AMERICAN JOURNAL OF INDUSTRIAL MEDICINE 53:743–756 (2010)

Psychosocial Work Factors and Shoulder Pain in Hotel Room Cleaners

Barbara J. Burgel, RN, PhD, FAAN,[1]* Mary C. White, RN, MPH, PhD, FAAN,[1] Marion Gillen, RN, MPH, PhD,[2] and Niklas Krause, MD, MPH, PhD[3]

Background *Hotel room cleaners have physically demanding jobs that place them at high risk for shoulder pain. Psychosocial work factors may also play a role in shoulder pain, but their independent role has not been studied in this group.*
Methods *Seventy-four percent (941 of 1,276) of hotel room cleaners from five Las Vegas hotels completed a 29-page survey assessing health status, working conditions, and psychosocial work factors. For this study, 493 of the 941 (52%) with complete data for 21 variables were included in multivariate logistic regression analyses.*
Results *Fifty-six percent reported shoulder pain in the prior four weeks. Room cleaners with effort–reward imbalance (ERI) were three times as likely to report shoulder pain (OR 2.99, 95% CI 1.95–4.59, P = 0.000) even after adjustment for physical workload and other factors. After adjustment for physical workload, job strain and iso-strain were not significantly associated with shoulder pain.*
Conclusions *ERI is independently associated with shoulder pain in hotel room cleaners even after adjustment for physical workload and other risk factors.* Am. J. Ind. Med. 53:743–756, 2010. *© 2010 Wiley-Liss, Inc.*

KEY WORDS: hotel room cleaners; psychosocial work factors; job strain; iso-strain; effort–reward imbalance; shoulder pain

INTRODUCTION

Evidence regarding the relationship between psychosocial work factors and shoulder pain is inconsistent, and the literature on cleaning work has focused primarily on biomechanical issues [Messing et al., 1998; Laursen et al., 2003; Mathiassen et al., 2003; Kumar, 2006, 2008; Woods and Buckle, 2006]. Some researchers have demonstrated a relationship between high psychological work demands and shoulder disorders [Andersen et al., 2003; Svendsen et al., 2004], but other studies have not [Harkness et al., 2003; Ostergren et al., 2005]. Low control/decision latitude at work was predictive of subsequent onset of shoulder symptom cases in one study [Andersen et al., 2003], but was not predictive in others [Harkness et al., 2003; Andersen et al., 2007]. In several studies, low social support from coworkers and supervisors was not associated with shoulder pain [Andersen et al., 2003; Harkness et al., 2003; Svendsen et al., 2004; Ostergren et al., 2005]. Job strain (high psychological

[1]University of California San Francisco (UCSF) School of Nursing, Department of Community Health Systems, San Francisco, California
[2]University of California Berkeley School of Public Health, Northern California Center for Occupational and Environmental Health, Berkeley, California
[3]Division of Occupational and Environmental Medicine, School of Medicine, University of California at San Francisco, San Francisco, California
Original data collection and data management was supported by a grant from the Las Vegas Culinary Workers Union Local 226 and UNITE HERE International Union, New York.
Contract grant sponsor: Culinary Workers Union Local 226, Las Vegas; Contract grant number: 49825; Contract grant sponsor: UNITE HERE International Union, New York; Contract grant sponsor: Northern California Center for Occupational and Environmental Health, University of California at Berkeley; Contract grant sponsor: National Institute for Occupational Safety and Health; Contract grant sponsor: American Association of Occupational Health Nurses.
*Correspondence to: Dr. Barbara J. Burgel, University of California San Francisco School of Nursing, 2 Koret Way, N505Y, San Francisco, CA 94143-0608.
E-mail: barbara.burgel@nursing.ucsf.edu

Accepted 20 January 2010
DOI 10.1002/ajim.20832. Published online in Wiley InterScience (www.interscience.wiley.com)

demands with low decision latitude) predicted new onset shoulder pain in women [Ostergren et al., 2005], but showed no relationship in another cohort study [Andersen et al., 2003]. In a study of injury claim cases, those with effort–reward imbalance (ERI) were 1.3 times (per standard deviation change in score) as likely to have a neck/upper extremity injury, after adjusting for potential confounders [Gillen et al., 2007]. In a systematic review of this problem, Bongers et al. [2002, 2006] concluded that the evidence linking psychosocial work factors and work-related shoulder disorders was not very strong or very specific. Methodological issues have been of concern as well. Many studies exploring psychosocial work factors have not controlled for biomechanical work factors, nor have they explored the potential contributions of home care-giving responsibilities. Furthermore, little is known about the relationships between psychosocial work factors and shoulder pain in cleaning personnel.

Prevalence of shoulder pain in working populations has been addressed in the literature. In one study of newly employed workers from 12 occupational groups, 20% reported shoulder pain in the prior month [Nahit et al., 2001]. In other working populations, the 12-month prevalence of shoulder pain ranged from 10% to 41% [Hoozemans et al., 2002; Svendsen et al., 2004; Silverstein et al., 2006; Andersen et al., 2007]. A higher prevalence of shoulder pain, though, has been documented in cleaning personnel. In a study of more than 4,000 Danish production and service workers, 49% of cleaning and kitchen staff reported severe neck and shoulder pain in the prior 12 months—the highest prevalence rate of any job classification studied [Andersen et al., 2007]. In a Swedish study of hospital cleaners, prevalence of neck/shoulder symptom cases was 49% in one hospital, and 64% in another [Unge et al., 2007]. In a small survey of Mexican American custodians, 31% reported experiencing shoulder pain within the prior 1 month [Flores and Deal, 2003].

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 [BLS, 2006a]. Among all occupational groups, maids and housekeepers are ranked 13 in numbers of total cases of work-related musculoskeletal disorders (WRMSD), with an incidence 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, 2006b].

Ergonomic evaluations of hotel cleaning tasks have documented repetition, awkward postures, overhead reaching, and lifting of loads [Frumin et al., 2006]. Repetitive upper extremity movements associated with cleaning (e.g., reaching above shoulder height, and lifting of loads) adversely affect the shoulder [Messing et al., 1998; Laursen et al., 2003; Mathiassen et al., 2003; Kumar, 2006, 2008; Woods and Buckle, 2006]. Hotel room cleaners in the highest quartile of physical workload, work intensification or ergonomic problems were more likely to report overall bodily pain, and severe upper/lower back and neck pain [Krause et al., 2005].

