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Women's perception of risk from occupational musculoskeletal exposures

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Women's Perception of Risk from Occupational Musculoskeletal Exposures

by

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DISSERTATION

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Dedication

To my husband, Bruce
You are my life's companion
Thank you for your support, encouragement and love

To my children Casey and Elise
You are the lights of my life
Thank you for laughter, tears and just the enjoyment of living

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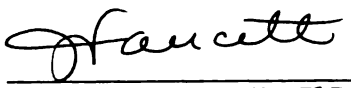
Women's Perception of Risk from Occupational Musculoskeletal Injury

Lynette Landry RN, MS, PhD

Perception of risk of injury from occupational exposure is associated with an individual's propensity to act. Given that women comprise greater than 50% of the workforce in the United States, an understanding of how risk is perceived will help to target interventions to specific groups of working women. **Aim:** The objective of this study was to examine a woman's demographics, health, occupational characteristics and the risk characteristics attributed to her occupational stressors as predictors of her perceptions about risk of injury to self and other women from occupational musculoskeletal exposures. **Methods:** The study used a cross-sectional design and invited a random sample of women living in Sonoma County, California, who were employed in the 12 months prior to survey administration to participate (n=123, 27% response rate). A telephone survey using Slovic's psychometric model of risk perception and consisting of 154 items was administered in English or Spanish. Predictors found to be significant ($p \leq 0.10$) in preliminary univariate analyses were included in multivariate equations of risk to self and to other women. **Results:** The final multiple regression equation computed for the perception of risk of injury to self explained approximately 66% of the variance. Significant unique contributions to the variation in the perception of risk of injury to self were found for bodily pain, occupational exposure to repeated strenuous physical activity or repetitive hand motion, perceived seriousness and controllability of the risk, and perception of risk to other women. Similarly, the final multiple regression equation computed for perception of risk of injury to other women explained approximately 57% of the variance. Significant unique contributions to the variation in the perception of risk of injury to other women were found for household size, occupational exposure to repetitive hand motion, familiarity of the risk, and perception of risk of injury to self. **Conclusion:** Exposure experiences and risk characteristics were found to increase women's perceptions of risk from occupational musculoskeletal exposures for themselves and others. These findings support the psychometric paradigm, but call for comparisons between genders related to occupational musculoskeletal exposures. The low response rate, however, suggests that the results have limited generalizability.



Julia Faucett, RN, PhD

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"Having access to information about the multiplicity of dimensions of women's health is essential to mobilize political support for a broadened vision of what actually contributes to all women's health and well-being"

Ruzek, Clarke and Olesen, 1997

Introduction

Ruzek, Clark and Olesen (1997) contend that women's health must be evaluated within a social context. A woman's social context is multidimensional and includes: culture, hierarchy, family, friends, and occupation. Of these social dimensions, there is a paucity of information on the influences of occupational and environmental exposures on the health status of women. Job stress and the resulting psychological sequelae have been the focus of most investigations into the relationship between women's work and their health. Another body of research has explored the effects of occupational exposures to chemicals and the subsequent risk of developing cancer or having an adverse reproductive outcome (Hatch & Moline, 1997). Unfortunately, when women's occupational injury risk has been evaluated it has been evaluated from within a large mixed gender cohort of primarily men. Furthermore, researchers have used job title to evaluate risk rather than exposures specific to a task (Messing, 1997). As men and women often participate in different tasks and have different exposures within a job title, specific tasks need to be studied in order to quantify women's occupational risk (Hatch & Moline, 1997).

In addition to understanding the unique occupational exposures of women, it is important to gain an understanding of their perception of risk to health from these exposures. Risk perception guides behavior and influences why a woman may or may not choose to reduce her risks from occupational exposures. Perceived risk has been used as the theoretical framework in studies evaluating why there is a difference among people in avoiding

situations that could affect health status, such as use of condoms or participation in a stop smoking program. However, there is a lack of research concerning women's perceived risk to health from occupational exposures. A perception of risk enables a woman "to take action removing or minimizing" the occupational hazard (Harrell, 1990, p. 1351). Given that, women comprise over 50% of the workforce in the United States (Stellman, 1999), an understanding of women's perceived risks from occupational exposures is important in developing interventions to reduce their risk.

Purpose

The purpose of this study is to characterize women's perceived risk to their musculoskeletal health from occupational exposures. A community sample of working women was interviewed in either English or Spanish. Analysis included exploration of the relationship between a woman's occupation, her occupational exposures and her perception of risk. Additionally, the influence of a woman's health status – general health, physical functioning and presence of musculoskeletal disorders – and her demographic characteristics on the perception of risk was studied.

Significance

Occupational Health

According to data from Healthy People 2010, 6.1 million workers in the United States suffered injuries that resulted in either lost time from work, medical treatment, or restricted work activity (Centers for Disease Control, 1999). This represents a rate of 6.6 injuries per 100 full-time workers. In addition, data from California indicate that exposure to harmful substances/environments or caustic/noxious/allergenic substances accounted for 9.4% and 2.1% of all work related injuries (California Department of Industrial Relations, 1999). These

statistics highlight the fact that occupational injuries and accidents represent significant public health and occupational health and safety problems. Over the last decade, women have been entering the workforce in increasing numbers. In 1996, 77.2% of women with school - aged children (7 to 16 years old) were employed outside the home (Stellman, 1999). In 1999, women comprised 58.1% of the civilian labor force in California (Bureau of Labor Statistic, 2000).

Employment Patterns.

The Bureau of Labor Statistics (1999) survey results indicate that though women comprise a significant proportion of the workforce, they are not evenly distributed throughout the workforce and tend to be clustered in specific occupations (see Table 1). Based on the results of the Bureau of Labor Statistics (1999) survey it is evident that despite a changing economy, women still tend to be clustered in jobs that have traditionally been occupied by women, making their employment patterns different from those of men (Messing, Tissot, Saurel-Cubizolles, Kaminski, & Bourgine, 1998; Stellman, 1999). As noted by Stellman (1999)

> "... even when men and women share employment in a particular industry, the jobs that they do generally are different. Often, they perform different tasks even within the same job title. Thus both employment patterns and jobs are different for males and females." (p. 567)

Women in blue-collar jobs tend to be employed in textiles, small machine operation and assembly line jobs (Stellman, 1999), compared to men who are employed in construction, heavy machine operations and handling and shipping. In addition, when evaluating

Table 1 Occupations in which women comprise >70% of workers (Bureau of Labor Statistics, 1999)

Occupation	% women employed in the occupation
Secretaries, stenographers, typists	97.9%
Private household (child care workers, cleaners/servants)	95.2%
Dressmakers	89.8%
Waiters/waitresses	77.4%
Animal caretakers, except farm	76.0%
Teachers (except college and university)	74.9%
Graders and sorters, agricultural products	72.8%
Health assessment and treating occupations (registered nurses, dietitians, therapists).	95.0%
Health technologists and technicians (clinical laboratory technicians, dental hygienists, radiological technicians, licensed practical nurses)	81.2%
Information clerks (interviewers, hotel clerks, reservation agents, receptionists)	88.3%
Records processing (order clerks, personnel clerks, library clerks, file clerks, records clerks)	77.8%
Financial records processing (bookkeepers, payroll clerks, billing clerks, cost/rate clerks, etc.)	90.8%
Misc. administrative support (general office clerks, bank tellers, data entry keyers, statistical clerks, teachers' aides)	83.4%
Health service occupations (nursing aides, health aides, dental assistants)	89.2%
Personal service occupations (hairdressers/cosmetologists, public transportation attendants, welfare service aides, family child care providers, early childhood teachers' assistants	80.8%

Table 1 Occupations in which women comprise >70% of workers (Bureau of Labor Statistics, 1999) (cont.)

Occupation	% women employed in the occupation
Textile, apparel, and furnishings machine operators (textile sewing machine operators, pressing machine operators, laundering/dry cleaning machine operators)	70.8%

women's jobs in the health care services sector, women tend to be concentrated in the non-diagnosing professions, specifically nursing, therapy and aides (Stellman, 1999). Emslie, Hunt, and Macintyre (1999) found that only 8% of the managers at a major bank in England were women, while 72% of the clerical workers were women.

Moreover, when women work in non-traditional settings, such as construction or mechanics, the tools provided to women are often designed for the 75th percentile male posing additional hazards. Messing, Dumais, Courville, Seifert, and Boucher (1994) interviewed male and female workers in Quebec and found that women reported that gloves were too big, tools were difficult to use or manipulate because handles were too far apart and tractors had seats that were too far away from the steering wheel and accelerator. If an employee is working with tools that are not fitted to that employee, there is an increased risk of injury. Imagine attempting to use a mop that weighs approximately 40 pounds when wet, when you only weigh 110 pounds.

Another issue in the investigation of exposures in women at work is that women's work has been traditionally viewed as "safe" and therefore has often been excluded from studies of occupationally related diseases and injuries (Messing, 1997). The result has been

that women's exposures to occupational environments that could be affecting their health status have been understudied. One reason for this research bias is that women are not initially conceptualized according to their occupation, but rather they are wives or mothers first, and professionals second (Emslie et al., 1999). For example, in studies of workplace carcinogens, the unique biological differences between men and women have not been considered. Yet, women are exposed to many known carcinogens. Stellman (1994) identified 24 occupational carcinogens commonly used in women's occupations, using data from the U.S. Department of Labor, the International Agency for Cancer Research and the Hazardous Substance Database of the National Library of Medicine (see Table 2). Though women are exposed to many potentially toxic and/or noxious substances, there have been few epidemiological studies on the unique effects of these substances on women's health.

Other Risk Factors.

In addition to the physical aspects of the occupational environment, women are exposed to non-physical factors that affect health. In a review of the literature, Faucett (1999) found that occupational non-biomechanical factors had a significant association with the development of occupational musculoskeletal disorders (MSDs). Occupational non-biomechanical factors were defined as job demand, job content, job control, social relationships at work, work role ambiguity and job satisfaction. Women workers are also faced with socioeconomic factors that govern employment and remuneration patterns. These socioeconomic factors, as delineated by Stellman (1999), include: 1) barriers to advancement; 2) occupational segregation; 3) underemployment; 4) low or no remuneration; 5) job instability or lack of tenure; and 6) multiple burdens, e. g. maintaining employment, child care, and maintenance of the home. Emslie et al. (1999) in a cross sectional study

Table 2 Occupations with exposure to carcinogenic compounds (Stellman, 1994)

Occupation	Carcinogen Exposed To
Cleaning Services	2-Chlorophenol
Dry Cleaning	Benzene
	Carbon tetrachloride
	Chloroform
	Tetrachloroethylene
Electronics	Cadmium oxide
	Dichloromethane
	Hexachlorobenzene
	Lead
	Nickel carbonyl
Hairdressing, cosmetology	Epichlorohydrin
Health care	Beta-propiolactone
	Dichloromethane
	Ethylacrylate
	Ethylene oxide
Office work	Tetrachloroethylene
Photography and photographic supplies	Chromium
	1,2-Dichloroethane
	Dimethylhydrazine
	Formaldehyde
	Resorcino
	Toulene-2,4-diamine
Printing	Benzene
	1,4-Dioxane
	Formaldehyde
Yarn, threading, and fabrics	Toluene diisocyanate

of bank employees, found that working conditions, specifically lack of job stimulation, job drain (work pace, stress, perceived control and perceived effects on health), and low work ethic at work were the only factors significantly associated with reported physical symptoms. These occupational non-biomechanical factors, above and beyond the physical exposures that women have, may place women at increased risk of injury or disability.

Previous research of women's occupational exposures has focused entirely on paid employment, but women have substantial exposures outside the workplace, as well. For example, Messing et al. (1998) analyzed the type of work and hours worked per week of men and women employed in poultry processing. Though men worked, on average, more hours at paid employment than women, 40.8 hours and 38.5 hours respectively, women worked more total hours per week than men when domestic work and farm work were included in the weekly average. The occupational risks of household work have not been studied or included in studies of women's occupational exposures, yet household duties comprise a significant amount of a woman's work life. In fact, as Messing, Doniol-Shaw, and Haentjens (1993) point out, only paid work in the "visible economy" has been considered in studies of women's occupational health. This narrow picture of women's work omits a large percentage of women who work in the home or outside the "visible economy," i.e. prostitutes, agricultural workers (Messing et al., 1993).

In addition to vertical job segregation (working in traditional jobs), women also experience horizontal job segregation (lack of advancement or similar remuneration). Women experience economic segregation because they are typically employed in segments of the economy that are low paying (see Table 3).

In fact, women in the top 20 jobs still earn approximately 67% of that of their male counterparts (Messing, 1997). Census Bureau estimates indicate that approximately 27.8% of female head of household families in the United States live below the poverty level[1] (U.S. Census Bureau, 2000). This economic segregation results in reduced employment options to women. Economic status, as well, has been shown to affect health status. Economic status influences the ability to obtain such things as routine (preventive) health care services and adequate food and housing. However, the influence of economic status may be confounded by the occupational environment of those working at the bottom of the economic ladder due to increased psychological demands as well as physical exposures.

In summary, as (Messing, 1997) states,

> Despite considerable progress in integrating women into the labor force, women are still found in specific jobs, where employment conditions are relatively unfavourable. This sexual division of labor affects women's health in 6 ways: (1) Women's jobs have specific characteristics...that may lead over time to physical and mental illness; (2) Spaces, equipment and schedules designed in relation to the average male body...may cause problems for women; (3) segregation may cause health risks.... (4) sex-based job assignments may appear to protect the health of both sexes and thus distract from more effective occupational health promotion practices; (5) discrimination against women is stressful...(6) part-time workers are excluded from many health-promoting benefits (p. 46-47).

Given the differences in occupational exposures of women, their perception of risk from *these* exposures may be different than the perception of risk from occupational

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[1] The 1999 Health and Human Services poverty guidelines define a family of 4 with an income of $17,050 or less a living in poverty (Federal Register, 2000).

Table 3 Salary ranges for occupations in which women comprise >70% of workers (Bureau of Labor Statistics, 1999)

Occupation	Mean annual income
Health assessment and treating occupations	$35,000 – $57,000
Health technologists and technicians	$18,000 - $33,000
Secretaries, stenographers, typists	$22,600 – $25,400
Information clerks (interviewers, hotel clerks, reservation agents, receptionists)	$15,000 - $23,000
Records processing (order clerks, personnel clerks, library clerks, file clerks, records clerks)	$17,000 - $24,000
Financial records processing (bookkeepers, payroll clerks, billing clerks, cost/rate clerks, etc.)	$22,000 - $25,000
Misc. administrative support (general office clerks, bank tellers, data entry keyers, statistical clerks, teachers' aides)	$16,800 – $21,600
Private household (child care workers, cleaners/servants)	$14,200
Waiters/waitresses	$12,200
Health service occupations (nursing aides, health aides, dental assistants)	$16,600 - $22,600
Personal service occupations (hairdressers/cosmetologists, public transportation attendants, welfare service aides, family child care providers, early childhood teachers' assistants	$13,700 – $15,300
Dressmakers	$18,600
Textile, apparel, and furnishings machine operators (textile sewing machine operators, pressing machine operators, laundering/dry cleaning machine operators)	$14,700 – $15,100
Animal caretakers, except farm	$14,800
Graders and sorters, agricultural products	$13,400

* Salary data for teachers (non college and non university) not available because those typically employed as teachers work less than 2080 hours/year (Bureau of Labor Statistics, 1999)

exposures of their male counterparts.

Perceived Risk

According to Bernstein (1998), risk perception is the way in which a person recognizes and responds "to the probabilities they confront" (p. 56). Further, in order to perceive risk, a person must feel that they are free agents in their own destiny, rather than being at the mercy of fate or the gods. Perception of risk is time dependent, in other words, if there is no perceived future there is no perception of risk. Thus, in order for a person to perceive risk, the person must believe there is a future and have a sense of control over their lives. Moreover, perception of risk is "proportional not merely to the gravity of the harm, but also to the probability of the event" (Hacking, 1975).

In order to manage a perceived risk, a decision about the probability of injury or affect on health must be made. The perception of risk from occupational exposures influences the protective behaviors that a worker demonstrates. For example, Stewart-Taylor and Cherrie (1998) found that male asbestos workers who perceived the risks of health effects from exposure to asbestos as low were more likely to use power tools in the removal of asbestos from buildings thereby increasing their exposure to asbestos. The perception of risk from occupational exposures influences if and when personal protective equipment will be used (de Vries & Lechner, 2000).

In addition to risk perception differences among professions or occupations, there may also be gender differences in the way risk is perceived. Men may perceive the risk to health from occupational exposures differently than women. Flynn, Slovic, and Mertz (1994) evaluated the perceived risk of 24 technologies among 1489 subjects. The sample was composed of 713 men and 776 women, of whom 214 (males and females) classified

themselves as non-white. White males, in general, classified all 24 technologies as less risky than did other study participants. Women and non-white males tended to assess the risk of these technologies as larger and more problematic than white males. This difference in risk perception may be because women and non-white males perceive themselves as more vulnerable, as deriving less benefit and as having less power and control over the technologies than white men have. These researchers hypothesized that sociopolitical factors, such as perceived control, alienation, trust and status, influence perception of risk. In general, women perceive the world as a riskier place than men do (Flynn et al., 1994; Savage, 1993). For example, women rated all technologies higher on the dread dimension then men. Additionally, women feel they are personally more at risk than men (Savage, 1993).

