Conceptually, as illustrated in Figure 1 and described earlier, this study explored specific workplace factors, including select psychosocial work factors (social context), biomechanical factors (external loads), and hotel (organizational factors) to determine which factors were associated with WRSP. Individual factors explored in this study included select socio-demographic, behavioral and anthropometric factors that may contribute to the development of WRSP.

Consequent steps, using this conceptual framework, could refine or expand on what was observed in this study. For example, an additional social context factor of potential interest to WRSP is the concept of unfair treatment at work, or, more broadly, organizational injustice. Organizational justice focuses on decision making at work, specifically the way in which supervisors engage employees in decision making (relational justice), and the extent to which decision-making procedures at work, are accurate, consistently applied, and without bias (procedural justice). Organizational justice may be a relevant theoretical construct to explore WRSP in low wage, and/or immigrant work groups (Elovainio, Kivimaki, & Helkama, 2001; Elovainio, Kivimaki, & Vahtera, 2002). Unfair treatment at work was strongly associated with low employment grade in the Whitehall II study, and was predictive of a subsequent cardiac event (DeVogli, Ferrie, Chandola, Kivimaki, & Marmot, 2007). Further study of the relationships between organizational injustice and WRSP is needed.

Future research questions could explore additional organizational factors and their relationship to WRSP, clarifying micro-organizational and macro-organizational factors influencing how hotel room cleaning is done. Hotel was the only macro-organizational factor available in this study. Other organizational factors that may prevent WRSP include the presence of, for example, on-site occupational health nursing or ergonomic staff, a management-employee safety committee, and ergonomic trainings, all potential future research questions. Shift scheduling and the amount of recovery time between work shifts may also be a factor contributing to WRSP (Elfering, Grebner, Gerber, & Semmer, 2008; Trinkoff, Le, Geiger-Brown, Lipscomb, & Lang, 2006).

External loads were very thoroughly assessed in this study by the three biomechanical indices. However, as measured, it was not possible to tease out the unique contributions of awkward postures, force and repetition to WRSP. A future research question may be to determine to what extent each of these risk factors contributed to a new onset of WRSP in hotel room cleaners, using observer-based ergonomic assessments.

From an individual perspective, additional exploration into height and its relationship to WRSP may be warranted, evaluating if those of shorter height work differently than those who are taller. Likewise, investigating height and its relationship with WRSP in other repetitive occupational groups may be of value. Additional individual factors that may contribute to WRSP include housework, sports and leisure activity, deserving of further study.

Most important in this study are the findings of a relationship between ERI and WRSP in this immigrant, primarily female group of hotel room cleaners. Future testing to assess the relationship between ERI and WRSP with other immigrant groups as well as with other racial/ethnic groups will clarify the unique contribution of ERI to adverse occupational outcomes in vulnerable populations. Moreover, a prospective cohort study should clarify if ERI predicts subsequent WRSP, controlling for socio-demographic, behavioral, anthropometric, biomechanical, and organizational factors in a diverse sample of cleaners. Exploring the effect of ERI interventions by occupational health nurses to reduce the incidence of WRSP will add to what is currently known about psychosocial work factors and WRSP.

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