However, psychosocial risk factors associated with cleaning work are not well defined. Psychosocial stressors of cleaning work may include working alone at dispersed locations limiting the opportunity for supervisor/coworker support [Zock, 2005; Chen and Skillen, 2006]. Lack of respect from others has been reported by cleaners [Messing et al., 1998; Zock, 2005; Chen and Skillen, 2006]. Cleaning work is considered a low skilled job and viewed as ''marginal employment.'' Marginal employment is often entry level temporary work, seen as ancillary to the main production of the business, employing those who are newly emigrated and/or with limited English skills [Karasek and Theorell, 1990; Zock, 2005].

To explore psychosocial work factors of hotel room cleaners, two models were used: the Job Demand-Control (JD-C) model and the Effort-Reward Imbalance (ERI) model. The JD-C model focuses on the intersection of perceived psychological demands of work and the degree of worker control and decision-making at work (decision latitude, which consists of decision authority and skill discretion). Job strain is defined as high psychological demands in the presence of low decision latitude [Karasek and Theorell, 1990]. This model was further expanded to include the role of social support from coworkers and supervisors as a third dimension; iso-strain is defined accordingly as job strain in the presence of low social support at work [Karasek and Theorell, 1990]. The ERI model examines the social exchange balance between the self-perceived amount of extrinsic work effort by the worker, in exchange for three types of rewards (salary, self-esteem, job opportunities). An imbalance is created when extrinsic efforts at work are greater than rewards [Siegrist and Peter, 1999a]. Job strain, iso-strain, and ERI potentially contribute to the development of WRMSD through stimulation of the adrenal–cortical stress response, which may simultaneously alter work patterns, work postures, and perceptions and responses to pain [National Research Council and the Institute of Medicine, 2001; Faucett, 2005].

The aim of this study was to assess if job strain, iso-strain, or ERI was associated with severe/very severe shoulder pain, while adjusting for biomechanical, socio-demographic, behavioral and anthropometric factors, including care-giving responsibilities at home.

MATERIALS AND METHODS

Data were used from the 2002 Hotel Room Cleaner Study conducted at five unionized casino hotels in Las Vegas [Lee and Krause, 2002]. The five hotels represented different types of hotels (e.g., those serving business, tour groups,

families) and varying labor–management relationships. Of 1,276 eligible room cleaners, 941 participated in the original study (74% response rate). For this analysis, 493 (52%) subjects had complete data for 21 variables, including the dependent (shoulder pain) and independent variables of interest (job strain, iso-strain, and ERI), as well as 17 selected covariates associated with job stress and/or shoulder pain.

A 29-page questionnaire was developed in English, and translated into Spanish and Serbo-Croatian. Study participants met with researchers after work, were informed of the study goals, risks and benefits, and completed the written survey. Trained research assistants, fluent in English, Spanish or Serbo-Croatian, and who were either college students or hotel room cleaners from non-participating hotels, aided survey completion [Lee and Krause, 2002; Krause et al., 2005].

Shoulder Pain

Musculoskeletal pain during the prior 4 weeks was measured in twelve regions, including ''shoulder/upper arms,'' by the question: ''How much pain have you experienced in the following parts of your body during the past 4 weeks?'' Pain was reported using a 6-item scale (none, very mild, mild, moderate, severe, and very severe). For this analysis, shoulder pain was dichotomized and defined as severe/very severe shoulder/upper arm pain versus none, very mild, mild, or moderate shoulder/upper arm pain. Of the 941 hotel room cleaners, 14 (1.4%) did not complete the musculoskeletal pain question and were excluded from the analysis.

Psychosocial Work Factors

Psychosocial work factors were measured by three standard constructs (job strain, iso-strain, and ERI) and their respective subscales. Job strain and iso-strain were assessed using the following items from Karasek's Job Content Questionnaire: psychological demands (five items), decision latitude (nine items), coworker support (four items), and supervisor support (three items) [Karasek, 1985]. Summing coworker and supervisor support generated a total support scale and a modifier was applied to supervisor support to equally weight it with coworker support. Psychological demand, decision latitude, and total support subscale scores were calculated using the formulas recommended by Karasek [1985]. For each subscale, any missing data were replaced with the mean of the non-missing items, if the respondent had answered at least 50% of the subscale items. For job strain and iso-strain subscales, this replacement strategy affected 6–15% of the observations. Continuous measures of job strain and iso-strain were created following suggestions made by Landsbergis et al. [1994]. Specifically, the job strain ratio was defined as the psychological demands score divided by the decision latitude score, and the iso-strain ratio as the psychological demands score divided by the sum of the decision latitude and total support scores. Quartiles for each psychosocial work factor and subscales were calculated from continuous ratio scores. The categorical measure for job strain included those who had scores above the sample median for psychological demands and below the median for decision latitude; likewise, the iso-strain category was defined as those above the median for psychological demands, below the median for decision latitude, and below the median for total support. The Cronbach's alpha for the job strain subscales were lower than published reliability data. The Cronbach's alpha for psychological demands was 0.51, as compared to the reported reliability of 0.61 [JCQ Center, 2008]. For the decision latitude subscale, the Cronbach's alpha was 0.51, with reported reliability ranging from 0.66 to 0.72 [JCQ Center, 2008]. One reverse coded item in the decision authority subscale did not perform well (''On my job I have very little freedom to decide how I do my work.''); retesting the Cronbach's alpha after removing this item increased the Cronbach's alpha to 0.65.

ERI was assessed using the questionnaire developed by Siegrist and Peter [1999b]. Extrinsic effort was measured with 6 items (of which one item assessed physical effort at work), and reward with 11 items. Overcommitment, an additional construct aimed to assess intrinsic effort, was not measured. For each subscale, any missing data were replaced with the mean of the non-missing items, if the respondent had answered at least 50% of the subscale items. For effort and reward subscales, this replacement strategy affected 8% and 15% of the observations, respectively. To generate the continuous ratio measure, the effort and reward subscales were individually summed, a multiplier was applied to the reward denominator, and effort was divided by reward to form a ratio, as per the Siegrist protocol [Siegrist and Peter, 1999b; Siegrist et al., 2004]. As a categorical variable, any ratio score above 1.0 signified imbalance. Following the suggestion by Siegrist et al., in order to more accurately differentiate psychological from physical efforts, an alternative measure of ERI was created that did not include the item assessing physical efforts [Joksimovic et al., 2002; Siegrist et al., 2004]. This ratio therefore consisted of a 5-item extrinsic effort subscale divided by the quotient of the reward subscale with a different modifier. The Cronbach's alpha for effort (0.81) and reward (0.89) subscales in this study were similar to other published literature on ERI [Siegrist et al., 2004].