In considering the differences in risk perception among men and women, attention should focus on differences in worldview. Worldview is defined as fatalism, hierarchy, individualism and egalitarianism (Slovic, 1997). Given traditional roles in society, women may have different worldviews than men. A mother of small children may not view the world from individualistic view point but rather a collective viewpoint in order to reduce the influence to her family of external risks, e.g. neighborhood crime may be perceived as a larger problem because of the collective threat to her and her children.

> In addition to differences in risk perception, there may be differences in how an individual assesses the acceptability of the risk. Fischhoff (2000) defines risk acceptability using the following judgments an individual will make about the risk: 1) the certainty and severity of the risk; 2) knowledge or familiarity with the risk; 3) whether or not the risk is voluntarily or involuntarily imposed; 4) if the health affects are reversible or irreversible; 5) there is compensation for exposure to the risk; 6) a

consideration of the risks and benefits of the alternatives; and 7) the benefits of the risk under consideration. For example, though the risks from a certain job exposure may be perceived as risky to a woman's health, a low-income head of household woman may opt to keep the job and it's associated risks, rather than risk becoming homeless, a fate judged to be worse.

Understanding how risk is perceived can facilitate the development of effective risk reduction strategies. For example, in designing a health and safety program it may be important to consider those exposures that are perceived of as safe but pose a risk of injury. Likewise, understanding how women perceive their risks from occupational exposures can guide further research into interventions to reduce occupational injuries across the continuum of women workers.

Conclusion

Women have unique occupational exposures and these exposures are not well understood, nor are their affects on health status. Given that there are increasing numbers of women entering the workforce, it is imperative to gain an understanding of how women perceive their risk from occupational exposures so that interventions, which consider risk perception as they relate to occupational exposures can be developed and tested.

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"There is no point in getting into a panic about the risks of life until you have compared the risks which worry you with those that don't, but perhaps should"

Lord Rothschild, 1979

Introduction

Previous research in occupational health has been guided by the misconception that women's work is safe and therefore does not need to be studied (Messing, 1997). A significant contributing factor to the differences in the health status of men and women may be differences in occupational exposures; though men and women may have the same job, the tasks they perform may be different (Messing, Tissot, Saurel-Cubizolles, Kaminski, & Bourgine, 1998). For example, in a study of poultry processing in France, researchers found that the exposures of men and women were different because of job segregation within the facility even though job titles were similar (Messing, Tissot et al., 1998).

Census Bureau data from 2000 indicates that approximately 40% of employed women work part time in paid positions (U. S. Census Bureau, 2003). Although, part time workers have similar task profiles, their jobs can be more monotonous and these workers have less on the job learning opportunities than full time workers (Matthews, Hertzman, Ostry, & Power, 1998). Women workers tend to be clustered in jobs that are highly repetitive, but that require minimal force for task completion, such as data entry, scanning groceries, sewing garments. Repetitive tasks increase the risk of several different types of musculoskeletal disorders (MSDs) including cumulative trauma disorders (from long term micro injury to muscle and soft tissue). Although it is known that repetitive movements cause musculoskeletal injury, the link between specific job titles or tasks and long-term disability is weak because it may be difficult to identify physical injury and often a well-defined event has not occurred (Messing, 1998).

Musculoskeletal injuries are the leading cause of work related disabilities. MSDs account for more than 60% of all new occupational illnesses in the United States (Hatch & Moline, 1997). Approximately 80% of all Americans will experience low back pain at some time during their work life much of which is likely to be the result of occupational activities (Armstrong et al., 1993). According to recent research, musculoskeletal disorders (MSDs) are the leading cause of morbidity among women workers, second in frequency to upper respiratory infections. Messing, Chatigny, and Courville (1998) noted that 55% of women's occupational injuries, in Quebec, were musculoskeletal, such as tendinitis, bursitis, sprains or backaches. Moreover, work related illness due to musculoskeletal injuries accounted for over 8.2% of the work related sick leave among Swedish working women (Ono, Lagerstrom, Hagberg, Linden, & Malker, 1995). Many of the injuries and diseases that women develop from occupational exposures may lead to chronic conditions, thus occupational injury may be an important reason why women leave the work force (Leino, Tuomi, Paakkulainen, & Klockars, 1999). Though there are a myriad of MSDs that can contribute to disability, the majority of occupational MSDs are either back pain or cumulative trauma disorders, usually to the upper extremities.

In 2001, according to the California Department of Industrial Relations (2003), there were over 60,000 reported work-related disorders, conditions, or illness among California workers. Over 57% of these disorders were related to repeated trauma, while 5.2% were skin disorders and 2.9% were respiratory diseases or conditions. Richter (1998) also found a higher degree of MSDs in a study that evaluated illnesses and injuries among women workers at national U.S. Department of Energy (DOE) sites. The number one reason for a work absence of 5 or more days was injury resulting from sprains or strains. Women working

at DOE sites had a rate of work absence due to musculoskeletal system disorders of 20.7/1000 (adjusted for age of the worker), which was second only to respiratory system illness (which included non-occupationally induced respiratory illnesses). These reported numbers may also be lower than the actual rates of occupationally related MSDs due to underreporting for a variety of reasons, including fear of reprisal, loss of job or immigration status.

Due to the differences in employment opportunities and employment patterns, women may have different occupational exposures than men. Additionally, they may perceive the risk from their occupational exposures differently than men. Perception of risk of injury increases the probability that action will be taken to minimize the consequences of the exposure. To plan and implement interventions to reduce the influence of adverse occupational exposures on women, it is important to understand of how women perceive their risks in the first place. However, to gain an understanding of how women perceive their risks from occupational exposures, it is first necessary to understand what those exposures are. This chapter will include a review of the literature on occupational musculoskeletal injuries focusing on women's work and the occupational exposures common to those jobs. The chapter will then examine the theory of risk perception, which provides the framework for this study.

Musculoskeletal Injuries/Illness

Literature searches of PubMed and Medline were conducted using key words women, musculoskeletal, and occupation (s, al) to identify the relevant background literature. Ten studies were selected for inclusion in the literature review based on whether the sample included a significant portion of women. An attempt was made to include studies that

considered women in a wide cross section of occupations since women are moving into many occupations that have been traditionally considered men's occupations.

Low Back Pain

Women are at risk of experiencing a back injury as a result of their occupational musculoskeletal exposures. Among the many job tasks a woman may perform are tasks that put workers at higher risk of injury including static postures, heavy lifting, repetitive body movement and walking more than two hours a day.

Using occupational injury information database researchers, in Sweden, compared the rates of musculoskeletal injuries among home care service workers (non-nurses), nursery school workers (non-professional teachers) and the general population of women workers (Ono et al., 1995). Men were excluded from the study because of the small number of men employed as home care service workers and nursery school workers. Of all factors studied, overexertion accidents had the highest incidence rate (19.2/1000 workers) among home care service workers, followed by musculoskeletal injuries due to falls (4.6/1000 workers). Within the class of overexertion accidents, back injuries were the most common, followed by injuries to the neck. Home care service workers had an incidence of 15.2 musculoskeletal injuries per 1,000 workers compared to 6.6 musculoskeletal injuries per 1,000 workers among nursery school workers. The annual incidence of musculoskeletal injury for both occupational groups, home care service workers and nursery school workers, was higher than the general population of women workers. The authors provided no information on the significance of difference between the 3 groups. Despite the lack of a detailed comparison with the general population of women workers certain job tasks and occupational exposures were identified as placing the woman at risk. Lifting accounted for the majority of

musculoskeletal injuries experienced (81.2%), 55% of which were associated with person handling (either patient or child). The incidence of musculoskeletal injuries in this study may have been underestimated because only those injuries that were reported to be work related were considered. Results of this study indicate that women employed in occupations generally considered safe, such as caring for children, are at risk of sustaining a musculoskeletal injury.

Macfarlane et al. (1997) examined predictors of low back pain using a mailed questionnaire with a prospective cohort of both men ($n = 655$) and women ($n = 727$) from a convenience sample within a geographic region of northwest England. Subjects ranged in age from 18 to 75. Subjects were followed for 12 months. Risk factors significantly associated with low back pain included walking or standing for more than 2 hours per day and lifting more than 25 pounds. No association was found in the relationship between onset of low back pain and duration of exposure. Because of its prospective design, this study was able to evaluate new episodes of pain in relation to job activity. There was an increased risk of experiencing back pain for women, specifically engineers, teachers, legal and health professionals. The increased risk for women in this study may be related to activities that have been shown to increase the risk of low back pain including static postures; bending, reaching or twisting; and heavy lifting. However, the short follow-up period (12 months) may have limited the researcher's ability to determine the full spectrum of exposures that may increase the risk of experiencing an episode of low back pain. Additionally, the cohort included workers who may have had prior episodes of back pain, but who had been pain free for the previous 12 month. Those who have had previous episodes of back pain may be more susceptible to subsequent episodes than those who have never experienced back pain.

Similarly, Alcouffe, Manillier, Brehier, Fabin, and Faupin (1999), in a cross-sectional survey of 7,010 workers employed in small companies (<3,500 employees) in the Paris metropolitan area, found an association between low back pain and lifting greater than 10kg, uncomfortable working positions, and perceived absence of a means to good quality work. The sample consisted of men (54.8%) and women (45.2%), however most of the women in the sample were employed in clerical positions (53%). Women had a higher prevalence of low back pain, particularly pain with radiation below the knee (the highest degree of severity). Results of this study indicate that there is a difference in risk of injury from occupational stressors between men and women workers when job task is considered rather than job title. Therefore efforts should be made to reduce those exposures that have been identified as increasing the risk of sustaining a back injury. However, the researchers did not measure any association between low back pain and the risk from static postures; bending, reaching or twisting; or repetitive tasks although these exposures exist in many industrial settings and are known to increase the risk of experiencing a back injury.

In a study of health care workers in United Kingdom, Smedley, Egger, Cooper, and Coggon (1995) surveyed 1,659 women using a self-administered questionnaire to determine exposures associated with the onset of new episodes of low back pain. A follow-up questionnaire was administered a year later. Occupational factors that were found to place health care workers at risk of experiencing low back pain were moving patients in bed, patient transfers from bed to chair and lifting patients from the floor. As with the previously mentioned studies, researchers identified heavy lifting as risk factor for experiencing a back injury. However, several exposures common to health care workers, and known to increase

the risk of low back pain were not considered, such as standing for long periods of time or walking for greater than 2 hours per day.

Working women are at risk of experiencing low back pain from the exposures they experience in the workplace. Risk factors for low back pain identified in this review of the literature include heavy lifting, walking or standing for more than 2 hours per day, driving for greater than 4 hours per day, and uncomfortable work positions. These studies also support the notion that though traditional women's jobs may be considered safe, the tasks required to perform the job place women at risk of experiencing low back pain.

Shoulder, Neck, Arms and Hands

Punnett and Bergqvist (1999), in a review of the literature, reported that women working at visual display units (VDUs) had an excess risk over men of neck, shoulder, elbow and hand/wrist symptoms across four of seven studies. However, this excess risk may be reflective of differences in job tasks among men and women rather than differences in susceptibility to injury. One study in the review included both men and women who performed highly repetitive tasks and thus were more comparable in types of exposure. There was no difference in the odds ratios for any of the symptoms (neck, shoulder, or hands/wrist) considered when stratified by gender in this study. The results of this review of the literature support the assertion that it is important to consider job tasks rather than job title when evaluating the risk of injury from the physical activities in which workers engage, since it is the task that defines the adverse exposures that can lead to injury.

In a study of all the worker's compensation claims for lost time from work resulting from repetitive strain injury (carpal tunnel syndrome, bursitis, tenosynovitis, tendintis and epicondylitis) from 1986 to 1991, Ashbury (1995) found that women had a higher rate of

worker's compensation claims than men and reported more time lost from work. The sample was drawn from a worker's compensation database in Ontario, Canada and included employed men (n = 7,301) and women (n = 8,707) employed in a full range of industries. In addition to the increased frequency of reported repetitive strain injuries (RSIs) among women workers, the relative risk to women was higher than men across all years of the study and important to the study, across all occupations. Women employed in several occupations had a higher relative risk (*RR*) of experiencing a RSI than men – material handling (*RR* = 6.0), construction (*RR* = 4.0) and processing (*RR* = 3.5). Again, the increased relative risk reported in this study for women may be a reflection of the job tasks that women do, which tend to be highly repetitive. However, rates of repetitive strain injury in this study may have been underestimated for two reasons. First, not all jobs in Ontario are covered by the worker's compensation system; hence, some occupations may not have been represented. Second, data was analyzed only for lost time claims. This can be problematic since many injuries occur where the workers continue to work and do not lose any time from work. No analysis of risk factors or job tasks that placed workers at risk was undertaken. The study provides information about the incidence of repetitive strain injuries in Ontario, but was not designed to provide insight into possible causative factors of injury.

Leino et al. (1999), using a retrospective cohort of hairdressers, a job most often held by women, and referents in a 15 year follow-up study using a self administered questionnaire, found that the relative risk (*RR*) for leaving the profession of hairdressing was increased for "disease of the neck or shoulder" or a "strain injury of the wrist or elbow" (*RR* = 1.7, 95% CI, 1.2 – 2.5 and *RR* = 2.7, 95% CI, 1.1 – 6.3, respectively). In addition, the *RR* for leaving the profession of hairdressing for health reasons was 1.33 (95% CI, 1.16 – 1.52), none of the

other factors considered (work organization, ergonomic, financial and social) had a *RR* of leaving the profession of greater than 0.62. The response rate (> 79% for each group) strengthened the results of this study. Thus experiencing a musculoskeletal injury at work may increase the risk of leaving a profession because of the perceived or real long-term health consequences of such injuries.

In a study evaluating the occurrence and risk of upper limb cumulative trauma disorders (CTDs), Meservy, Suruda, Bloswick, Lee, and Dumas (1997) administered a survey to 67 women and 78 men, at a medical device manufacturing company, as well as a medical screening exam. Additionally, a job analysis for each job task was completed in order to identify ergonomic risk factors inherent in each particular task. The risk factors identified included wrist flexion, ulnar deviation, neck flexion, arm rotation and use of pinch grips. Women had higher point prevalence and period prevalence rates of upper extremity CTDs than men. Although, the sample was drawn from within one industry and only workers in production/assembly were included, differences in work stations and tool design may have been responsible for the increased prevalence of CTDs among women. Workstations built for a large person can increase the risk of injury when used by a small person. Typical assembly lines are not adjustable and differences in height in the workstation can influence the degree of rotation or extent of reach required for task completion. In addition, the risk of injury may also be the result of a difference in the time spent performing non-work activities, such has housework, caring for children or cooking. As the study was conducted at one site, the study has limited generalizability to other industrial settings. Additionally, the cross sectional design of the study did not allow analysis of the casual relationship between exposure and the development of a cumulative trauma disorder from the exposures. However, researchers used

National Institute for Occupational Safety and Health (NIOSH) definitions in doing the job analysis making the study highly replicable.

In a large cross sectional study (n = 12,907) of the general population of England, Scotland and Wales, Palmer (2001) identified risk factors for neck pain. The mailed surveys included questions regarding the respondent's occupation, occupational sources of vibration, work place activities, and questions from the Standardized Nordic Questionnaire of Musculoskeletal Symptoms to determine the prevalence of neck pain. Of the total sample, 34% reported neck pain in the last year, 20% had neck pain in the last week and 11% reported pain that interfered with activity. The rates of reported neck pain (pain in the last week, pain in the last year and pain interfering with activity) were higher among women than men across ages and social classes. Although in both men's and women's occupations, there were several occupations where increased numbers of workers reported neck pain but there was no statistical difference in prevalence across occupations. The only occupational activity that was found to place workers at increased risk of experiencing neck pain was use of hands above shoulder height for greater than 1 hour per day. The increased risk from working with hands above the shoulder was found for women workers only (PR = 1.7 (1.3-2.1)). As with the study by Meservy et al. (1997), the increased rate of neck pain among women who were exposed to having their hands above their heads for greater than 1 hour a day may have been the result of workstation design, such that women because of their size had to reach overhead more frequently than men. Another explanation for these findings could be that women have weaker arm and shoulder girdle muscles than men so that overhead work is more fatiguing to women resulting in increased reports of upper body pain. In addition, women had higher response rates (67%) than men (33%), which could have led the authors to overestimate the

prevalence of neck pain among women workers. Further complicating the interpretation, only current occupation was considered. Associations between high-risk occupations and injury may have been lessened due to the healthy worker effect. Workers who have experienced neck pain, especially neck pain that interferes with activity may have changed jobs or employers as a result of the pain, resulting in an underestimation of the prevalence of neck pain in this sample.