Covariates

Past and current physical job demands were measured by six variables: number of years worked as a hotel room cleaner, number of hours worked per week, number of beds made per day, a 26-item physical workload index, a 26-item

work intensification index, and an 11-item ergonomic index [Krause et al., 2005]. The physical workload index, the work intensification index, and the ergonomic index were generated through focus groups with hotel room cleaners, and were composite indices analyzed as continuous variables. The physical workload index summed the frequency of 26 selected work tasks. The work intensification index summed the same 26 work tasks, and if they were being done more, the same, or less frequently as compared to 5 years ago. The ergonomic index assessed the presence of 11 ergonomic problems identified in focus groups [Krause et al., 2005]. Cronbach's alpha coefficients for these three biomechanical indices ranged from 0.82 to 0.89.

Individual worker factors included anthropometric variables (height and weight), behavioral factors (current smoking and alcohol use) and the following socio-demographic variables: age, gender, marital status (married/partnered vs. all others), ethnicity (Latinos/Latinas vs. all others), place of birth (U.S. born vs. all others), years of education, and care-giving at home (number of people currently living in the home needing childcare, elder care, and/or disability care). Height and weight were measured at the time of the survey by portable scales; all other individual worker variables were self-reported. The sample included 11 males, who did not differ from females on shoulder pain, job strain, iso-strain, or ERI scores. Therefore, gender was not considered a confounder and not included in multivariate analyses. Missing values of covariates were not replaced, thereby limiting the analytic sample for this study to 493 respondents. Measured body height and weight had the largest proportion (25%) of missing values ($n = 237$, and $n = 232$, respectively), followed by number of hours worked/week (7%, $n = 69$), and years of education (6%, $n = 59$). In order to assess the occurrence and magnitude of possible selection bias, all analyses were repeated after replacement of missing values for covariates. As described in the Discussion Section, the reduced sample introduced a mostly conservative bias with effect measures slightly reduced for most psychosocial work factors. In order to avoid inflation of statistical significance, we report the results from analyses without mean replacement of missing covariate values.

The place of employment (hotel) was used as a proxy variable to assess the impact of macro-organizational factors on shoulder pain. 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 et al., 2008].

These above covariates were chosen because they could be linked conceptually or empirically to job stress, social support, or shoulder pain based on the extant literature [Miranda et al., 2001; Krause et al., 2005; Ostergren et al., 2005; Werner et al., 2005; Rugulies et al., 2008]. Each variable was regarded as a confounder for later model building if its addition shifted the beta coefficient of the independent variable of interest by 5% or more. All the above variables confounded the relationship between job strain and iso-strain with shoulder pain. However, for ERI, marital status, ethnicity, place of birth, years of education, current smoking, and alcohol use did not meet this criterion for confounding and were not included as covariates in later model building. Listwise deletion of observations with missing values on any of the 17 covariates resulted in a final analytic sample of 493 room cleaners with complete data for all variables.

Data Analysis Procedures

Descriptive statistics

The distribution of all variables across the two categories of shoulder pain was described in terms of means, standard deviations, and medians for continuous variables and proportions for categorical variables. Differences in pain status were analyzed using Student's *t*-test for continuous and Chi-square tests for categorical variables. Correlations were measured using Pearson's product moment coefficient (r) for normally distributed continuous variables or Spearman's rank correlation coefficient (rho) for categorical or non-normally distributed continuous variables.

Multivariate analysis

Associations between psychosocial work factors and the dichotomized pain outcome were analyzed with separate logistic regression models for each psychosocial work factor. All analyses were incrementally adjusted for age (model 1), selected socio-demographic, behavioral, and anthropometric factors (model 2), biomechanical factors (model 3), and hotel (model 4). For model covariates, see footnotes in Tables II–V. All data analyses were conducted using Stata statistical software, version 9.2.

Institutional Review Board

The Committee on Human Subjects at the University of California at Berkeley and also at San Francisco approved this study.

RESULTS

For shoulder pain within the prior 4 weeks, 8% reported none, 5% reported very mild, 10% reported mild, 22% reported moderate, 27% reported severe, and 29% reported very severe shoulder pain. Fifty-six percent reported severe or very severe shoulder pain, the outcome of interest for this study.

Table I describes the analytic sample by shoulder pain and covariates. Nearly all were female (98%, data not

TABLE I. Socio-Demographic, Behavioral, Anthropometric, Hotel, Biomechanical, and Psychosocial Work Factors by Shoulder Pain Among Hotel Room Cleaners

Factors	Total sample, N = 493 (100%)	None, very mild, mild or moderate pain, N = 219 (44%)	Severe or very severe pain, N = 274 (56%)	*P*-value
Socio-demographic factors				
Age				0.938
Mean (SD)	41.18 (9.7)	41.22 (10.4)	41.15 (9.0)	
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 (years)				0.003
Mean (SD)	9.22 (3.6)	9.76 (3.4)	8.79 (3.6)	
Median	9	10	9	
Range	0–18	0–18	0–18	
Care-giving at home[a]				0.821
Mean (SD)	0.99 (1.3)	0.98 (1.4)	1.00 (1.2)	
Median	1	0	1	
Range	0–9	0–9	0–6	
Behavioral factors				
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 (9.2)	2.58 (8.9)	1.96 (9.4)	
Median	0	0	0	
Range	0–100	0–80	0–100	
Anthropometric factors				
Weight (kg)				0.827
Mean (SD)	69.04 (14.0)	68.89 (15.0)	69.16 (13.3)	
Median	67	67	67	
Range	41–132	43–132	41–110	

(*Continued*)

TABLE I. (*Continued*)

Factors	Total sample, N = 493 (100%)	None, very mild, mild or moderate pain, N = 219 (44%)	Severe or very severe pain, N = 274 (56%)	*P*-value
Height (cm)				0.012
Mean (SD)	156.66 (8.0)	157.68 (8.5)	155.84 (7.5)	
Median	156	157	155.5	
Range	135–198	137–198	135–191	
Hotel				
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 and work factors				
Years of work[b]				0.251
Mean (SD)	7.74 (5.4)	7.42 (5.6)	7.99 (5.2)	
Median	7	6	7	
Range	0.5–32	0.67–32	0.50–30	
Hours worked/week				0.300
Mean (SD)	40.26 (11.0)	40.82 (9.9)	39.81 (11.8)	
Median	40	40	40	
Range	5–80	8–80	5–80	
Beds made/day				0.102
Mean (SD)	19.35 (6.7)	18.79 (6.7)	19.79 (6.8)	
Median	19	18	19	
Range	3–40	4–36	3–40	
Physical workload index[c]				0.000
Mean (SD)	141.40 (68.2)	123.33 (61.1)	155.83 (70.1)	
Median	135.9	114.7	153.3	
Range	2.6–399.4	14.5–352.2	2.6–399.4	
Physical workload intensification compared to 5 years ago[d]				0.000
Mean (SD)	57.17 (9.0)	54.65 (8.5)	59.18 (8.9)	
Median	56.2	54	59.1	
Range	26–78	26–78	38–78	
Ergonomic index[e]				0.000
Mean (SD)	28.65 (7.6)	26.50 (7.4)	30.36 (7.3)	
Median	28	25	30	
Range	11–44	11–44	13–44	
Psychosocial work factors				
Psychological demand				0.243
Mean (SD)	37.08 (7.0)	36.67 (7.0)	37.41 (7.0)	
Median	36	36	38	
Range	18–48	18–48	20–48	
Decision latitude				0.103
Mean (SD)	56.13 (9.9)	56.95 (9.8)	55.48 (10.0)	
Median	56	58	54	
Range	26–88	26–88	32–86	
Coworker support				0.705
Mean (SD)	10.86 (2.5)	10.90 (2.2)	10.82 (2.7)	
Median	11	11	11	
Range	4–16	4–16	4–16	

TABLE I. (*Continued*)

Factors	Total sample, N = 493 (100%)	None, very mild, mild or moderate pain, N = 219 (44%)	Severe or very severe pain, N = 274 (56%)	*P*-value
Supervisor support				0.006
Mean (SD)	9.34 (3.4)	9.81 (3.2)	8.96 (3.6)	
Median	9.3	10.7	8	
Range	4–16	4–16	4–16	
Total support				0.033
Mean (SD)	20.20 (4.9)	20.72 (4.4)	19.78 (5.3)	
Median	20.3	21	20	
Range	8–32	8–32	8–32	
Job strain ratio[f]				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[g] (%)				0.267
No	320 (65)	148 (46)	172 (54)	
Yes	173 (35)	71 (41)	102 (59)	
Iso-strain ratio[h]				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[i] (%)				0.121
No	380 (77)	176 (46)	204 (54)	
Yes	113 (23)	43 (38)	70 (62)	
Effort (6-item)				0.000
Mean	20.41 (5.8)	18.31 (5.6)	22.09 (5.4)	
Median	21	18	23	
Range	6–30	6–30	6–30	
Reward				0.000
Mean	35.61 (12.1)	39.73 (10.9)	32.32 (12.1)	
Median	37	41	33	
Range	11–55	11–55	11–55	
Effort/reward imbalance (ERI) ratio[j]				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]Care-giving at home is the number of persons currently living in the home needing childcare, eldercare, and/or disability care.
[b]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.
[f]Job strain ratio: psychological demand divided by decision latitude.
[g]Job strain categories determined by sample median splits: psychological demand score $\geq$36 in combination with a decision latitude score $\leq$56.
[h]Iso-strain ratio: psychological demand divided by (decision latitude + total support).
[i]Iso-strain categories determined by sample median splits: psychological demand score $\geq$36, a decision latitude score $\leq$56, in combination with total support score $\leq$20.4.
[j]Effort–reward imbalance ratio: extrinsic effort divided by (reward $\times$ multiplier).

TABLE II. Associations Between Psychological Demand, Decision Latitude, and Social Support at Work with Shoulder Pain Among 493 Hotel Room Cleaners: Results From Incrementally Adjusted Logistic Regression Analyses*

Psychosocial job factor	OR	95% CI	*P*-value
Psychological demand			
Model 1	1.01	0.99–1.04	0.243
Model 2	1.03	1.00–1.05	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			
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			
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			
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

*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, care-giving 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.

TABLE III. Associations Between Alternative Measures of Job Strain and Shoulder Pain Among 493 Hotel Room Cleaners: Results From Incrementally Adjusted Logistic Regression Analyses*

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	1.22	0.74–2.02	0.432
Highest	1.58	0.94–2.63	0.081
Model 2			
Lowest	Reference		
Second	1.10	0.65–1.87	0.730
Third	1.31	0.78–2.22	0.306
Highest	1.80	1.04–3.10	0.035
Model 3			
Lowest	Reference		
Second	0.96	0.54–1.69	0.885
Third	1.14	0.65–2.00	0.649
Highest	1.30	0.72–2.34	0.380
Model 4			
Lowest	Reference		
Second	0.93	0.52–1.66	0.810
Third	1.10	0.61–1.96	0.756
Highest	1.20	0.66–2.21	0.548
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

*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 (categorical, Latinos vs. all others), born in/outside of the USA, marital status (married/partnered versus all others), years of education, care-giving 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.

shown), married/partnered (69%), Latinas (78%), born outside the USA (85%) with an average age of 41 years. Average number of years of education was 9. Care-giving responsibilities at home ranged from 0 to 9 children or elders needing care (mean = 1). Married/partnered room cleaners had a significantly higher prevalence of shoulder pain ($P = 0.008$). Being of Latina ethnicity ($P = 0.001$) and being born outside the USA ($P = 0.015$) were factors associated with a higher prevalence of shoulder pain, as was fewer years of education ($P = 0.003$). Shoulder pain did not differ by care-giving demands at home ($P = 0.821$).

Thirteen percent of the sample currently smoked. Alcohol use ranged from 0 to 100 drinks per month, with 2.2 drinks on average consumed per month. Shoulder pain did not vary by smoking and alcohol use. Weight ranged from 41 to 132 kg (90–291 lbs), with a mean weight of 69 kg (mean = 152 lbs). Height ranged from 135 to 198 cm (53–77 in.), with a mean height of 157 cm (mean = 62 in.). Shoulder pain did not differ by weight, but shorter height

TABLE IV. Associations Between Alternative Measures of Iso-Strain and Shoulder Pain Among 493 Hotel Room Cleaners: Results From Incrementally Adjusted Logistic Regression Analyses*

Psychosocial job factor	OR	95% CI	*P*-value
Iso-strain ratio[a]			
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

*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 (categorical, Latinos versus all others), born in/outside of the USA, marital status (married/partnered versus all others), years of education, care-giving 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.
[a]Iso-strain ratio: psychological demand divided by (decision latitude + total support).

was significantly correlated with shoulder pain (Spearman's rho $= -0.11$, $P = 0.012$). There were no significant differences in shoulder pain by hotel ($P = 0.279$). However, there were differences in job strain ($P = 0.019$), iso-strain ($P = 0.000$), and ERI ($P = 0.054$) between hotels (data not shown).