Hansson et al. (2000) used a case control study of women workers employed in a laminate factory to determine the risk of experiencing a musculoskeletal injury in an industrial setting. The exposed group consisted of 87 current employees and 55 former employees who performed repetitive industrial tasks. The referent group included 35 workers who performed non-repetitive industrial tasks, 33 office workers and 59 former employees. By including former workers in the analysis, the researchers were able to reduce the healthy worker effect on the study, and were able to determine if the worker left the job because of a musculoskeletal injury. Subjects completed questionnaire that contained items to determine the prevalence of musculoskeletal disorders using the Nordic Questionnaire and psychosocial workload as measured by the Job Content Questionnaire (Karasek, 1998). A physical exam was used to validate the symptoms reported on the Nordic Questionnaire. Each task performed by the control group was observed. EMG electrogonometers were used to determine the load of tasks under study on specified muscle groups. The exposed group reported more musculoskeletal disorders than the referent group. There was no statistical difference between the groups in the load on *m. trapezius*; however, the exposed group had a statistically significant increase in load on *m. infraspinatus*. In this analysis, the psychosocial work environment did not influence the risk of having a musculoskeletal disorder or the

impact of the physical exposures on MSDs. The researchers did not include analysis of the differences between the two groups; therefore it is difficult to determine if group differences were responsible for study findings rather than differences in exposure. The short period considered for the presence of a musculoskeletal disorder (7 days versus the traditional 1 year) may have resulted in underreporting of pain thereby causing the researchers to either over or under estimate the risk to the exposed group. Additionally, the ability of the researchers to find a statistically significant difference between the exposed group and the referent group in relation to hand and wrist disorders may have been decreased because of the inclusion of office workers in the referent group. The authors' defined repetitive motion as assembly line tasks such as assembly, pressing, or finishing laminate plates. However, office workers often do tasks that are highly repetitive putting them at risk of developing a musculoskeletal disorder involving the neck and/or upper limb.

Many of the studies reviewed used a cross sectional design. Although an association was found in these studies between occupation and/or job task and a MSD, a causal link could not be established. This review of the literature underscores the importance of analyzing individual exposures (job tasks) rather than group exposures (job title) in order to identify the risk of injury from occupational musculoskeletal exposures. This review of the literature identifies specific activities, such as lifting heavy objects; driving for long periods of time; static postures; repetitive motion; bending, twisting or reaching; and overhead work that increase the risk of musculoskeletal injury among workers. As indicated by this literature review, women are employed in a wide variety of occupations that place them at high risk of sustaining a musculoskeletal injury and these injuries are most likely due to identifiable and predictable exposures. Moreover, the risk of injury may not be fully appreciated by the

worker especially repeated and common exposures; therefore it is important to understand how risk is perceived in occupational settings so that effective methods of communicating with workers about their risk of injury from occupational activities can be developed.

Theoretical Framework

Every day people assess the risks and benefits of activities in which they engage in. Perception of risk guides individuals in making choices about what they are willing to be exposed to in their environment. Osei, Amoh, and Schandorf (1997) define risk as the probability of an adverse event or as something that is judged to be hazardous. Fleming, Flin, Mearns, and Gordon (1998) define risk perception as the probability given to an event occurrence and the level of concern about the consequences of the occurrence. In fact, risk perception is multidimensional. It is dependent on the subjective properties given the situation. In other words "'facts' do not have a uniform existence apart from the persons who observe and interpret them. Rather 'real' facts are the ways in which different people come into and define situations" (Burton, 1994, p.3). The perception of risk is based on an individual's assignment of risk to an exposure or hazard. Thus, perception of risk is dependent on characteristics of the individual as well as characteristics of the risk itself.

Personal Characteristics

Worldview.

The concept of worldview originated in the work of social anthropologist Mary Douglas in the 1970s (Boholm, 1996). Worldviews are based on social relationships and are the result of shared beliefs and values. An individual's orientation to social relationships and external dictates define his/her worldview (Marris, 1998). Thus, a person's worldview reflects the social and political interactions of the individual with their environment (Dake, 1992).

Differences in group orientation and the belief in where external control emanates from define the four identified worldviews: hierarchy, individualism, egalitarianism and fatalism (Peters & Slovic, 1996). Slovic (1997) states that an individual's worldview and affect are the orienting dispositions of risk perception. Research in risk perception has shown that a person's worldview influences how the risks and benefits of various technologies are ranked (Dake, 1991; Peters & Slovic, 1996).

An individual who is oriented to group and accepts external control is said to have a hierarchical worldview. Conversely an individual who is not oriented to group and does not accept external control is said to be individualistic. Egalitarians and fatalists make up the two opposite poles of the continuum – high group orientation/low external control and low group orientation/high external control, respectively. Thus, the four worldviews are differentiated by one's social relationships, and beliefs about one's power and influence over the circumstances of one's life.

Paulo Freire (1997), in Pedagogy of the Oppressed, describes the fatalistic attitude of a peasant - "he goes along with the boss and says 'What can I do? I'm only a peasant" (p. 43). Fatalism is the belief in destiny, the feeling of external control or powerlessness. Those with a fatalistic viewpoint consider themselves victims with little control over their external environment (O'Connor, Bord, & Fisher, 1998; Olmstead, Guy, O'Mally, & Bentler, 1991). This may extend to distrust and a belief that large organizations exploit the workforce and nature (O'Connor et al., 1998). Egalitarians believe in human equality. As a result, egalitarians think that they can, in cooperation with other group members, change conditions in their community or their workplace (DeWaal, 1997). A hierarchical viewpoint, in contrast, posits that experts or governmental authorities have the knowledge necessary to manage the

risk or threat effectively (O'Connor et al., 1998). Further, a hierarchical viewpoint supports the social structure and views social deviation as threatening to that social structure (Dake, 1991). Finally, those with an individualistic viewpoint believe that they can manage their own risks. They will have little faith in government authorities or experts' ability to manage risk (O'Connor et al., 1998).

Kouabenan (1998) suggested that worldview skews the perception of risk in a study of the effects of a fatalistic viewpoint on risk perception. The researchers recruited subjects (n = 533) who had varying degrees of knowledge about the risks of driving. Additionally, the subjects had differing ethnic backgrounds and professions. The pen and paper survey consisted of nine items that measured fatalism. These items were scored using a 1-4 scale ("strongly agree" to "strongly disagree"). Risk–taking was measured with 42 items, again using a 1-4 scale ("strongly agree" to "strongly disagree") for item scoring. A global index score was developed for fatalism and one for risk-taking. Factor analysis was then performed to determine the degree of inter-item correlation (r = 0.13 to r = 0.44) among the different items included in the fatalism index. The index was also reliable (α = 0.78). Though the overall scale was reliable, the modest inter-item correlations of the fatalism items indicate that some of the scale items may have been measuring different concepts. The risk-taking index was also reliable (α = 0.84). The results of this study indicate that the subjects with a fatalistic worldview tended to overestimate or underestimate the risks of traffic accidents. Regardless of whether the subject underestimated or overestimated the risk of traffic accidents, those with a fatalistic viewpoint reported taking greater risks when driving. Moreover, subjects with a fatalistic viewpoint had the most simplistic explanations for the causes of accidents.

Dake (1991) evaluated the association between three worldviews (individualism, hierarchy, egalitarianism) and risk perception across three domains – societal concern, societal risk-taking and political orientation. A random sample (n = 134) was selected using zip codes in a geographic region of Northern California. Demographic characteristics were also used in sample selection in order to insure the sample included a wide cross section of the general public. Worldview was correlated in the hypothesized direction with both societal concerns and societal risk-taking. Subjects with high egalitarianism scores were averse to technological risks, environmental risks, and societal risk-taking, while subjects with high individualism and hierarchy scores were averse to social deviation and were pro-societal risk-taking. For example, egalitarianism was positively correlated (r = 0.03 – 0.46) with 18 items on the societal concerns scale with the highest correlation occurring with the societal concern "threat of nuclear war and annihilation." Conversely, individualism and hierarchy were negatively correlated with societal concerns about technology and the environment. However, hierarchy and individualism were moderately correlated (r = 0.54) thus the tool developed for this study may not have been able to discriminate between the two worldviews.

Palmer (1996) also evaluated the relationship between three worldviews (egalitarianism, individualism, hierarchy) and risk rankings. Twenty-four health and financial activities were ranked on a 1 to 100 scale of riskiness. Additionally, each activity was rated on a 0 – 1 scale for probable benefit, probable harm, probable status quo, expected benefit and expected harm based on the simplified conjoint expected risk model (SCER) developed by Holtgrave and Weber. Subjects who rated highest on the individualism scale used expected harm to rate the threat from financial and health related activities (r = 0.63, $p < 0.001$). In contrast, subjects

with a hierarchical point of view used both expected and probable benefits to rate the risks from these activities ($r = 0.32$, $p < 0.05$). In regression analysis, the three worldviews were found to have a linear relationship with all the dependent variables in the SCER model. The R^2 ranged from 0.55 to 0.80 and in the hypothesized direction. Generalizability of study results to the general population is limited however because the subjects included in the study were all undergraduate students, and overwhelmingly of Asian descent. Nonetheless, this study is important because it validates the relationship between worldview and the perception of risk across a variety of activities.

Peters and Slovic (1996) analyzed the responses of 1,512 English-speaking subjects to an 154-item instrument designed to study the role of affect and worldview in the support of nuclear energy. Subjects were selected nationally using random digit dialing and were interviewed by phone. Worldview was measured on a 15-item scale adapted from Dake (Dake, 1992). Factor analysis with varimax rotation in this study loaded fatalism and hierarchy onto the same factor ($\alpha = 0.60$). Individualism and egalitarianism loaded onto two remaining factors ($\alpha = 0.42$ and 0.50 respectively). Worldview was correlated with support of nuclear energy in the hypothesized direction. Egalitarians had the lowest scores ($r = -0.28$) in support of nuclear energy while fatalist/hierarchist had the highest scores ($r = 0.20$). In separate regression analyses both affect and worldview were predictive of support for nuclear energy ($r = 0.50$ and 0.38 respectively). When both affect and worldview were entered into regression analysis the predictive power increased ($r = 0.55$, $p < 0.0001$). The low coefficient alpha in the factor analysis of the worldview scale reduces the reliability of the scale.

Taken together these studies suggest that worldview may influence the perception of risk. Furthermore, measurement of worldview as been increasingly subjected to more rigorous psychometric testing, results of various studies indicate that though the measurement of individualism and hierarchy remain problematic perception in risk is influenced in the hypothesized direction by an individual's worldview (Marris, Langford, & O'Riordan, 1998; O'Connor et al., 1998). It may well be that an individual does not have an exclusive worldview, but rather that one worldview may represent a dominant way of thinking, such that a person may score high on a scale that measures egalitarianism but may also have scores on scales that measure individualism or fatalism (Langford, 2000; Peters & Slovic, 1996). Thus, the person would probably rank the risk in a pattern that would be predicted for a subject with an egalitarian viewpoint for most technologies or health activities; though may rank risks on some technologies or health activities as an individualist or fatalist. "Worldviews then may be one system for assessing value" (Peters & Slovic, 1996, p. 1431), they are based on the individual's social and cultural milieu and influence how risk is perceived.

Previous Experience.

It has been hypothesized that previous experience with an exposure or hazard will influence how present and future risk from that or a similar exposure or hazard is perceived. However, Harrell (1990), in evaluating the role of previous experience in occupational risk assessment, found that current exposure to work place hazards was a stronger predictor of increased perception of risk than was previous experience. Two hundred forty four adults (male = 59%, female = 41%) were interviewed face-to-face using a structured survey. The majority of those interviewed (49%) reported working with white-collar equipment, while

39.8% reported working with blue-collar equipment and 8.6% worked with no equipment. Subjects were asked how many work related injuries they had had during the previous five years. Twenty-five percent of study participants reported having had at least one on-the-job injury within the last five years ($M = 0.7$, $SD = 3.3$), however having had a work related injury was not predictive of perception of risk. The author provides no indication about which workers had been injured (either white collar or blue collar) or the types of injury that were sustained.

In contrast, Greening (1997) found that people who had witnessed an electrocution accident at a public swimming pool had a higher perception of risk from electrocution than the control group (t (15)=1.89, $p < 0.05$). In this case control study, 16 cases were recruited six months after witnessing an electrocution accident. Sixteen controls were recruited from recreational facilities within the same geographical area. Likewise, (Cree & Kelloway, 1997) had subjects (n=130) rate the likelihood of an event occurrence and the risk of the event occurrence to self and others. Study participants were mainly men (69%). Accident exposure was measured on two 4-item scales, one scale measuring own direct exposure and the other scale measuring observed exposure. All subjects were recruited from the production lines of six plastics manufacturing plants. Previous experience (both direct experience and vicarious experience) was significantly ($p < 0.01$) associated with increased perception of risk both to self and others. Additionally, increased risk perception was related to a stated intention to leave work ($\beta = 0.23$, $p < 0.01$) or willingness to participate in a work place health and safety program ($\beta = 0.23$, $p < 0.01$).

The difference in study results evaluating the influence of previous experience may be the result of several factors. First, the measure used to quantify previous experience was not

standardized across the studies; therefore, the researchers may have been measuring different concepts. Second, the recency of a work-related injury may affect how previous experience influences the perception of risk, i.e. more recent events have a greater influence on perceived risk than more remote events. Third, type of injury may also affect the relationship between previous experience and the perception of risk. The role of an individual's previous experience with a work place hazard in the perception of risk remains unclear. Further research studying the association between previous experience and risk perception is needed.

Demographic Characteristics.

Age, income and education are three demographic characteristics that research has shown influence how risk is perceived (Savage, 1993; Barke, Jenkins-Smith, & Slovic, 1997; Flynn, Slovic, & Mertz, 1994; Kraus, Malmfors, & Slovic, 1992). Savage (1993). In a study that evaluated the influence of personal demographics on the perception of risk from four common hazards, noted differences in risk perception across age, gender, ethnicity, income and educational level. Subjects (n = 799, male = 43%, female = 57%) were selected using random digit dialing (who lived in a large metropolitan area in the Midwest). Differences in the perception of risk across three previously identified domains (dread, unknown and personal exposure) were evaluated. Dread risk is defined as hazards or exposures that evoke feelings of dread and are related to the perceived seriousness of the exposure, perceived catastrophic potential of the exposure, and the perceived immediacy of the effects of the exposure. Women, people with lower incomes, people with less education, and Blacks were more likely than white men to perceive each of the four hazards within two risk domains (dread and personal exposure) as risky. Additionally, young people perceived the dread risk from three of the four hazards as riskier than did older people. Since there was no difference

between groups in this study on the perception of risk within the unknown domain, a supposition cannot be made that lack of knowledge about the hazards influenced the feeling of dread that these hazards evoked.

O'Connor et al. (1998) in a national sample of 1,225 (male = 62%, female = 38%) found that older subjects tended to believe that experts could decrease the threat from study hazards. A flaw in this study, however is that people over the age of 66 may have been over represented, as they composed 24% of the total sample. Subjects were asked to complete a mailed questionnaire containing items focused on public hazards, such as AIDS, water pollution, hazardous chemical wastes and violent crime. Subjects were asked about their risk perception, political and social values and their demographic characteristics. Older subjects also believed they lacked the ability to protect themselves from the threats imposed by the hazards and that increased government spending would not mitigate the risk from the hazards. Study results indicate that age influences how risk is perceived and what factors could be successful in mitigating the hazard. There was no significant difference in the perception of risk when gender was considered, except that women believed that increased government spending would effectively reduce crime. The questionnaire was 15 pages long, so subject burden may have influenced responses to items within the questionnaire as well as the survey response rate.

In national phone interview study of the influence of gender and race on the perception of risk (n = 1,512) Flynn et al. (1994) found that ethnic minorities (both men and women) tended to rate the threat from different types of hazards as higher than white males. Non-white women had the highest risk ratings of all the groups studied. Subjects were asked to rate the health risks of 25 hazards on a 1-4 scale (almost no health risk to high health risk).

Only English speaking subjects were surveyed with the sample being comprised of 98.1% white subjects hence not representative of the general population. A stratified sampling plan could have increased the participation of minorities in this study; to further test the assertion that ethnicity is associated with the perception of risk. Additionally, given the large percentage of non-English speaking Americans, administration of the survey in languages other than English would also have increased minority representation in the sample.

In a study that evaluated how experts and lay people judged the risks from chemical exposures, Kraus, et al. (1992) found that those people with a college degree did not perceive the risk from chemical exposures to be as risky as those with less education. The study included comparisons between two samples. One sample was composed of experts from the Society of Toxicology, living in the United States. This sample (n = 360) was composed mainly of men (84.6%) with a Ph.D. degree (91%). The second sample was a community sample (n = 262), using a sampling frame based on zip codes in a Northwest metropolitan area. As with the 1st sample, the 2nd sample was primarily men (58%), many of whom had a graduate degree (23.1%). Between group comparisons were conducted as well as within group comparisons in the 2nd sample. Women perceived that the chemical exposures were risky and had a less favorable attitude toward the benefits of the chemicals, regardless of educational level. Overall, toxicologists rated the risks from the chemical exposures lower than the general population sample. Specialized knowledge may increase the understanding of the multiple dimensions of the risk, thereby changing the perception of risk.