TABLE V. Associations Between Alternative Measures of Effort–Reward Imbalance and Shoulder Pain Among 493 Hotel Room Cleaners: Results From Incrementally Adjusted Logistic Regression Analyses*

Psychosocial job factor	OR	95% CI	*P*-value
Effort			
Model 1	1.13	1.09–1.17	0.000
Model 2	1.13	1.09–1.17	0.000
Model 3	1.10	1.06–1.14	0.000
Model 4	1.10	1.06–1.14	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 (6-item effort scale)			
Model 1	2.21	1.70–2.87	0.000
Model 2	2.18	1.67–2.83	0.000
Model 3	1.67	1.27–2.19	0.000
Model 4	1.70	1.29–2.23	0.000
Effort–reward imbalance ratio (5-item effort scale)			
Model 1	2.22	1.70–2.89	0.000
Model 2	2.19	1.67–2.86	0.000
Model 3	1.67	1.27–2.20	0.000
Model 4	1.70	1.28–2.25	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	2.26	1.31–3.90	0.003
Third	4.76	2.73–8.33	0.000
Highest	8.57	4.76–15.44	0.000
Model 3			
Lowest	Reference		
Second	1.84	1.04–3.26	0.036
Third	3.52	1.94–6.38	0.000
Highest	5.11	2.66–9.79	0.000
Model 4			
Lowest	Reference		
Second	1.87	1.05–3.35	0.035
Third	3.47	1.88–6.42	0.000
Highest	5.49	2.81–10.73	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	4.16	2.84–6.10	0.000
Model 3	2.96	1.96–4.48	0.000
Model 4	2.99	1.95–4.59	0.000

*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: care-giving at home 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.

On average, participants had worked as room cleaners for 8 years, worked 40 hr per week, and made 19 beds per day. Years of work, number of hours worked per week, and the number of beds made per day did not significantly vary by shoulder pain. However, higher physical workload (Spearman's rho = 0.24, $P = 0.000$), greater work intensification as compared to 5 years ago (Spearman's rho = 0.24, $P = 0.000$), and a greater number of ergonomic problems (Spearman's rho = 0.25, $P = 0.000$) were each individually correlated with shoulder pain.

Psychological demand and decision latitude scores did not vary by shoulder pain. However, those with shoulder pain had significantly lower supervisor support ($P = 0.006$), and total social support scores ($P = 0.033$). Using median sample splits, 35% of the sample experienced job strain and 23% experienced iso-strain. Job strain and iso-strain scores, analyzed as both a ratio and as a sample median split, did not vary by shoulder pain.

For the subscales of ERI, those with shoulder pain had significantly higher effort scores (generated using the 6-item scale) than those without shoulder pain. When re-tested with a 5-item effort score (i.e., removing the physical effort item included in this subscale), this significant difference was maintained: those with shoulder pain had higher effort scores (mean 18 [SD 5], range 5–25), as compared to those without shoulder pain (mean 15 [SD 5], $P = 0.000$, data not shown). Those with shoulder pain had lower reward scores than those without pain ($P = 0.000$). Overall, 54% of the sample experienced ERI. Those with higher ERI scores had a significantly higher prevalence of shoulder pain ($P = 0.000$).

Moderate correlations were observed 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 overall sample experienced both job strain and ERI; 18% (n = 89) experienced both iso-strain and ERI.

Table II shows results from logistic regression analyses estimating the effects of psychological demand, decision latitude, coworker support, supervisor support, and total social support at work on shoulder pain. Four models were incrementally adjusted for potential confounders as described in the Materials and Methods Section. Those with higher psychological demands had a higher odds of having shoulder pain, but this relationship was not statistically significant. For decision latitude and social support at work, higher scores appeared to be protective in models 1 and 2; however, this relationship was not maintained in models 3 and 4 adjusting for biomechanical and hotel factors.

Job strain, analyzed as a ratio, was significantly related to shoulder pain in model 2 (OR 2.52, 95% CI 1.02–6.24, $P = 0.045$) (Table III). However, after adjusting for biomechanical work factors in model 3, the effect measure dropped from an OR of 2.52 to an OR of 1.44, and lost statistical significance. When the job strain ratio was analyzed in quartiles, results were compatible with a positive dose–response relationship between job strain and shoulder pain, although a statistically significant relationship was only observed in model 2 before adjustment by biomechanical factors. A decrease in the effect measure with the addition of biomechanical factors to the model was also observed when the categorical measure of job strain was used.

As shown in Table IV, iso-strain, analyzed as a ratio, was significantly and strongly related to shoulder pain in model 2. However, after adjusting for biomechanical work factors, the OR dropped from 4.92 in model 2 to an OR of 1.70 in model 3. Further confounding by hotel lowered the effect measure to an OR of 1.45. Similar confounding effects were seen when the iso-strain ratio was analyzed in quartiles and when the categorical measure of iso-strain was used.

As seen in Table V, effort, reward, the ERI ratio (both 6-item and 5-item), and the categorical variable of ERI were all significantly associated with shoulder pain in all four models. Room cleaners with higher effort scores had a significantly higher prevalence of shoulder pain, whereas higher rewards were associated with a significantly lower prevalence. Those with a higher ERI ratio (6-item) had 1.7 times the odds of reporting shoulder pain in the fully adjusted model (95% CI 1.29–2.23, $P = 0.000$). The 5-item ERI ratio demonstrated a similar point estimate. Of interest, the addition of job-strain to the fully adjusted ERI ratio (6-item) model 4 raised the point estimate only slightly to 1.74 (data not shown). Those in the highest quartiles of ERI were 5.5 times as likely to report shoulder pain compared to those in the lowest quartile of ERI in the fully adjusted model 4 (OR 5.49, 95% CI 2.81–10.73, $P = 0.000$). Those with an ERI score over 1.0 had three times the odds of reporting shoulder pain than those with a score of 1 or less (OR 2.99, 95% CI 1.95–4.59, $P = 0.000$). Substantial confounding by biomechanical factors was observed in the regression of the ERI ratio (OR 2.18 in model 2 decreased to OR 1.67 in model 3), of the quartiles of the ERI ratio (OR 8.57 of highest quartile in model 2 dropped to 5.11 in model 3), and the regression of the categorical variable of ERI (OR 4.16 in model 2 decreased to 2.96 in model 3). There was only minimal confounding observed by the addition of hotel in model 4.

DISCUSSION

This is the first study to explore psychosocial work factors in relationship to shoulder pain in hotel room cleaners and the first study demonstrating significant associations between ERI and shoulder pain in a primarily female, immigrant Latina sample.

Shoulder Pain Prevalence

In this study, 56% of the sample of hotel room cleaners from five unionized Las Vegas hotels reported shoulder pain

in the prior 4 weeks. This is higher than the 31% 1-month prevalence of shoulder pain reported in a study of Mexican-American custodians working at a university [Flores and Deal, 2003]. It is, however, similar to the 49% 12-month prevalence of shoulder pain reported by kitchen and cleaning staff [Andersen et al., 2007], and the 49–64% prevalence in hospital cleaners [Unge et al., 2007]. Likewise, it is similar to the one-month prevalence in this same sample for upper back (59%) and lower back (63%) pain as reported earlier by Krause et al. [2005].

Job Demand-Control Model

Job strain and iso-strain were associated with shoulder pain, but effect sizes decreased substantially and associations were no longer statistically significant after adjustment for physical workload and ergonomic factors. This finding is in line with inconsistent findings in the literature on psychosocial work factors and shoulder pain [Bongers et al., 2002, 2006] and comparable to findings regarding the associations between job strain and other musculoskeletal disorders, for example, back or neck pain, where recent reviews also observed that associations with psychosocial work factors are confounded by biomechanical factors [Davis and Heaney, 2000; Ariëns et al., 2002].

The results should not be interpreted as the absence of job stress among room cleaners. Previously, in Karasek's original work, janitors were classified as having a passive occupation with low decision latitude and with low psychological demands [Karasek and Theorell, 1990]. Given this profile, janitors would not be anticipated to have adverse health outcomes. Although it is difficult to compare 2002 job strain scores in one relatively homogeneous sample of hotel room cleaners to earlier population-based data, 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 U.S. population sample and the New England Medical Center (NEMC) data collected from 16 large employers in 1994 [Karasek et al., 1998]. Therefore, in contrast to the classification of janitors as passive jobs, hotel room cleaning jobs would be more accurately classified as high strain jobs, that is, those with high psychological demands above the national comparison data and with decision latitude scores below the national average. Likewise, based on comparisons with such population data for coworker and supervisor support, hotel cleaning jobs are characterized by exposure to iso-strain.

Effort–Reward Imbalance

ERI scores and the effort and reward subscales were each statistically significantly associated with shoulder pain even after adjusting for socio-demographic, behavioral, anthropometric, biomechanical, and hotel factors. These findings are similar to those of Gillen et al. [2007] who observed significant associations between ERI and neck/upper extremity claims in their fully adjusted models. The ERI model had been proposed to be more responsive to labor market forces (i.e., opportunities for job promotion), specifically in the rewards subscale [Tsutsumi and Kawakami, 2004; van Vegchel et al., 2005], and our findings may support this notion. The reward subscale, which captures wages, job opportunities, and self-esteem, may have particular utility in further explorations of occupational stress in hotel room cleaners and other low wage service work. Wages and benefits are a concern of hotel room cleaners [Frumin et al., 2006] but were very similar in this occupational group working under similar union contracts. Likewise, job growth and career opportunities are likely to be limited for room cleaners both because of the structure of employment [Parker and Krause, 1999] and because of relatively low levels of education. About 68% of Las Vegas hotel room cleaners agreed that their job promotion prospects were poor. Further, respect and recognition by others contribute to self-esteem, one of the rewards measured by the ERI model. In focus groups with Las Vegas room cleaners the issue of lack of respect from supervisors and management had been raised repeatedly as a major concern. In this study, only 45% of room cleaners agreed to the statement "I receive the respect I deserve from my superiors" in contrast to 72% of room cleaners who confirmed that they receive respect from their immediate co-workers. Lack of respect, low appreciation by others for cleaning work, and inconsiderate and rude treatment have been reported by cleaning personnel in several other studies [Messing et al., 1998; Chen and Skillen, 2006; Woods and Buckle, 2006]. There was substantial variation in room cleaners' perceived respect from superiors across the five hotels, ranging from 39% to 56%. This indicates an intervention opportunity at the hotel/macro-organizational level.

It is not clear to us why ERI was more strongly associated with shoulder pain than job strain or iso-strain. It is possible that the dimension of self-esteem and respect received from superiors, an important concern for these hotel workers, was better captured by the reward subscale of the ERI instrument than by the related items of the social support subscale of the JCQ instrument, and, in the absence of much variation in other rewards, accounted for the stronger effects of ERI compared with JCQ scales.

Strengths and Limitations

Controlling for biomechanical factors was a strength of this study. The confounding effect of these factors was consistently demonstrated for all psychosocial work factors and their subscales, as evidenced by a dampening of the point estimates. Residual confounding was minimized by the use of six biomechanical and work factors, three of which were

composite self-report indices. While the data come from a self-administered survey, the 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, an accepted and efficient composite measurement approach for non-routinized work [National Research Council and the Institute of Medicine, 2001, p. 92]. Several studies have validated such composite self-report measures of exposure against the ''gold standard'' of direct observation [Pope et al., 1998; Stock et al., 2005], lending support to the methodology used in this study, despite a lack of direct observation or objective ergonomic assessment of the cleaning work. Other unmeasured factors could cause shoulder pain and these results may represent simply the co-occurrence of those with ERI, however, the large effect sizes and extensive control for confounding, including even some responsibilities at home, makes such an alternative explanation of our findings very unlikely.

The cross-sectional design precludes conclusions about temporal precedence and therefore causation: ERI could be a causal factor for shoulder pain; shoulder pain could be a causal factor for reported ERI.

Selection bias may have resulted from only sampling those room cleaners who were at the workplace on the study days and may not be representative of all hotel room cleaners in the selected hotels. The original survey sampled 74% of the available and eligible room cleaners [Krause et al., 2005]. Although an analysis of non-responders was not done in the original survey, a participation rate of over 70% is generally considered a good protection against selection bias [NIOSH, 1997; Hulley et al., 2001]. The analytic sample for this study consisted of only 52% of the original survey participants due to list-wise deletion of observations with incomplete data on potential confounders. To assess any potential for selection bias introduced by this sample reduction, a post hoc analysis was conducted using a sample with mean value replacement for any missing values for covariates (not for the outcome and three psychosocial work factors). Model 4 was re-tested for the job strain ratio, iso-strain ratio, ERI ratio, and the categorical variable of ERI using this larger sample. For job strain, the list-wise deletion of observations introduced a small but conservative bias with a reduction of the OR from 1.42 ($n = 852$) to 1.32 ($n = 493$). For iso-strain, a moderate conservative bias was introduced through the list-wise deletion of observations, with reduction of the OR from 2.18 ($n = 835$) to 1.45 ($n = 493$). For ERI, there was minimal non-conservative bias introduced using the smaller analytic sample: the OR for the ERI ratio (6-item) was 1.65 ($n = 905$) as compared to OR 1.71 ($n = 493$); the OR for the categorical ERI was 2.49 ($n = 905$) as compared to OR 2.99 ($n = 493$). Clearly, the results cannot be explained by selection bias.