Risk perception may be influenced by age, ethnicity, gender, income and education. In this review of the literature, age was found to influence the perception of risk. Likewise, ethnicity was found to influence the perception of risk in both studies that evaluated the

relationship between these variables. However, both studies included small samples of non-whites. The relationship between ethnicity, income and education and the perception of risk needs further investigation.

Though worldview, previous experience and demographic characteristics are thought to explain a significant amount of the variance in risk perception, in a study by Marris (1998), worldview explained no more of the variance (approximately 12%) than subject demographics. In fact, most of the variance in risk perception in that study was explained by the subjective characteristics of the risk. However, worldview remained predictive of how risks were ranked. Therefore, in evaluating how women perceive their risks from occupational exposures, it is necessary to consider the subjective risk characteristics of these exposures, as well as worldview, previous experience and personal characteristics.

Risk Characteristics

As Sahlin and Persson (1994) state "people are afraid of what they can not see and what is out of their control" (p. 48). The subjective risk characteristics assigned to an exposure influence how an exposure is seen to affect health. Benthin, Slovic, and Severson (1993), evaluated the influence of risk characteristics on the risk ratings, by adolescents ($n = 41$) of 30 health affecting behaviors and identified eight subjective risk characteristics. Using a convenience sample of high school students, consisting of 62% females, they identified the following subjective risk characteristics: 1) voluntariness of the exposure; 2) immediacy of the effects; 3) knowledge regarding the risk (either societal or personal); 4) control over the exposure/risk; 5) familiarity of the risk; 6) catastrophic potential of the risk; 7) the feeling of dread an exposure evokes; and 8) sense of vulnerability to injury from the exposure. Results, from this study, suggest that adolescents participate in risky behaviors if they report personal

knowledge of the risk, have less fear that the behavior will harm self or others, the affects of the behavior are not viewed as serious and if they feel they have personal control over the behavior and its consequences.

The Benthin et al. (1993) study validated the relationship between the seven risk characteristics hypothesized by Kraus and Slovic (1988) as influencing risk perception and ratings of risk. The researchers tested whether the subjective risk characteristics identified from previous research and tested over diverse hazards were stable over a single technological domain. The seven risk characteristics identified by Kraus and Slovic (1988) include: 1) knowledge; 2) newness; 3) voluntariness; 4) control; 5) dreadedness; 6) catastrophic potential; and 7) equity (see table 4).

The results reported by Kraus and Slovic (1988) were compiled from the results of two studies. Study 1 was a convenience sample (n = 108, 55% female), ranging in age from 18 to 52 years old (M = 24 years). There were 48 subjects in Study 2. Again, the sample was a convenience sample, predominately female (n = 34, 71%) and young (mean age = 23 years). Subjects in study 1 were asked to evaluate risks profiles across 32 hazards, while subjects in study 2 were asked to evaluate risks within a single hazard domain – railroads. In study 1, when the risk characteristics were entered into regression equations for each of the hazards, all beta coefficients generated by these equations for each risk characteristic were significant and the R^2 for the various equations ranged from 0.957 – 0.981. Additionally, there was little variation in the beta coefficients across different types of technologies suggesting that subjective risk characteristics are relatively stable across different hazards and across individuals. In study 2, the seven risk characteristics were loaded onto 2 factors. Factor 1 included voluntariness, control, knowledge and dread. Factor 1 explained 46% of the

Table 4 Comparison of subjective risk characteristics evaluated in previous research on risk perception

Benthin, et al. (1993)	Hallman and Wandersman (1989)	Greening (1997)	Osei et al. (1997)	Kraus and Slovic (1988)
Voluntary			Voluntary	Voluntariness
Immediacy			Immediate	
Knowledge	Knowledge		Availability of Information	Knowledge
Familiarity	Imaginability		Familiar	Newness
Dread				Dread
Catastrophic Potential	Seriousness		Consequences	Catastrophic Potential
Vulnerability	Proximity		Personal Involvement	
	Confidence		Trust	
	Distribution of the Problem			Equity
	Business			
Control	Control	Control	Control	Control
	Probability		Probability	
	Consequences			
			Alternatives	
	Benefits		Benefits	

variance in risk perception among subjects. Factor 2 included catastrophic potential, newness, dread and equity (which had a negative loading on the factor). Dread loaded on Factor 1 at $r = 0.76$ and on Factor 2 at $r = 0.50$. Factor 2 explained 32% of the variance in risk perception in this study. Together the 2 factors, labeled by the author as catastrophic

potential and knowledge, explained 78% of the total variance in the model. The two studies evaluated the association between assigned risk characteristics and the perception of risk, either within a single hazard domain or across multiple hazards. However, when results of these two studies were compared, the researchers found that all seven hypothesized risk characteristics influence the perception of risk but four are highly predictive of overall perceived risk - catastrophic potential, dread, control and newness.

Hallman and Wandersman (1989) recruited 268 residents from communities within a 25-mile radius of a hazardous waste facility to participate in a study. Subjects were interviewed using a structured survey instrument. The study evaluated whether 12 hypothesized risk characteristics predicted a subject's perception of the health risks caused by the hazardous waste facility. Using factor analysis, these researchers found that there were differences in which subjective risk characteristics influenced risk perception dependent on the temporal measure of the health outcomes, i.e. future or present health risk. In a regression analysis of the model, eight characteristics were significantly associated with the perceived risk to present health (total model $R^2 = 0.44$). These characteristics were 1) confidence – confidence in workers or experts; 2) seriousness – consequences to self, property or the environment; 3) consequences – controllability of the risk; 4) probability – estimate of event occurrence due to a specific cause; 5) distribution of problems – equitable distribution of risk or benefits; 6) knowledge – knowledge about the risks and benefits; 7) business – worked for the landfill or had done business with them; and 8) proximity – nearness of the exposure. A second regression equation with the dependent variable of perceived future health risk showed that six characteristics were significantly associated with perceived risk to future health status (total model $R^2 = 0.50$). These predictors were 1) confidence; 2) seriousness; 3) consequences;

4) probability; 5) distribution of problems and 6) imaginability – imagine the consequences of an exposure. Results of this study indicate that subjective risk characteristics influence both perception of risk to self and to others. However, knowledge about the risks of exposure may be more important to perception of risk to self than others.

Two particular risk characteristics, control and probability, have been hypothesized as influencing risk perception to a greater degree than other characteristics. Greening (1997) tested a model in which perceived control was hypothesized to be a mediating variable between heuristics (mental patterns use to make judgments) and perceived risk. In her case control study of people who had witnessed an electrocution at a public swimming pool (refer to previous discussion of the study on page 36 for details regarding the sample) and using 3 regression equations to test the model she found that perceived control was not a mediating variable, though control remained an important subjective characteristic in the perception of risk. Moreover, (Fleming et al., 1998) found that oil platform workers, in the United Kingdom, perceived their occupational risks lower when they felt they had control over the job.

A study by Osei et al. (1997) was conducted in Ghana and included a random sample of 500 subjects (78% male). Subjects were asked to rank a list of hazards by perceived risk and benefit. Moreover, information on ten attributed risk characteristics – voluntariness, control, familiarity, immediacy, alternatives, consequences, availability of information, personal involvement, trust and probability – was collected for each hazard. Study results suggest that perceived probability of an event occurrence and the perceived consequences of the occurrence, in combination, influence risk perception more than the other eight risk characteristics evaluated in their study.

Research studying the influence of risk characteristics on the perception of risk suggests that certain risk characteristics may be more important in risk perception than others. Across the six studies reviewed, control was predictive in four of the studies. Differences in the definition of control across the studies reviewed may have led to the differences in findings of the association between control and the perception of risk. Other characteristics that have been shown to be predictive across multiple studies include knowledge, familiarity, vulnerability, seriousness, equity and voluntariness.

Theoretical Model

Risk is "experienced within a psychosocial context that serves as a powerful set of cues and organizing elements that provide both a meaning to the symptomatology as well as a convenient and available framework for causal explanations of symptoms" (MacGregor & Fleming, 1996, p. 773). The theoretical model for this study used definitions of subjective characteristic that have been validated in the previously mentioned studies. A total of nine subjective risk characteristics were used in the theoretical framework (Figure 1). These nine characteristics were chosen based on the results of previous research. They may be important in describing how the risk from occupational exposures is perceived. These characteristics and their definitions are summarized in Table 5.

In addition to the subjective risk characteristics, personal characteristics are important in the perception of risk. As discussed previously, several studies have shown the importance of demographic variables and a person's worldview. In keeping with previous research, the model proposed for this study evaluated the following personal characteristics: ethnicity (measured as acculturation to the society), income and education and worldview (fatalism, egalitarianism, hierarchy or individualism).

Figure 1 Risk Perception Theoretical Framework

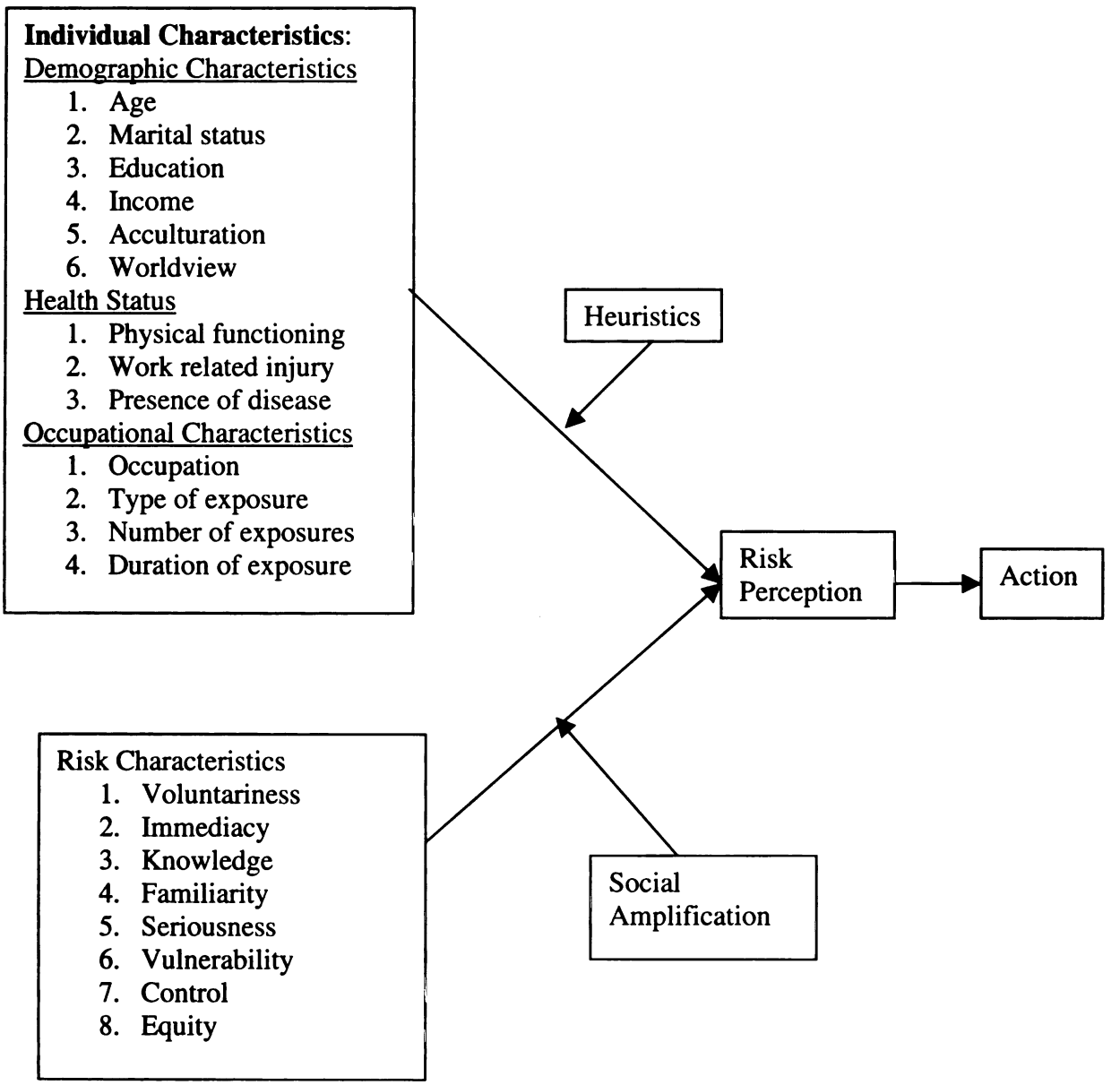

Table 5 Definition of subjective risk characteristics

Risk Characteristic	Definition
Voluntariness	Choice about exposure to hazard/risk
Immediacy	Delayed or immediate affects from exposure, temporary or permanent
Knowledge	State of knowledge about the exposure
Familiarity	Experience (personal and societal)
Seriousness	Likelihood of widespread injury as a result of exposure to the hazard/risk
Vulnerability	Fear of exposure of consequences of exposure
Control	Degree of control over exposure
Equity	Equal distribution of the exposure (shared risks and benefits)

Moreover, two mediating variables add complexity to the model - social amplification and heuristics. Social amplifications results in heightened awareness about the risks posed by the hazard. Social amplification can be influenced by three factors. First, media coverage of the risk may amplify and distort the potential consequences. Second, there may be social groups who polarize views or escalate rhetoric about the risk. Third, risk perception is based on interpretation of the magnitude of a similar event and how it was managed (Slovic, 1994). Slovic et al. (1982) found a high correlation ($r = 0.70$) between media coverage and perceived risk of death from 41 causes.

Heuristics (typical judgment patterns) may also mediate the perception of risk. When an individual does not have the ability to determine the probability of an event occurrence and the person will make a decision regarding the potential risk based on heuristics (Slovic, 1994;

Slovic, 1982). Heuristics are general inferential rules that are used in problem solving (Slovic, 1982). Heuristics can skew an individual's perception of risk, either making the exposure seem more or less hazardous. Heuristics and biases have strong influences on decisions about how to react to the risk.

Although both these types of mediating variables may be important to the perception of risk, not much is known about how women specifically perceive risks from occupational musculoskeletal exposures. This initial investigation of the model focused on describing how risk is perceived. Further, the association between personal and risk characteristics and the perception of risk from occupational exposures in a community-based sample of employed women was explored. Analysis of impact of social amplification and heuristics and biases on risk judgment was not undertaken in this study.

Research Questions

Based on the review of the literature and the conceptual framework, the following research questions were developed and became the focus of this study:

1) How do women perceive their risk of occupational musculoskeletal injury?
    a) To what extent is the perception of risk from musculoskeletal injury associated with:
        i) Demographic characteristics of the woman
        ii) World view of the woman
        iii) Occupation of the woman
        iv) Health status of the woman
        v) Risk characteristics attributed to the exposure by the woman.
2) How do women perceive other women's risk of occupational musculoskeletal injury?
    a) To what extent is the perception of risk from musculoskeletal injury associated with:

i) Demographic characteristics of the woman

ii) World view of the woman

iii) Occupation of the woman

iv) Health status of the woman

v) Risk characteristics attributed to the exposure by the woman.

Hypotheses

From the research questions for the study, the following hypotheses about the theoretical relationships between the variables were posited:

1) A subject's demographic characteristics (age, marital status, acculturation, number of children, education, income) are strongly associated with:

   a) the overall and item rating of risk to a subject's health from occupational musculoskeletal exposures,

   b) the overall and item rating of risk to women's health from occupational musculoskeletal exposures, in general.

2) A subject's worldview (fatalism, hierarchy, individualism, egalitarianism) is moderately associated with:

   a) the overall and item rating of risk to the subject's health from occupational musculoskeletal exposures,

   b) the overall and item rating of risk to women's health from occupational musculoskeletal exposures, in general.

3) A subject's occupation is strongly associated with:

   a) the overall and item rating of risk to the subject's health from occupational musculoskeletal exposures,

b) the overall and item rating of risk to women's health from occupational musculoskeletal exposures, in general.

4) Health status is strongly associated with:

a) the overall and item rating of risk to the subject's health from occupational musculoskeletal exposures,

b) the overall and item rating of risk to women's health from occupational musculoskeletal exposures, in general.

5) The subjective risk characteristics a subject assigns to her occupational musculoskeletal exposures is strongly associated with:

a) the overall and item rating of risk to the subject's health from occupational musculoskeletal exposures,

b) the overall and item rating of risk to women's health from occupational musculoskeletal exposures, in general.

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"Research is formalized curiosity. It is poking and prying with a purpose. It is a seeking that he who wishes may know the cosmic secrets of the world and that they dwell therein."
Zora Neale Hurston (1942)

The objective of this study was to describe the exposure characteristics of working women and explore the associations between demographic characteristics, occupational characteristics, worldview, health status, subjective risk characteristics and the perception of risk of injury to self and the perception of risk to other women from occupational musculoskeletal exposures.

Research Design

The study was an exploratory study designed to examine the theoretical links hypothesized in the study framework. A cross sectional design was used for the study. The cross sectional study design permitted the examination of the association between variables in the framework. However, the study design did not allow the researcher to identify causal links between the variables. Because causal links could not be established by the study design, the researcher clarified the hypothetical relationships in the theoretical framework (Hulley, 1988). Refer to Chapter 2 for a description of the hypothetical links between variables that were examined in the study.