The only macro-organizational factor available in this study was ''hotel.'' Univariate analyses did not show any significant relationship between hotel and shoulder pain. However, levels of job strain, iso-strain, and ERI all varied across hotels even though all hotels were full-service hotels, had similar pay structures, and were unionized. No additional data were available about hotel factors. Future research could explore additional organizational factors, their relationship to shoulder pain across different types of hotels, and how they may influence unionization density and micro- and macro-organizational factors that in turn influence how exactly hotel room cleaning is done. Other organizational factors that may prevent shoulder pain and/or alter psychosocial work factors include the presence of, for example, on-site occupational health nursing or ergonomic staff, a management–employee safety committee, and ergonomic trainings, data that were not available for this secondary data analysis.

In summary, this study illustrates the importance of psychosocial work factors, primarily ERI, in relationship to shoulder pain for hotel room cleaners from unionized casino hotels in Las Vegas. ERI showed a strong and statistically significant relationship with shoulder pain, even after adjusting for relevant confounding factors including biomechanical demands. Job strain and iso-strain were also associated with shoulder pain but these associations were heavily confounded by biomechanical workload and were no longer statistical significant after adjustment for these covariates. Prospective studies are needed to clarify the causal role of psychosocial work factors, including organizational micro- and macro-factors for shoulder pain outcomes. Occupational health professionals need to be more aware of psychosocial work factors that are associated with shoulder pain and other adverse health outcomes. Primary prevention measures may include the design of healthy organizations and work groups, where there is recognition of the importance of mutual respect and the balance between efforts in exchange for rewards at work.

ACKNOWLEDGMENTS

The original study was funded by the Culinary Workers Union Local 226, Las Vegas; grant number: 49825; UNITE HERE International Union, New York, and the Northern California Center for Occupational and Environmental Health, University of California at Berkeley. This secondary analysis was supported, in part, by a NIOSH T42 Training Grant and a 2008 Research Award from the American Association of Occupational Health Nurses. The authors wish to acknowledge Shelley Arredondo, MD, MPH of the University of California, San Francisco, and thank the

original research team and the study participants for their time, insights and efforts.

REFERENCES

Andersen JH, Kaergaard A, Mikkelsen S, Jensen UF, Frost P, Bonde JP, Fallentin N, Thomsen JF. 2003. Risk factors in the onset of neck/shoulder pain in a prospective study of workers in industrial and service companies. Occup Environ Med 60:649–654.

Andersen JH, Haahr JP, Frost P. 2007. Risk factors for more severe regional musculoskeletal symptoms: A two-year prospective study of a general working population. Arthritis Rheum 564:1355–1364.

Ariëns GAM, Bongers PM, Hoogendoorn WE, van der Wal G, van Mechelen W. 2002. High physical and psychosocial load at work and sickness absence due to neck pain. Scand J Work Environ Health 28: 222–231.

BLS. 2006a. Occupational Employment and Wage Estimates, May 2006: 37-2012 Maids and Housekeepers. Retrieved June 7, 2007, from http://www.blsgov/oes/current/oes372012.htm.

BLS. 2006b. Table 11: Number, incidence rate and median days away from work of occupational injuries and illnesses with days away from work involving musculoskeletal disorders by selected occupations, All United States, private industry, 2006. Retrieved November 12, 2007, from http://www.blsgov/iif/oshwc/osh/case/ostb1792.pdf.

Bongers PM, Kremer AM, ter Laak J. 2002. Are psychosocial factors, risk factors for symptoms and signs of the shoulder, elbow, or hand/wrist?: A review of the epidemiological literature. Am J Ind Med 415: 315–342.

Bongers PM, Ijmker S, van den Heuvel S, Blatter BM. 2006. Epidemiology of work-related neck and upper limb problems: Psychosocial and personal risk factors Part I and effective interventions from a bio-behavioural perspective Part II. J Occup Rehabil 163:279–302.

Chen SI, Skillen DL. 2006. Promoting personal safety of building service workers: Issues and challenges. AAOHN J 546:262–269.

Davis KAG, Heaney CA. 2000. The relationship between psychosocial work characteristics and low back pain: Underlying methodological issues. Clin Biomech (Bristol, Avon) 15:389–406.

Faucett J. 2005. Integrating 'psychosocial' factors into a theoretical model for work-related musculoskeletal disorders. Theor Issues Ergon Sci 66:531–550.

Flores LY, Deal JZ. 2003. Work-related pain in Mexican American custodial workers. Hispanic J Behav Sci 252:254–270.

Frumin E, Moriarty J, Vossenas P, Orris P, Krause N. 2006. Workload-related musculoskeletal disorders among hotel housekeepers: Employer records reveal a growing national problem. Retrieved November12, 2007 from http://www.hotelworkersrisingorg/pdf/hskpr_analysis0406.pdf.

Gillen M, Yen IH, Trupin L, Swig L, Rugulies R, Mullen K, Font A, Burian D, Ryan G, Janowitz I, Quinlan PA, Frank J, Blanc P. 2007. The association of socioeconomic status and psychosocial and physical workplace factors with musculoskeletal injury in hospital workers. Am J Ind Med 504:245–260.

Harkness EF, Macfarlane GJ, Nahit ES, Silman AJ, McBeth J. 2003. Mechanical and psychosocial factors predict new onset shoulder pain: A prospective cohort study of newly employed workers. Occup Environ Med 6011:850–857.

Hoozemans MJ, van der Beek AJ, Frings-Dresen MH, van der Woude LH, van Dijk FJ. 2002. Pushing and pulling in association with low back and shoulder complaints. Occup Environ Med 5910:696–702.

Hulley SB, Cummings SR, Browner WS, Grady D, Hearst W, Newman TB. 2001. Designing clinical research: An epidemiologic approach, 2nd edition. Philadelphia: Lippincott Williams & Wilkins.

Job Content Questionnaire Center. 2008. Job Content Questionnaire: Frequently asked questions. Retrieved September 12, 2008, from www.jcq.org.

Joksimovic L, Starke D, von dem Knesebeck O, Siegrist J. 2002. Perceived work stress, overcommitment, and self-reported musculoskeletal pain: A cross-sectional investigation. Int J Behav Med 92:122–138.