Research Setting

The study was conducted in Sonoma County, California. Since Sonoma County has a diverse population, it was theorized that a wide range of women's occupations, across the socioeconomic spectrum would be represented in the randomly selected sample . Approximately 500,000 people live in Sonoma County, of whom, in 1999, 7.7% lived below the poverty level (U.S. Census Bureau, 2000). Results of the 2000 Census indicate that, 74.5% of the county's population is White with Hispanics being the largest minority at

17.3% of the population (U.S. Census Bureau, 2000). The median age in Sonoma County is 37.5 years and 70% of the female population is aged between 19 – 49 years old (U. S. Census Bureau, 2000).

There are a wide variety of businesses in the county, though many are small enterprises. According to the U. S. Census Bureau (2001), there are over 150,000 businesses in Sonoma County but approximately 90% of these employ less than 100 employees. In analyzing the types of businesses in the county, the U. S. Census Bureau (2001) found that most people were employed in the following types of businesses: manufacturing, retail and wholesale trade, administration, education, health care, accommodation and foodservice, and other services. However, Sonoma County is also considered an agricultural county, so it was assumed that women would also work in various jobs within the agricultural sector including dairies, wineries (chiefly bottling lines, but some field work) and forestry. Given the diversity of the county a full range of occupational musculoskeletal exposures was expected.

Sample

Overview

A sample of currently employed working age women living in Sonoma County was used for this study. The sample included only currently employed women. Only one woman per household was included in the study. Exclusion criteria were women whose primary language was not Spanish or English. Subjects were chosen using a simple random sample strategy.

Sample Accrual

In an attempt to achieve a representative sample, a simple random sample of phone numbers in Sonoma County was used for the study. A phone number list, with contact

addresses, for Sonoma County was purchased from Gannett Telematch of Springfield VA. Subjects were randomly selected from the phone list of over 9,000 residents of Sonoma County using SPSS (Statistical Package for Social Sciences, Chicago, IL).

In order to increase the probability that the study results were not spurious, a power analysis using nQuery Advisor was performed to calculate the needed sample size. Results of the power analysis results indicate that for a multiple linear regression model which already included 5 independent variables with a squared multiple correlation (R^2) of 0.15 (a medium effect size), a sample size of 155 would have 80% power to detect at $\alpha = 0.05$ an increase in R^2 of 0.05 as the result of adding one additional independent variable to the equation.

Sampling Procedure

An introductory letter explaining the study was sent to the address that corresponded to the each randomly selected phone number. The letter was printed in both English and Spanish. The letter was addressed to "working woman" rather than "resident" in an effort to assure that women in the household received the initial communication about the study. The letter explained the study and informed the recipient to expect a phone call about the study in approximately 7 to 10 days. Included with the letter was a refusal card, which the recipient was instructed to use if they declined to participate in the study. The refusal card had prepaid postage on it so that the recipient incurred no cost. During the initial phone call, a description of the study was given to the subject. If the woman agreed to participate in the study, an appointment was set up for administration of the survey. The appointment time and date were set based on subject convenience. Some subjects opted to complete the survey during the initial phone call rather than scheduling a future appointment. For those subjects who scheduled a future time and date for survey administration, the subject was sent a letter

confirming the appointment date and time. Included with the confirmation letter were colored cards with the response categories for each of the scales used in the survey. This was done in order to facilitate understanding of the response categories, since the subject did not have a paper copy of the survey to refer to during the survey administration. Prior to administration of the survey, verbal informed consent was obtained.

During the initial phone call, if a man or child answered the phone they were asked if there was a woman in the household. If the response was "yes", then the person was asked if the woman was at home. If only one woman was home at the time of the initial call, that woman was asked if she would be willing to participate in the study. If the household had more than one eligible woman residing there, the following selection criteria were used. First, if the woman who answered the phone and met the inclusion criteria, that woman was asked to participate in the study. If two or more women were at home, then the woman closest in age to a random allotment table was asked to participate in the study. This was done in order to assure that women of all ages had an equal opportunity of being included in the study.

A log was kept of the number of attempts made to reach a subject. A maximum of five attempts was made to reach each subject. Each attempt was made on a different day and at a different time to increase the likelihood that the subject was contacted, as described above. If the subject was not contacted by the fifth attempt, that subject was dropped from the sample.

Consent Procedure and Data Protection

Informed Consent

As mentioned above, an introductory letter was mailed to addresses from the random list of phone numbers. The letter contained informed consent information. Additionally

verbal informed consent, using a telephone script, was obtained prior to administration of the survey.

Confidentiality

Each subject was given a subject number, which was the only identifier on the actual survey. A separate list of subject information including phone number, address and subject number was maintained. The completed surveys and the subject list were kept in a locked cabinet to which only the primary investigator and the research team had access.

Survey

Overview

A survey was developed specifically for this study. The survey included questions designed to obtain information regarding a woman's occupational history, demographic information, cultural bias, perception of health risks from occupational exposures, subjective characteristics of risks specific to occupational musculoskeletal exposures and general health status. In order to assure subject willingness to complete the survey, characteristics of survey design were considered. The survey was designed to start with more general, less threatening items in order to allow the subject to feel comfortable about the survey and increase the probability that more sensitive questions would be answered (Aday, 1996). In order to assure that low literacy subjects could comprehend the questions and response categories, the survey was constructed so that women with a 6th grade reading level could understand the survey questions.

Pilot Testing

The instrument was pilot tested on the phone to a diverse group of women using the snowball technique. Women in the first group interviewed were asked to identify a friend,

neighbor or relative who might be willing to participate in the pilot testing. The person who was referred was contacted and asked if they would be willing to participate in the pilot study. Verbal informed consent was obtained prior to the administration of the survey. The survey was administered to 21 women for the pilot test. Minor changes in format and item wording were made as a result of the pilot test. The survey was administered by telephone during the pilot testing in order to simulate study methodology. Refer to chapter 4 for pilot testing results.

Translation

Given that Spanish speaking only subjects were included in the pool of subjects, the survey was translated into Spanish. Following the original translation to Spanish, another translator back translated the instrument into English. Back translation was done in order to assure that the Spanish version was measuring the same concepts as the original English version. Five bilingual women in the original pilot study were asked to complete both versions of the survey. Following completion of both surveys, the women completing the survey were interviewed to determine if the Spanish version of the survey was comparable to the English version. No changes were made to the Spanish version of the survey as a result of the pilot testing.

Administration

During the initial phone call, all interviewers used a script to explain the purpose of the study. Then again at the beginning of each phone interview, the purpose of the study was reviewed, the agenda for the survey was established and verbal informed consent was obtained. In addition, the primary investigator and the interviewers met periodically in order to evaluate how the interviews were being conducted, discuss issues that had arisen during

the administration of the survey and discuss changes in the introduction or agenda that needed to be made in order to improve the efficiency of administration or completeness of the survey. No changes were made in study methodology with the exception of administering the survey during the initial phone call for some subjects.

Measures

The interview questionnaire focused on the research questions posited in Chapter 2. There were several different sections in the survey, as described below. Table 6 provides a summary of the domains included in the survey, scales used within each study domain, total items in each scale, and source of the scale.

Dependent Variables

The dependent variables for this study were perception of risk of injury to self and perception of risk of injury to other women from occupational musculoskeletal exposures. A subject's perception of risk of injury from her own occupational musculoskeletal exposures was determined by using one item with a 4-point scale, ranging from "not likely" to "very likely", for each type of musculoskeletal exposure the woman had. Such that if a subject had two of five different types of occupational musculoskeletal exposures the subject was asked to rate the risk from each of these exposures. The subject was then asked to rate the risk of injury to other women for each of those musculoskeletal exposures the subject had. The subject was asked to rate the risk of injury to other women using the same 4-point scale that had been used to determine perception of risk of injury to self. The types of musculoskeletal exposures considered are described in detail in the occupational health section below.

Demographic Characteristics

Demographic items included age, income, educational level, and country of origin,

Table 6 Summary of question domain, scale, and number of items for each scale and source.

Question	Scale	Number of items	Source
Occupation	1. General work history	8 items	Occupational Health Addendum to NHIS (1988)
	2. Work status	4 items	
Work –related injury	1. Work-related injury	1. 13 items	1. Occupational Health Addendum to NHIS (1988)
	2. Severity	2. 4 items	
Occupational exposure	1. Musculoskeletal exposures	1. 5 items	1. Occupational Health Addendum to NHIS (1988)
	2. Task frequency	2. 5 items	2. Occupational Health Addendum to NHIS (1988)
Acculturation	1. Acculturation	1. 7 items	1 (Marin & Marin 1991)
	2. Years worked in the United States	2. 2 items	
Risk characteristics	1. Voluntariness 2. Immediacy (present) 3. Immediacy (future) 4. Knowledge 5. Familiarity 6. Seriousness 7. Control 8. Vulnerability 9. Equity	9 items	(Slovic, 1987) (Hallman & Wandersman, 1989)

Table 2 Summary of question domain, scale, and number of items for each scale and source (cont.).

Question	Scale	Number of items	Source
Health Status	1. General health status	1. 1 item 4 items	1. NHIS SF36 (Ware, 1993)
	2. Physician diagnosed illness/ injury	2. 21 items	
	3. Physician visits	3. 2 items	
	4. Physical functioning	4. 8 items	4. SF 36 (Ware, 1993)
	5. Role functioning	5. 4 items	5. SF36 (Ware, 1993)
	6. Bodily pain	6. 2 items	6. SF36 (Ware, 1993)
	7. Work limitations	7. 10 items	7. WRFQ (Lerner, 2001)
Worldview	1. Hierarchy 2. Individualism 3. Egalitarianism 4. Fatatlism	25 items	(Marris, Langford, & O'Riordan, 1998)

Age and level of education were continuous variables. As were the two items on income. First, the subject was asked about total household income for the previous year then about their personal income for the same period.

Acculturation.

The perception of risk has been shown to differ among people of different ethnic backgrounds (Savage, 1993). Degree of identification with the dominant culture

(acculturation) was used to evaluate the association between ethnicity and perception of risk. First, the subject was asked where they were born. If the subject responded other than the United States, then the subject was asked about their country of origin, number of years worked in the United States, and number of years lived in the United States. All women were asked about their native language. Only those women whose native language was not English were asked to respond to the acculturation items. The seven acculturation items from the Marin and Marin (1991) scale use language preference to gauge acculturation to the dominant culture. Those subjects who respond that they think, speak, read or converse in a language other than English most of the time have been found to be less acculturated to the dominant culture than those who think, speak, read or converse in mostly English (Marin & Marin 1991). The 7-items have a 5-item response set, "only other language" to "only English". A composite acculturation score was calculated for each subject with a total score of 35 indicating full acculturation to the dominant culture and a score of seven indicating little or no acculturation.

Length of time employed in the United States was also ascertained. The longer a person has been working in the United States, the more likely they are to have adopted some aspects of the dominant culture (Marin & Marin 1991). As with the other demographic variables, acculturation and years worked in the United States were included in both the descriptive analysis and, if significantly correlated with the dependent variables, in the regression analyses.

Worldview.

Worldview has been shown to influence the perception of risk. Each person is hypothesized to have one of four predominant worldviews: fatalism, egalitarianism,

hierarchy or individualism. Four scales, one for each cultural bias, were used to identify a subjects' predominant cultural bias. Items from the cultural bias scale used by (Marris et al., 1998) were used to quantify each subject's predominant cultural bias. Each item was scored using a 6-point Likert scale, from "strongly disagree" to "strongly agree".

Health Status

A rating of general health status was obtained using one item from the National Health Interview Survey ((NHIS). The item uses a 5-point scale to rate present health status from "excellent" to "poor". In addition, each subject was asked about physician diagnosed illnesses and/or injuries and utilization of physician services. The presence of a physician diagnosed illness and/or injury was ascertained using one item with a list of 18 illnesses or injuries requiring a "yes" or "no" response. There were also be 3 open-ended "other response" options for illnesses or injuries not on the list. A total physician diagnosed illness/injury score of 21 was possible, by summing all of the "yes" responses, each of which was given a score of one..

Utilization of physician services was determined by asking each subject if they had seen a physician within the last 12 months and if so, how frequently. The subject was asked the reason for the physician visit.

In order to quantify current physical functioning items from the Short Form Health Survey (SF-36) were used. Items used from the SF-36 included a 10-item physical functioning (PF) scale, a 4-item role physical (RP) scale, a 4-item general health (GH) scale, and a 2-item bodily pain (BP) scale. The 10–item physical functioning (PF) scale uses a 1-3 rating for each item ("yes, limited a lot", "yes, limited a little" and "no, not limited at all") to ascertain the subject's current ability to perform every day activities. The 4-item RP scale

uses "yes" or "no" responses to evaluate the subject's perception of their ability to engage in work or activities, while the 4-item GH scale requires the subject to rate their health status. Amount of bodily pain is measured using the first item of the 2-item BP scale. Amount of bodily pain is ranked from "none" to "very severe" (a range of 6 possible responses). The second item of the 2-item bodily pain scale requires the subject to rate the degree to which their bodily pain interferes with their ability to perform activities of daily living (ADL). Degree of inference with ADL is ranked on a 1 to 5 scale ("not at all" to "extremely"). Scoring on each of the SF36 scales was done per author recommendations (Ware, 1993).

Items from the Work Role Functioning Questionnaire (WRFQ) were chosen as another method of evaluating a subject's physical functioning. WRFQ items are focused on ability to perform work activities. The WRFQ has been validated in several studies (Lerner, 2001, 2002) that included subjects with various chronic health conditions. The 10-items selected for inclusion in this study focused on work limitations that are caused by musculoskeletal conditions, e.g. ability to lift heavy objects or ability to use hand held equipment (computer mouse, pen, phone, keyboard). Subjects are asked to rate the degree to which their physical condition interferes with their ability to perform these tasks. Possible responses range from difficult "all of the time" to difficult "none of the time". A sum was calculated for this scale such that a lower score was indicative of greater limitations in a subject's ability to perform work activities.

Work-related Injury.

In addition to work history and occupational exposures, previous or present work-related injuries were identified. Work-related injuries are hypothesized to influence the perception of risk from occupational exposures in a manner similar to health status. Again, items from the

Occupational Health Addendum of the NHIS were used. The scale in the Occupational Health Addendum that measures work-related injuries contains 21 items. The items in this scale are both open – ended and closed – ended items.

Based on responses to the first item in the scale, which was dichotomous, the subject was categorized as having had a work-related injury or not. If the subject indicated that she had had a work related injury then the subject was asked about the recency of the injury. Those subjects who had a recent injury (within the 12 months preceding survey administration) were asked about the number of injuries, number of lost work days, physical limitations resulting from the injury, and the type of injury(s) sustained. Recency of injury was hypothesized to influence the perception of risk from musculoskeletal exposures, such that those women who had sustained a work-related musculoskeletal injury within the previous 12 months would rate the risks from their exposures higher than those women who had not had a recent work-related injury.

Occupational Characteristics

The general work history questions for this survey were adapted from items developed for the NHIS, Occupational Health Addendum (1988). There were five open – ended items to identify the longest held occupation of the subject. There were three items similar to those used to determine longest held occupation to identify current occupation. Both the longest held and present occupation items included open-ended items to encourage a fuller description of the tasks and duties of the job.

Occupation was coded using a standardized coding scheme used by the U.S. Department of Labor and was based on the information obtained from the general work history section of the survey. In cases where the subject's occupation was unclear, job duties were used to

assist in classifying a woman's occupation. If there was a difference in the longest held occupation and present occupation, present occupation was used to categorize the subject's occupation.

In order to determine work status, four items were included asking the average number of hours worked per week, weeks worked per month, months worked per year, and estimated hours worked yearly. It was hypothesized that women who work longer hours have increased risk of occupational musculoskeletal injury, thereby potentially influencing their perception of risk from the exposure.

Occupational Exposures.

The occupational exposures section of the survey contained four items from the Work History section of the Occupational Health Addendum to the NHIS that focus on occupational exposures. In addition, an additional exposure item – static postures – was added to the types of musculoskeletal exposures that women in the workplace may experience. The item for static postures was added because static postures have been shown to increase the risk of musculoskeletal injury (Rodgers, 1986). The five types of occupational musculoskeletal exposures were: 1) physically strenuous work, 2) repeated bending, twisting, lifting, 3) frequent twisting and bending of hands or wrists (repetitive motion), 4) use of hand-held vibrating tools, and 5) static postures.

Each occupational exposure item required a "yes" or "no" response for that particular exposure. If a subject indicated that they had a specific occupational musculoskeletal exposure, then the subject was asked to indicate how many hours and minutes per day she was exposed to the stressor. Duration of exposure (hours/minutes per day) was felt to influence perception of risk of injury. Two exposure scores were assigned to each subject,

one based on the total number of occupational exposures the subject had (range 1 to 5) and the second based on the duration of the occupational exposures. Both mean number of hours of exposure per subject and total number of hours of exposure were considered.