Karasek R. 1985. Job Content Questionnaire and User's Guide. Lowell, MA: University of Massachusetts Lowell.

Karasek R, Theorell T. 1990. Healthy work: Stress productivity, and the reconstruction of working life. New York: Basic Books. 373 p

Karasek R, Siegrist J, Theorell T. 1998. Joint statement on the relationship between two theoretical models measuring stress at work: The demand-control model, and the effort-reward imbalance model. Retrieved November 25, 2005, from http://www.uni-duesseldorfde/MedFak/workstress/jointstatement.html.

Krause N, Scherzer T, Rugulies R. 2005. Physical workload, work intensification, and prevalence of pain in low wage workers: Results from a participatory research project with hotel room cleaners in Las Vegas. Am J Ind Med 485:326–337.

Kumar R. 2006. Ergonomic Evaluation and Design of Tools in Cleaning Occupation Doctoral Thesis. Retrieved November 2, 2008 from http://epublluthse/1402-1544/2006/16/LTU-DT-0616-SE.pdf.

Kumar R. 2008. Musculoskeletal risk factors in cleaning occupation: A literature review. Int J Ind Ergon 382:158–170.

Landsbergis P, Schnall P, Warren K, Pickering T, Schwartz J. 1994. Association between ambulatory blood pressure and alternative formulations of job strain. Scand J Work Environ Health 20:349–363.

Laursen B, Sogaard K, Sjogaard G. 2003. Biomechanical model predicting electromyographic activity in three shoulder muscles from 3D kinematics and external forces during cleaning work. Clin Biomech (Bristol, Avon) 184:287–295.

Lee PT, Krause N. 2002. The impact of a worker health study on working conditions. J Public Health Policy 233:268–285.

Mathiassen SE, Burdorf A, van der Beek AJ, Hansson GA. 2003. Efficient one-day sampling of mechanical job exposure data–a study based on upper trapezius activity in cleaners and office workers. AIHA J 642:196–211.

Messing K, Chatigny C, Courville J. 1998. 'Light' and 'heavy' work in the housekeeping service of a hospital. Appl Ergon 296:451–459.

Miranda H, Viikari-Juntura E, Martikainen R, Takala EP, Riihimaki H. 2001. A prospective study of work related factors and physical exercise as predictors of shoulder pain. Occup Environ Med 588:528–534.

Nahit ES, Macfarlane GJ, Pritchard CM, Cherry NM, Silman AJ. 2001. Short term influence of mechanical factors on regional musculoskeletal pain: A study of new workers from 12 occupational groups. Occup Environ Med 586:374–381.

National Research Council, The Institute of Medicine. 2001. Musculoskeletal disorders and the workplace: Low back and upper extremities. Washington DC: National Academy Press.

NIOSH. 1997. Musculoskeletal disorders and workplace factors: A critical review of epidemiologic evidence for work-related musculoskeletal disorders of the neck, upper extremity, and low back. Cincinnati, OH: DHHS NIOSH, Publication no. 97-141.

Ostergren PO, Hanson BS, Balogh I, Ektor-Andersen J, Isacsson A, Orbaek P, Winkel J, Isacsson SO. 2005. Incidence of shoulder and neck

pain in a working population: Effect modification between mechanical and psychosocial exposures at work? Results from a one year follow up of the Malmo shoulder and neck study cohort. J Epidemiol Community Health 599:721–728.

Parker E, Krause N. 1999. Job quality in the hospitality industry: Findings from the San Francisco Housekeeping Study. Madison, WI: Center on Wisconsin Strategy, University of Wisconsin-Madison.

Pope DP, Silman AJ, Cherry NM, Pritchard C, Macfarlane GJ. 1998. Validity of a self-completed questionnaire measuring the physical demands of work. Scand J Work Environ Health 245:376–385.

Rugulies R, Scherzer T, Krause N. 2008. Associations between psychological demands, decision latitude, and job strain with smoking in female hotel room cleaners in Las Vegas. Int J Behav Med 151:34–43.

Siegrist J, Peter R. 1999a. The model of effort-reward imbalance: Theoretical background. Retrieved November 25, 2005, from http://www.uni-duesseldorfde/MedFak/workstress/theory.html.

Siegrist J, Peter R. 1999b. Questionnaire Guidelines: Measuring effort-reward imbalance at work. Retrieved November 25, 2005, from http://www.uni-duesseldorfde/MedFak/workstress/guidelines.html.

Siegrist J, Starke D, Chandola T, Godin I, Marmot M, Niedhammer I, Peter R. 2004. The measurement of effort-reward imbalance at work: European comparisons. Soc Sci Med 58:1483–1499.

Silverstein B, Viikari-Juntura E, Fan ZJ, Bonauto DK, Bao S, Smith C. 2006. Natural course of nontraumatic rotator cuff tendinitis and shoulder symptoms in a working population. Scand J Work Environ Health 322:99–108.

Stock SR, Fernandes R, Delisle A, Vezina N. 2005. Reproducibility and validity of workers' self-reports of physical work demands. Scand J Work Environ Health 316:409–437.

Svendsen SW, Bonde JP, Mathiassen SE, Stengaard-Pedersen K, Frich LH. 2004. Work-related shoulder disorders: Quantitative exposure-response relations with reference to arm posture. Occup Environ Med 6110:844–853.

Tsutsumi A, Kawakami N. 2004. A review of empirical studies on the model of effort-reward imbalance at work: Reducing occupational stress by implementing a new theory. Soc Sci Med 5911:2335–2359.

Unge J, Ohlsson K, Nordander C, Hansson GA, Skerfving S, Balogh I. 2007. Differences in physical workload, psychosocial factors and musculoskeletal disorders between two groups of female hospital cleaners with two diverse organizational models. Int Arch Occup Environ Health 81:209–220.

van Vegchel N, de Jonge J, Bosma H, Schaufeli W. 2005. Reviewing the effort-reward imbalance model: Drawing up the balance of 45 empirical studies. Soc Sci Med 605:1117–1131.

Werner RA, Franzblau A, Gell N, Ulin SS, Armstrong TJ. 2005. A longitudinal study of industrial and clerical workers: Predictors of upper extremity tendonitis. J Occup Rehabil 151:37–46.

Woods V, Buckle P. 2006. Musculoskeletal ill health amongst cleaners and recommendations for work organisational change. Int J Ind Ergon 361:61–72.

Zock JP. 2005. World at work: Cleaners. Occup Environ Med 628:581–584.