Risk Characteristics

Eight risk characteristics have been identified from a review of the literature, as key to the way risk is perceived (refer to Chapter 2). However since the dependent variable was a rating by the subject of the likelihood of injury to self or to other women, the risk characteristics scale consisted of 9-items – omitting probability and including 2 questions to quantify immediacy (refer to Appendix A for item wording). Each subject was asked to rate the risk characteristics of their occupational musculoskeletal exposures. Each of the risk characteristics was scored using a 4-point scale ("not at all" to "a lot"), except the knowledge and familiarity items that were scored using a "yes" or "no" response. As with worldview a cumulative score was not possible, so that each item was analyzed independently for its association with the perception of risk.

Data Preparation

Before data collection began, a survey codebook was developed. The codebook facilitated data entry and assured that the interviewers consistently coded the items the same before data entry. The codebook was used during the pilot study of the instrument in order to assure completeness and accuracy. Changes were made to the codebook following the administration of the pilot interview.

Once the survey was completed and coded, survey results were entered in SPSS (Statistical Package for Social Sciences, Chicago, IL) for data analysis. One person did the

data entry in order to ensure consistency. The data entry was checked by the primary investigator for accuracy, using the original surveys and the codebook.

Data Analysis

It is important, in designing an interview schedule, that the researcher come to a decision regarding the structure and type of questions that will provide the desired results. Studies evaluating the reliability and validity of various federal and non-federal surveys have shown that errors in the design and administration of surveys are of two types: systematic (bias) and random (variable) (Aday, 1996). In designing and conducting a survey it is important to reduce systematic error by assuring that the questions are valid and reliable and by reducing bias that can be introduced by non response and non coverage.

Reliability

Reliability of an item on a survey is questionable if the item does not accurately reflect the underlying concept of that question. In order to assure that both the English and Spanish versions of the survey developed for this study were reliable a post hoc test of internal consistency was conducted on the both. Evaluation of internal consistency assures that questions in a particular scale are measuring the same concepts.

The alpha coefficient was calculated for all the relevant scales in the questionnaire. The alpha coefficient was used rather than split half coefficients because the alpha coefficient allows computation of all possible halves and a single value for the data set is obtained (Aday, 1996; Waltz, 1991). An alpha coefficient of 0.70 reflects an acceptable level of reliability (Aday, 1996). If the reliability of a scale was found to be less than 0.7, the scale correlation matrix was analyzed to determine which items were measuring the same concept. Items with a low correlation to other items in the scale were removed from the analysis to

determine the influence on the alpha coefficient. If the overall alpha increased with the removal of a single item then that item was removed from the final analysis of the scale.

Validity

In addition to determining the reliability of the instrument, the validity of the instrument must also be determined. In considering evaluation of the validity of the instrument, the researcher must first determine the purpose of the measurement (Waltz, 1991). As an instrument was specifically developed for this study, it was important to evaluate the content validity. In order to do this, three expert researchers in Occupational Environmental Health and Community Health were asked to review the instrument. Changes in the content were made based on the judgments of these researchers. Factor analysis was performed on the two scales that were developed for this study, risk characteristics and worldview, to further determine the content validity of the scales.

Descriptive Statistics

Following completion of survey administration and data entry, data analysis was performed. "Don't know responses" or "refused to answer" were not included in the final analysis of specific items. However, missing data, "don't know responses" and "refused to answer" responses were assigned unique codes prior to data entry. If an item was missing over 50% of the total possible responses, it was not included in the statistical analysis of the association between study variables.

Initial descriptive statistics were tabulated in order to describe the sample. All variables, including the dependent variables and composite variables, were included in the descriptive analysis of the sample. The descriptive statistics included the sample mean, median, standard deviation and range for each variable.

Bivariate Analysis

After the descriptive statistics for the sample were completed, bivariate analysis was performed. Bivariate analysis was done to test the initial associations between the independent variables and dependent variables in preparation for the multivariate analysis. Since the dependent variables were continuous variables, the choice of which statistical test was determined by whether the independent variable was continuous or categorical. Thus, either a t-test or an analysis of variance (ANOVA) was performed. P-values and confidence intervals were calculated for all t-tests and ANOVA tests of association performed. Those independent variables that were found to be significantly correlated ($\alpha \leq 0.10$) with the dependent variables were then entered into multiple linear regression analysis. As stated in the power analysis for this study β was set at 0.80 and α was set at 0.05 for all statistical tests performed.

Regression Analysis

Unlike bivariate analysis in which only the association between one independent variable and the dependent variable can be tested, multivariate analysis allows the researcher to analyze the effects of multiple independent variables on the dependent variable. Multiple linear regression analysis enhances the understanding of the influence on the variability of the dependent variable from each independent variable when entered into the equation in a stepwise manner. Therefore, the multiple linear regression equations, constructed for this study included all independent variables that were correlated to the dependent variables in bivariate analysis at set limit of $\alpha \leq 0.10$. Two multiple linear regression equations were constructed, one for each dependent variable, so that the unique contribution of the associated independent variables on the perception of risk to self and the perception of risk to

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This chapter will review the statistical results of the study. A description of the pilot study will be provided, as well as a discussion of the reliability and validity of the survey scales. The descriptive statistics of the sample will be explored, followed by bivariate and multivariate analysis of the variables hypothesized to have theoretical linkages.

INSTRUMENT DEVELOPMENT

Pilot Study

A pilot study was conducted in both English and Spanish to test the administration of the survey, using 16 English-speaking subjects and 5 Spanish-speaking subjects. The mean age of the pilot study participants was 40.5 (*SD* = 10.59) years (see table 7). The mean number of years of school completed was 14.4 (*SD* = 5.03) years. Additionally, a large proportion of the pilot study participants were married (*n* = 12, 57%), had no children (*n* = 10, 47.6%), were born in the United States (*n* = 11, 52%) and lived in dual earner households (*n* = 13, 61.9%). Of those women not born in the United States, the mean number of years that these women had lived in the United States was 20.35 years (*SD* = 10.49) and all but three had worked in the United States for greater than 10 years (*M* = 16.30, *SD* = 11.03).

The mean number of years that pilot study participants had worked in their longest held occupation was 12.4 years (*SD* = 6.32) and the mean age at which these women had started working in their longest held occupations was 25 years (*SD* = 8.21). The most frequently held longest occupations, using Bureau of Labor Statistics (BLS) SOC Occupational Classifications (2001), were healthcare practitioner/ technical (*n* = 5), business/financial operations (*n* = 3), sales/related occupations (*n* = 2), and personal care/service (*n* = 3). There were two occupational categories that were most frequently mentioned as current occupation: healthcare practitioners/technical (*n* = 5) and sales/related

Table 7 Pilot study demographic characteristics (n = 21)

	Mean	Median	Standard Deviation	Minimum	Maximum
Age (years)	40.5	41	10.59	25	57
Education (years)	14.43	15	5.03	2	23
Household size	3	2	1.6	1	7
Number of children	1.67	1	2.48	0	10
Number of years lived in United States	20.35	20.0	10.49	4	36
Number years worked in the United States	16.3	19	11	1	30
Number of wage earners	1.62	2	0.5	1	2
Longest held occupation (years)	12.4	12	6.3	2	25
Age started longest held occupation	25.5	26	8.2	12	46
Employment status (number of hours worked/week)	33.7	36.0	8.98	10	45

occupations (n = 5). Nine (42.9%) of 19 pilot study participants reported that they worked 40 hours or more per week, while two (10.6%) reported they worked less than 20 hours per week (data were missing for two subjects). No inferential statistics were calculated for the pilot study group.

Based on the pilot study, a question was added to the original instrument. The question "What is your native language?" was added following the questions about country of origin and time lived and worked in the United States because it was felt that those subjects who were born in the United States and whose native language was English did not need to be asked the acculturation items. Thus, a skip was added to the instrument. Following survey administration, women were asked to provide feedback about the survey. None of the pilot study participants identified areas of concern with the instrument, therefore item wording was not changed and the structure of the instrument remained the same other than

the addition of the previously mentioned question and skip.

Reliability

Reliability tests were performed on the scales used in the study. All scales were found to have alpha coefficients exceeding $\alpha = 0.70$ (see table 8), with the exception three of the worldview scales. No items were removed for analysis purposes.

Worldview

Reliability testing of the worldview scales indicated that they were only marginally reliable. The egalitarianism scale was the most reliable ($\alpha = 0.72$). The reliability scores on the other worldview scales were hierarchy ($\alpha = 0.51$), individualism ($\alpha = 0.62$) and fatalism ($\alpha = 0.55$). As in previous studies, individualism was positively correlated with hierarchy ($r = 0.222, p = 0.017$) and negatively correlated with egalitarianism ($r = -0.187, p = 0.044$) (Marris, Langford, & O'Riordan, 1998).

Table 8 Reliability of acculturation, SF-36 scales, Work Role Functioning Questionnaire and risk characteristics scales

	Alpha	Inter-item correlations	
		Low	High
Acculturation	0.935	0.489	0.949
Physical functioning (SF-36)	0.920	0.257	0.784
Role physical (SF-36)	0.851	0.651	0.742
General health (SF-36)	0.809	0.308	0.753
Bodily pain (SF-36)	0.744	na	na
Work Role Functioning (WRFQ)	0.914	0.597	0.844
Risk characteristics	0.730	0.185	0.603

Factor Analysis

Worldview

Given the low reliability of the worldview scales, principal component factor analysis was performed. Eigenvalues of 1 or greater were used for factor extraction. The factors were rotated using varimax rotation. Factor analysis of the items showed that there were nine factors that explained 70.03% of the variance. Four factors, using this methodology, explained 41.98% of the variance (see table 9). Items were loaded on the nine factors if they were correlated at or above 0.5, resulting in five factors containing 3 items, three factors containing 2 items and one factor containing 1 item. One item "If a person has the get-up-and-go to acquire wealth, that person should have the right to enjoy it" did not load on any of the nine factors. As the anthropological theory on which the worldview scales was built posits that there are four dominate worldviews that influence perception, no changes were made to the worldview scales.

Risk Characteristics

Unlike previous studies, three factors were identified during factor analysis of the risk characteristics. Eigenvalues of 1 or greater were used for factor extraction. The factors were rotated using varimax rotation. Knowledge, familiarity and equity loaded on Factor 1. Factor 1 explained 28.692% of the variance with an eigenvalue of 2.58. Immediacy (present and future) and equity loaded on Factor 2. Factor 2 explained 19.398% of the variance with an eigenvalue of 1.75. Control and voluntariness loaded on factors Factor 3. Factor 3 explained 19.11% of the variance with an eigenvalue of 1.72.

In comparison with the factor analysis of the risk characteristics reported by Slovic (1987), the risk characteristics in this study loaded onto different factors. In the

Table 9 Worldview factor analysis – varimax rotation component matrix

	1	2	3	4	5	6	7	8	9
Future too uncertain for serious plans****	0.609	0.277	0.004	0.3.81	-0.001	-0.001	-0.257	0.311	-0.001
Making money the main reason for hard work**	0.553	-0.191	-0.008	0.127	-0.004	-0.003	0.163	-0.119	0.131
People make friends only because they're useful****	0.729	-0.118	0.004	-0.107	-0.126	0.006	-0.122	-0.009	-0.122
Those that get ahead taxed to help poor***	-0.216	0.687	-0.365	0.005	-0.004	-0.004	0.001	0.114	0.139
Support a tax change so wealthy pay more***	-0.004	0.854	0.112	0.260	-0.008	0.006	0.003	0.001	0.005
Often been treated unfairly****	0.223	0.571	-0.115	-0.170	0.276	-0.296	0.139	-0.203	-0.234
Should be more discipline youth*	0.002	-0.124	0.782	-0.241	0.129	0.002	0.209	0.000	-0.007
More strict about right and wrong*	0.282	0.225	0.501	-0.005	-0.183	-0.199	.0.507	0.122	0.254
Family traditions important*	0.001	-0.161	0.671	0.189	-0.0006	-0.001	-0.257	0.311	-0.001
Government assure standard of living***	0.005	-0.003	-0.002	0.831	-0.0005	-0.002	0.115	0.002	-0.008
Peace if wealth more equally divided***	-0.005	0.328	-0.101	0.731	-0.004	-0.003	0.163	-0.119	0.131

*Item from hierarchy scale
**Item from individualism scale
***Item from egalitarian scale
****Item from fatalism scale

Table 9 Worldview factor analysis – varimax rotation component matrix (cont.)

Support mandatory draft*	-0.208	0.004	0.182	-0.193	0.774	0.126	-0.232	0.000	-0.002
Don't trust anyone****	0.199	-0.008	-.006	0.142	0.817	-0.002	0.007	0.117	0.179
More ability should earn more**	0.222	-0.007	0.252	-0.289	0.197	0.428	0.330	0.185	0.130
Better that life sorts out those who try**	0.144	-0.005	-0.008	-0.001	0.002	0.800	0.003	0.006	-0.009
Being on time important*	-0.286	0.263	0.499	-0.006	-0.002	0.539	-0.008	0.000	-0.155
Equal treatment means fewer problems***	0.000	0.206	-0.004	0.216	-0.164	0.190	0.690	-0.268	0.008
Racial discrimination a problem***	-0.194	0.001	0.003	0.155	-0.007	-0.173	0.663	0.303	-0.06
No using in doing things for others****	0.425	-0.007	-0.141	-0.191	0.316	-0.116	-0.107	0.454	0.007
Free society exists if companies prosper**	0.347	-0.142	0.126	-0.268	-0.004	0.329	-0.003	0.504	-0.129
Value regular routines*	-0.133	0.005	0.162	0.004	0.007	0.009	0.006	0.821	-0.006
Cooperation rarely works****	0.190	0.001	0.003	-0.009	0.199	0.001	0.135	0.105	0.813

*Item from hierarchy scale
**Item from individualism scale
***Item from egalitarian scale
****Item from fatalism scale

Slovic model the first factor included knowledge, familiarity and immediacy. Factor 1 in this study consisted of knowledge, familiarity, seriousness, and vulnerability. Factor 2 in the Slovic model consisted of voluntariness, vulnerability, seriousness, control and equity. Factor 2 in this study consisted of immediacy (present and future) and equity. The Slovic model did not have of a third factor while this study had a third factor consisting of voluntariness and control.

Validity

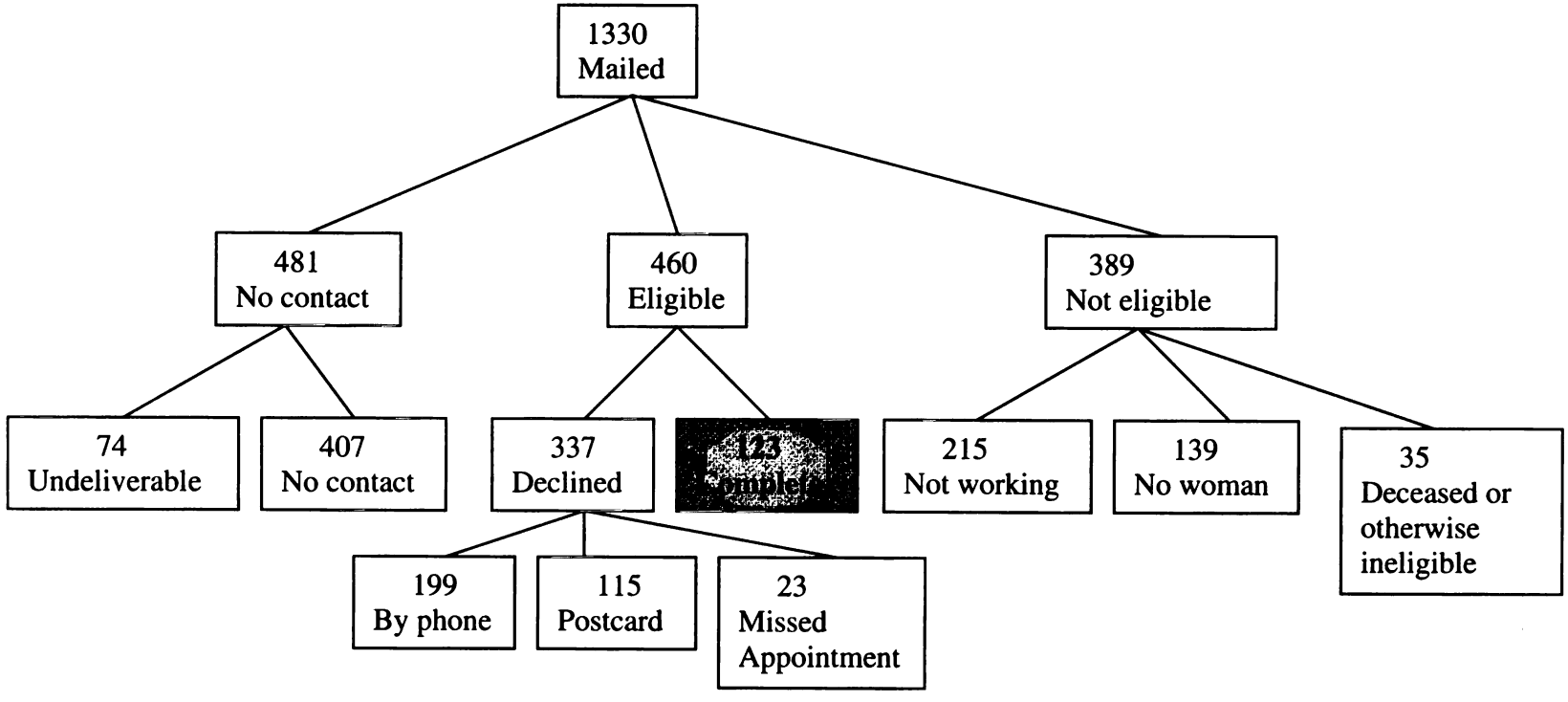
Several tests of validity were done. As expected, there was a positive correlation between the number of years worked in the United States and the scores on the acculturation scale ($r = 0.877, p = 0.022$), such that those women who had worked in the United States for a longer period of time scored higher on the acculturation scale. Number of years lived in the United States was not correlated with scores on the acculturation scale.

Scores on the Work Role Functioning Questionnaire (WRFQ) and the physical functioning (PF) scale of the SF-36 were highly positively correlated ($r = 0.72, p = 0.000$). Both of these scales measure ability to perform daily activities. Perception of general health was measured using a single question and the general health (GH) scale of the SF-36. These two items were strongly, positively correlated ($r = -0.75, p = 0.000$).

RESULTS

Data collection for this study occurred between May 2002 and March 2003. A total of 1330 letters were mailed to residents in Sonoma County. The final sample size was 123 from a total eligible of 460, resulting in a 26.7% response rate (refer to figure 2 for sample acquisition details). However, the actual response rate may have been higher because refusals to participate, both by phone and by postcard, may have come from women who were not

Figure 2 Sample acquisition details



eligible for inclusion in the study.

Initial Analyses

Demographic Characteristics

The women of this study, in general, were older, more likely to be married, better educated and wealthier than women on average in Sonoma County (see table 10). The mean age of women in the sample was 48.3 years of age. The median age of women in Sonoma County, according to the 2000 Census, is 39 years old. Eighty-eight (71.5%) women were married, fourteen (11.4%) identified themselves as separated/divorce and seven (5.7%) were single. Compared with results of the 2000 Census, more women in this sample were married than the general population of Sonoma County (50.3%) (Department of Finance, 2002). All but three women had some college education. Sixty-seven (54.5%) had 16 years of education or more. The median number of years of school completed for the general population of Sonoma County is 13.9 years compared to a median for this sample of 16.0 years. Most of the women (n = 79, 64.8%) lived in dual income households, while thirty women (24.6%) lived in single income households and eleven (8.9%) lived in households with three wage earners. Nearly half of the women (n = 61, 49.6%) lived in households with 3 or more people, forty-seven women (38.2%) lived in two person households. This correlates closely with Census Bureau statistics that indicate that the average family size for Sonoma County is 3.12 people. Given the mean age of the sample, many of the subjects had adult children who lived outside the home. The majority of women (n = 97, 79.9%) in this sample had one or more children.

The median household income for this sample was $82,000 per year, ranging from $4,000 to $400,000, however household incomes tended to cluster around $50,000 ($n$ = 10,

Table 10 Demographics characteristics (N=123)

	Mean	Median	Standard Deviation	Minimum	Maximum
Age (years)	48.3	49	11.23	20	82
Number of children*	1.80	2	1.49	0	8
Education (years)	15.6	16	3.27	3	30
Household size (# of people)	2.82	2	1.41	1	10
Income (household)*	$95,063	$82,000	$65,321	$4,000	$400,000
Income (personal earnings)*	$51,939	$43,000	$55,167	$4,000	$400,000
# wage earners**	1.84	2	0.62	0	4

*n=108
**n=122

9.3%) and $100,000 ($n$ = 14, 13.0%). Clustering around these points may have been the result of asking open-ended income questions rather than forcing a response into predefined income categories. Nearly half of the women (n = 61, 56.5%) stated that their annual household income was between $50,000 and $100,000, however a large proportion of these women (n = 26, 21.1%) lived in households with annual incomes greater than $100,000. Comparatively, the median income for Sonoma County was approximately $57,000 in 1998, according to State of California statistics (Department of Finance, 2002). Likewise, stated median personal earnings for this sample were higher than the Sonoma County median in 1998 of approximately $31,000. The median personal earnings for women in this sample were $43,000. Median household income and personal earnings for this sample may have been different than reported because fifteen (12.2%) of the women refused to answer the income questions. Most of the women (n = 75, 61.8%) in the sample worked 40 hours or more per week. Of the women who worked full-time (40 hours or more per week), twenty-four women (20.9%) worked 50 or more hours per week.

Age was positively, weakly correlated ($r = 0.26$, $p = 0.004$) with number of children the woman had, with increasing age women had more children. Age was negatively correlated with number of wage earners in the household ($r = -0.30$, $p = 0.001$), hours worked per year ($r = -0.192$, $p = 0.033$) and hours worked per week ($r = -0.183$, $p = 0.042$). With increasing age, women reported fewer wage earners in the household and they worked fewer hours (both per week and per year). Personal earnings were not correlated with educational attainment or marital status. Those women who had fewer children had more years of education ($r = -0.267$, $p = 0.003$).

Acculturation.

Most of the women ($n = 114$, 92.7%) were born in the United States, however the sample included women from Mexico ($n = 2$, 1.6%), and one woman each from Guatemala, Venezuela, Iran, Philippines, France, South Korea and Germany. One woman was born in the United States, but reported that her native language was Payiute. Conversely, the woman born in Germany reported that her native language was English. Four surveys were administered in Spanish. According to the 2000 Census, 17.6% of the population of Sonoma County is Hispanic. Hispanics were under represented in this sample.

Of those women ($n = 9$, 7.3%) not born in the United States, the mean number of years that they had lived in the United States was 24.89 years ($SD = 15.87$, range 1-47) and mean number years that they had worked in the United States was 15.2 years ($SD = 11.65$, range 1-35). Scores on the acculturation scale (Marin and Marin, 1991) ranged from 7 to 31 out of a maximum possible of 35. The mean score was 20.33 ($SD = 9.37$). The current occupation for two (22.2%) of the nine women was healthcare practitioner/technical, the remaining women were in management, legal, education/training/library, healthcare support,

food preparation/serving and building and grounds – cleaning/maintenance occupations.

Health Status

Physician Diagnosed Illness.

Approximately 76% of the women (n = 94) stated they had 2 or more physician diagnosed illnesses. The most frequently reported physician diagnosed illness in this cohort was back problems (n = 51, 41.5%), followed by arthritis (n = 43, 35.0%), repetitive strain injury/carpal tunnel syndrome (RSI/CTS) (n = 36, 29.3%) and other musculoskeletal disorders (MSDs) (n = 33, 26.8%). Frequency of MSDs by age is described in table 11. Back problems were positively correlated with having RSI/CTS (r = 0.293, p = 0.001), arthritis (r = 0.317, p = 0.000), and other MSDs (r = 0.379, p = 0.000).

Of the non-musculoskeletal physician diagnosed illnesses, the most frequently reported was asthma (n = 25, 20.3%) (see table 12). Heart disease was positively correlated with hypertension (r = 0.273, p = 0.002) and diabetes (r = 0.323, p = 0.000). There was also a moderate positive correlation between asthma and chronic lung disease (r = 0.363, p = 0.000). Chronic lung disease was positively correlated with having cancer (r = 0.300, p = 0.001) and heart disease (r = 0.225, p = 0.013).

Utilization of Medical Services.

The number of physician visits during the 12 months previous to survey administration varied from zero to thirty (M = 3.79, Mdn = 2.00, SD = 4.77), with most women (n = 81, 66.9%) seeing a physician more than once during the year. However, ten (8.3%) women reported that they had not seen a physician in the previous 12 months. The most frequently stated reason (n = 59, 48.8%) for the physician visit was for a routine physical exam, followed by musculoskeletal problem (n = 12, 9.9%) and infectious diseases

Table 11 MSDs by age category

Age Category	Back Problem (*N*=123)		Arthritis (*N*=123)		Repetitive Strain Injury (*N*=123)		Other MSD (*n*=113)	
	Yes *n* (%)	No *n* (%)	Yes *n* (%)	No *n* (%)	Yes *n* (%)	No *n* (%)	Yes *n* (%)	No *n* (%)
<30	1 (0.8)	7 (5.7)	-	8 (6.5)	-	8 (6.5)	2 (1.8)	5 (4.4)
31-40	8 (6.5)	11 (8.9)	3 (2.4)	16 (13.0)	5 (4.1)	14 (11.4)	4 (3.5)	14 (12.4)
41-50	17 (13.8)	27 (22.0)	10 (8.1)	34 (27.6)	14 (11.4)	30 (24.4)	15 (13.3)	26 (23.0)
51-60	16 (13.0)	20 (27.8)	18 (14.6)	18 (14.6)	14 (11.4)	22 (17.9)	8 (7.1)	24 (21.2)
>61	9 (7.3)	7 (5.7)	12 (9.8)	4 (3.3)	3 (2.4)	13 (10.6)	4 (3.5)	11 (9.7)
Total	51 (41.5)	72 (58.5)	43 (35.0)	80 (65.0)	36 (29.3)	87 (70.7)	33 (29.2)	80 (70.8)

Table 12 Frequency of Physician Diagnosed Illnesses (N=123)

Illness	Number	Percent*
Hypertension	22	17.9
Heart Disease	4	3.3
Diabetes	8	6.6
Cancer	9	7.3
Asthma	25	20.5
Migraine Headache	23	18.7
Chronic Lung Disease	4	3.3
Ulcer	11	8.9
Kidney/bladder Problems	18	14.6
Back Problems	51	41.5
Repetitive strain injury/carpal tunnel syndrome	36	29.3
Arthritis	43	35.0
Skin Disease	13	10.6
Infertility	9	7.3
Menstrual Cycle Disorder	16	13.0
Other injury	12	9.8
Other	17	13.8

*Total more than 100% because of multiple co-morbidities

(n = 11, 9.1%). Though asthma was one of the most frequently reported physician diagnosed illnesses, only three (2.5%) women reported that a respiratory problem was the reason for their physician visits during the previous 12 months (see table 13).

Table 13 Reason for physician visit (n= 110)

Reason for MD visit	Number	Percent
Obstetric	4	3.6
Infectious Disease	11	10.0
Musculoskeletal	13	11.8
Cancer	2	1.8
Cardiovascular	4	3.6
Endocrine	1	0.9
Respiratory	3	2.7
Gastrointestinal	2	1.8
Urinary Tract	2	1.8
Other	9	8.2
Routine	59	53.6

Most women (n = 86, 79.6%) stated they had seen a physician fewer than 5 times during the previous 12 months. Six (5.6%) women had seen a physician between 11 and 20 times during the previous year, while 2 (1.9%) had seen a physician more that 21 times

SF-36 Scales

The scales of the SF-36 – physical functioning (PF), role physical (RP), bodily pain (BP) and general health (GH) - were positively inter-correlated (see table 14). Most women (n = 80, 65%) rated their health as "excellent" or "very good" using the single question (1 = excellent to 5 = poor) (see table 15). The mean score on the GH scale was significantly better than the published norms (Ware, 1993). Scores on two of the other scales of the SF-36, PF

Table 14 Correlations among scales of the SF-36 and Work Role Functioning Questionnaire

	Physical Functioning (PF)	Role Physical (RP)	Bodily Pain (BP)	General Health (GH)	Work Role Functioning (WRFQ)
Physical Functioning (PF)		$r = 0.527$ $n = 121$	$r = 0.503$ $n = 121$	$r = 0.505$ $n = 121$	$r = 0.722$ $n = 118$
Role Physical (RP)			$r = 0.477$ $n = 122$	$r = 0.334$ $n = 122$	$r = 0.584$ $n = 119$
Bodily Pain (BP)				$r = 0.283$ $n = 112$	$r = 0.637$ $n = 119$
General Health (GH)					$r = 0.551$ $n = 119$
Work Role Functioning (WRFQ)					

* All correlations significant at $p = 0.05$ level (2-tailed)

Table 15 Health status measures and t -test with SF 36 published norms (N=123)

	Mean	Median	Standard Deviation	Min.	Max.	Norm mean (N=1,412)	p value	SD
General health status	2.21	2	1.02	1	5			
Number of physician visits	3.79	2	4.77	0	30			
PF (SF 36)*	87.55	95	20.82	0	100	81.47	0.002	24.60
RP (SF-36)**	78.55	100	34.27	0	100	77.77	0.801	36.20
BP (SF-36)**	68.49	71	24.48	0	100	73.59	0.023	24.25
GH (SF-36)**	76.06	82	21.98	10	100	70.61	0.007	21.50
Work Role Functioning***	39.71	43	8.18	3	45			

*n=121
**n=122
***n=119

and BP, were also significantly different than published norms. Women, in this sample, scored higher on the PF scale than the normative sample, even though they reported significantly more bodily pain.

There was a significant difference in group means between women who had a musculoskeletal disorder and those women who did not on the SF-36 scales, the PF, RP, BP and the GH (see table 16). Those women who reported having a MSD scored lower on all the SF-36 scales than did their counterparts without MSDs, indicating that the presence of a MSD affected the perception of health status such that women with MSDs perceived their physical functioning as lower than women without a MSD. Additionally when compared with the normative sample, women with MSDs scored significantly lower on the BP scale (see table 17). There was no significant difference between women with MSDs and the normative sample on any the remaining scales of the SF-36. Conversely, those women who did not have a MSD scored significantly higher on all of the scales of the SF-36 than the normative sample (see table 18). Thus women, in this sample, who did not have a MSD felt

Table 16 T-test comparison between women with MSDs and SF 36 published norms (n=80)

	Mean	Median	*SD*	Min.	Max.	Norm mean (N=1,412)	*p* value	*SD*
PF (SF 36)*	83.34	90.00	23.88	0	100	81.47	0.746	24.60
RP (SF-36)	71.67	100.00	38.39	0	100	77.77	0.159	36.20
BP (SF-36)	60.13	62.00	23.91	0	100	73.59	0.000	24.25
GH (SF-36)	73.21	82.00	23.31	10	100	70.61	0.321	21.50

*n=79

Table 17 T-test comparison between women without MSDs and SF 36 published norms (n=42)

	Mean	Median	*SD*	Min.	Max.	Norm mean (N=1,412)	*p* value	*SD*
PF (SF 36)	97.35	100.00	5.78	75	100	81.47	0.000	24.60
RP (SF-36)	91.67	100.00	18.86	25	100	77.77	0.000	36.20
BP (SF-36)	84.43	84.00	16.47	51	100	73.59	0.000	24.25
GH (SF-36)	81.48	87.00	18.26	30	100	70.61	0.000	21.50

Table 18 T-test comparisons of women with and without musculoskeletal disorders and scores on the SF-36 scales and WRFQ

	Women without musculoskeletal disorders (n=42)		Women with musculoskeletal disorders (n=80)				95% CI of the difference	
	Mean	*SD*	Mean	*SD*	*t*	Sig.	Lower	Upper
Physical Functioning (PF)*	97.351	5.779	82.342	23.883	5.301	0.000	9.388	20.631
Role Physical (RP)	91.667	18.859	71.667	38.397	3.856	0.000	9.731	30.269
Bodily Pain (BP)	84.429	16.468	60.125	23.906	5.890	0.000	16.134	32.473
General Health (GH)	81.476	18.261	73.213	23.309	1.997	0.048	0.001	16.457
Work Role Functioning Questionnaire (WRFQ)	43.071	3.853	37.883	9.284	4.275	0.000	2.784	7.593

their health status was better than did the normative sample.

The occupation with the most women reporting a back problem was sales and related occupations (n = 11, 8.9%), followed by management (n = 8, 6.5%) and education/training/library (n = 7, 5.7%) (see figure 3). As with back problems, women in sales and related occupations most frequently reported having RSI/CTS (n = 8, 6.5%), followed by office/administrative support and management (n = 5, 4.1% for each occupation). There was a significant difference in group means between women who had a physician diagnosed illness and scores on two of the SF-36 scales – the RP and the GH the SF-36 (see table 19). Women with a physician diagnosed illness (non- musculoskeletal in nature) did not rate their physical functioning or the amount of bodily pain differently than did women without a physician diagnosed illness. However, those women with a physician diagnosed illness rated their functioning on the RP and GH scales lower than did their counterparts without a physician diagnosed illness.

There was a weak to moderate correlation between back pain, arthritis, other MSDs and RSI/CTS and three scales of the SF-36 (PF, RP and BP) (see table 20). The GH scale was not significantly correlated to any of the other MSDs and back problems and then only weakly correlated. High SF-36 scores were also associated with fewer physician visits and fewer co-morbidities. Duration of exposure to the occupational musculoskeletal activities score was negatively associated with the BP scale suggesting that greater exposure was associated with more bodily pain (r = -0.232, p = 0.016).

Work Role Functioning Questionnaire.

Scores on the Work Role Functioning Questionnaire ranged from 3 to 45 (out of a total possible of 45), where a lower score indicates more limitations in the ability to perform

Figure 3 Physician diagnosed MSDs by occupation

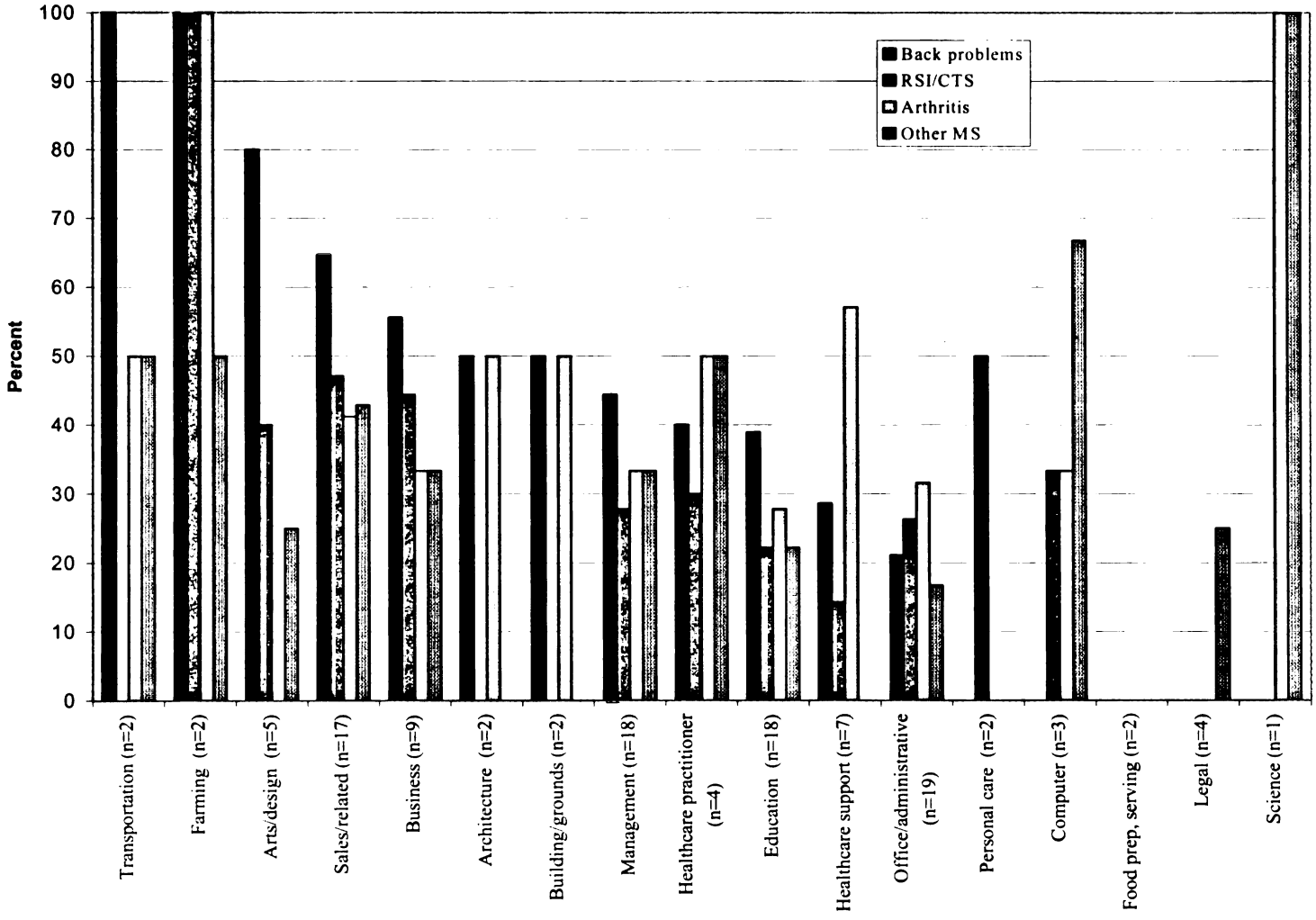


Table 19 T-tests comparisons for women with and without physician diagnosed illness (non musculoskeletal) and scores on the SF-36 scales and WRFQ

	Women without physician-diagnosed illnesses (n=34)		Women with physician-diagnosed illnesses (n=87)				95% CI of the difference	
	Mean	*SD*	Mean	*SD*	*t*	Sig.	Lower	Upper
Physical Functioning (PF)	91.963	18.204	85.963	21.653	-1.347	0.180	-13.967	2.657
Role Physical (RP)	92.647	15.727	73.106	37.856	-4.027	0.000	-29.148	-9.934
Bodily Pain (BP)	75.059	21.416	65.955	25.226	-1.860	0.065	-18.795	0.586
General Health (GH)	83.853	19.526	73.046	22.239	-2.486	0.014	-19.414	-2.201
Work Role Functioning Questionnaire (WRFQ)	42.206	4.617	38.718	9.058	-2.764	0.007	-5.989	-0.988

activities at work. Forty-eight (40.3%) of the women, in this sample, experienced no limitations in the ability to perform musculoskeletal tasks at work (score of 45). As with the scales of the SF-36, MSDs were positively correlated with limitations in the ability to perform activities at work. The WRFQ was positively correlated to scales on the SF-36 (see table 15). There were no significant correlations between any of the demographic characteristics of this sample and scores on the WRFQ. As with the scales of the SF-36, there was a significant difference in group mean scores between women with MSDs and those without MSDs on the WRFQ (see table 18). Thus, women with MSDs had lower

scores on Table 20 Correlation between scales of the SF-36, Work Role Functioning Questionnaire and MSDs and number of physician visits

	Back Problems	RSI/ CTS	Arthritis	Other MSDs	Number of MD diagnosed illnesses	Number of physician visits
Physical Functioning (PF)	$r = 0.273$ $p = 0.002$ $n = 121$	$r = 0.185$ $p = 0.043$ $n = 121$	$r = 0.320$ $p = 0.000$ $n = 121$	$r = 0.324$ $p = 0.001$ $n = 111$	$r = -0.473$ $p = 0.000$ $n = 121$	$r = -0.408$ $p = 0.000$ $n = 119$
Role Physical (RP)	$r = 0.267$ $p = 0.003$ $n = 122$	$r = 0.234$ $p = 0.009$ $n = 122$	$r = 0.198$ $p = 0.029$ $n = 122$	$r = 0.282$ $p = 0.003$ $n = 112$	$r = -0.463$ $p = 0.000$ $n = 122$	$r = -0.288$ $p = 0.001$ $n = 120$
Bodily Pain (BP)	$r = 0.500$ $p = 0.000$ $n = 122$	$r = 0.309$ $p = 0.001$ $n = 122$	$r = 0.309$ $p = 0.001$ $n = 122$	$r = 0.379$ $p = 0.000$ $n = 112$	$r = -0.351$ $p = 0.000$ $n = 122$	$r = -0.430$ $p = 0.000$ $n = 120$
General Health (GH)	$r = 0.189$ $p = 0.037$ $n = 122$	$r = 0.136$ $p = 0.134$ $n = 122$	$r = 0.162$ $p = 0.075$ $n = 122$	$r = 0.084$ $p = 0.376$ $n = 112$	$r = -0.442$ $p = 0.000$ $n = 120$	$r = -0.431$ $p = 0.000$ $n = 120$
Work Role Functioning (WRFQ)	$r = 0.344$ $p = 0.000$ $n = 119$	$r = 0.246$ $p = 0.007$ $n = 119$	$r = 0.270$ $p = 0.003$ $n = 119$	$r = 0.221$ $p = 0.021$ $n = 109$	$r = -0.480$ $p = 0.000$ $n = 119$	$r = -0.474$ $p = 0.000$ $n = 117$

the WRFQ (more limitations in their ability to perform every day work activities) than did women who did not have MSDs. Moreover, there was significant difference in group mean scores between women who had a physician diagnosed illness and those who did not have a physician diagnosed illness and scores on the WRFQ (see table 19). Women with physician diagnosed illness tended to rate their ability to perform daily work activities lower than women without a physician diagnosed illness.

Worldview.

Using the methodology delineated by Marris, the mean for each of the worldview scales was calculated (Marris et al., 1998). The mean was set as the cut off point for each scale so that scores above the mean were used to determine the predominate worldview of each subject. If the subject scored above the mean on more than one worldview scale then the subject was identified as not having a predominate worldview. Thus, only 37 of the 120 subjects with completed worldview responses had a predominate worldview. Of those women with a predominate worldview, most women (n = 18) were egalitarians (see table 21 and table 22).

There was a negative association between functioning on the PF scale and fatalism (r = -0.203, p = 0.027), women with lower scores on the scale (rated their physical functioning as low) had a fatalistic worldview. Women with more education were more likely to have an egalitarian worldview (r = 0.221, p = 0.016) than a hierarchical worldview (r = -0.276, p = 0.002). BP and individualism were negatively correlated (r = -0.203, p = 0.029), so that women with who scored lower on the BP scale (reported bodily pain) tended not to have an individualistic worldview.

Table 21 Worldview mean scores (n=120)

	Mean	Standard Deviation	Minimum	Maximum
Hierarchy	4.43	0.68	2.83	6.0
Individualism	4.06	0.80	1.8	6.0
Egalitarianism	4.46	0.89	1.83	6.0

Fatalism	1.81	0.63	1.0	4.0

Table 22 Predominate worldview (n=120)

	Number	Percent of total
Hierarchy	9	7.5
Individualism	4	3.3
Egalitarianism	18	15.0
Fatalism	6	5.0
No predominate worldview	83	69.2

Work-related Injury.

Fifty-five (45.5%) women reported ever having had a work-related injury. Nine of the women (7.5%) reported having a work related injury in the 12 months prior to survey administration. Of the nine women injured during the previous 12 months, eight (88.9%) reported having a physical limitation as a result of that injury. Six of the nine women (66.7%) who stated they had had a work-related injury during the previous 12 months reported that their job had been modified in some way as a result of the injury (change the way the job performed, reduced hours, use new equipment, job change or change in employer). Four of the nine women (44.4%) were working in healthcare when they were injured. Other professions women were working in when injured included teaching (n = 1), graphic design (n = 1), secretarial/administrative assistant (n = 2) and bus driving (n = 1). Of the nine recently injured women, two (22.2%) reported having more than one work-related injury in the previous 12 months. The mean number of days of work missed was 22.33 days (SD = 32.26, range 0 - 90). However, five (55.6%) of the nine women missed less than 5 days of work due to their injury.

Occupational Characteristics

General Work History.

The most frequently reported currently held occupations (using BLS SOC Occupational Classifications) were management (n = 18), education/training (n = 18), healthcare professionals/technical (n = 10), sales/related occupations (n = 17) and office/administrative support (n = 19) (Bureau of Labor Statistics, 2001). The only occupational classifications not represented in the sample, for currently held occupation, were community/social services, protective services, construction/extraction, installation/maintenance/repair and production occupations. Four of the five occupational classifications not represented in the sample (currently held occupations) are typically male dominated occupations. Patterns of employment, current occupation and longest held occupation did not vary appreciably in this group of women (see table 23). Eighty-one (65.9%) of the women in this sample began working in their longest held occupation before they were 30 years old (M = 26.79, SD = 8.89, range 12 - 52). While the mean number of years worked in the longest held profession was 17.65 years (SD = 9.2, range 1 - 46).

The current occupation was collapsed into SIC Major Categories – administration, technical, service, education and transportation/farming- as follows: (a) Administration – business/financial, sales/related and office/administrative support occupations (n = 46), (b) technical – computer/technical, architecture/engineering and life physical science occupations (n = 6), (c) service – healthcare practitioners/technical, healthcare support, food preparation/serving related, building/grounds cleaning/maintenance, legal, arts/design/media/sports and personal care service occupations (n = 49), (d) education (n = 18) and (e) transportation/farming (n = 4). The reclassification of occupation into the SIC

Table 23 Occupations using BLS SOC Occupational Classification (N=123)

Occupational Category	Longest Held Occupation *n* (%t)	Current Occupation *n* (%t)	Change (longest held occupation to current occupation) *n* (%t)
Management	14 (11.4)	18 (14.6)	4 (3.2)
Business/Financial Operations	15 (12.2)	9 (7.3)	-6 (4.9)
Computer/Mathematical	4 (3.3)	3 (2.4)	-1 (0.8)
Architecture/Engineering	3 (2.4)	2 (1.6)	-1 (0.8)
Life, Physical and Social Sciences	1 (0.8)	1 (0.8)	No change
Community/Social Services	1 (0.8)	-	-1 (0.8)
Legal	4 (3.3)	4 (3.3)	No change
Education/Training/Library	18 (14.6)	18 (14.6)	No change
Arts, Design, Entertainment, Sports/Media	3 (2.4)	5 (4.1)	2 (1.7)
Healthcare Practitioners/Technical	16 (13.0)	10 (8.1)	-6 (4.9)
Healthcare Support	6 (4.9)	7 (5.7)	1 (0.8)
Food Preparation/Serving	6 (4.9)	2 (1.6)	-4 (3.3)
Building and Grounds, Cleaning/Maintenance	2 (1.6)	2 (1.6)	No change
Personal Care/Service	1 (0.8)	2 (1.6)	1 (0.8)
Sales/Related Occupations	15 (12.2)	17 (13.8)	2 (1.6)
Office/Administrative Support	14 (11.4)	19 (11.4)	5 (4.0)
Farming, Fishing and Forestry	-	2 (1.6)	2 (1.6)
Transportation/Material Moving	-	2 (1.6)	2 (1.6)

Major Categories was done so that the relationship between occupation and the perception of risk of injury to self and the risk of injury to other women could be analyzed. Current occupation was further collapsed into white collar occupations (n = 101) and blue collar occupations (n = 21) based on job tasks descriptions for each occupational title.

Occupational Musculoskeletal Exposures.

Of the five types of musculoskeletal exposures (repeated strenuous physical activity; repeated bending, twisting or reaching; repetitive hand motion; use of hand-held vibrating tools; and static postures) considered in this study, the most frequently reported exposure was repetitive hand motion (n = 76, 61.8%). Sixty-nine (56.1%) of the women reported their jobs required them to maintain static postures (see table 24). Fourteen women (11.4%) denied having any of these five musculoskeletal exposures at work. Most women (n = 76, 61.8%) were exposed to two or more of the occupational musculoskeletal exposures as part of their job. Further, thirteen (10.6%) of the women had four of the occupational musculoskeletal

Table 24 Occupational musculoskeletal exposures (N=123)

	Number	Percent*
Strenuous physical activity	37	30.1
Repeated bending, reaching and lifting	55	44.7
Repetitive motion	76	61.8
Vibration	7	5.7
Static postures	69	56.1
No reported exposures	14	11.4

*Total more than 100% because of multiple exposures

exposures, while three (2.4%) had all five of the exposures at work. Of the women who had four occupational musculoskeletal exposures at work, four worked in management, three were healthcare practitioners/technical, two each in sales/related occupations and office/administrative support and one each in education/training/library and healthcare support. Of the three women who had all five occupational musculoskeletal exposures, they were employed in business/finance, arts/design/entertainment/sports/media and transportation/material moving.

The mean number of musculoskeletal exposures experienced by these women at work was 1.98 (SD = 1.25). For any single exposure, the mean number of hours a woman was exposed varied from 1.79 (SD = 1.87) hours (using hand-held vibrating tools) to 5.41 (SD = 2.4) hours (static postures) (see table 25). The mean number of hours of any one of the occupational musculoskeletal exposures was 5.5 (SD = 2.52).

Repeated strenuous physical activities were moderately, positively associated with repeated bending, twisting or reaching ($r = 0.587, p = 0.000$) and weakly, positively associated with the use of hand-held vibrating tools ($r = 0.221, p = 0.014$). Static postures and repetitive hand motions were positively correlated ($r = 0.248, p = 0.006$). Use of hand-held vibrating tools was also positively correlated ($r = 0.273, p = 0.002$) with repeated bending, twisting or reaching. Principal component analysis confirmed that there were two groups of occupational exposures in this sample. The first group of exposures included strenuous physical activity; repeated bending, twisting or reaching and use of hand-held vibrating tools. The second group of exposures included repetitive hand motion and static postures. Of the women (n = 37) who reported doing physical strenuous activities at work, seven (18.0%) currently worked in sales/related occupations, while six (16.2%) currently

Table 25 Duration of occupational musculoskeletal exposures performed (n=108)

	Mean	Median	Standard Deviation	Minimum	Maximum
Employment status (hours/week)	36.80	40	12.97	6	70
Hours per day performing strenuous physical activity	2.95	2.0	2.30	0.5	8
Hours per day performing repeated bending, reaching and lifting	4.01	4.0	2.54	0.5	10
Hours per day performing repetitive hand motion	5.37	6.0	2.51	0.5	13
Hours per day using hand-held vibrating tools	1.79	1.0	1.87	0.5	5.5
Hours per day in static postures	5.41	6.0	2.4	1	10
Duration of exposure (maximum hours/day of any exposure)	5.49	6.0	2.52	0.5	13

worked in education/training/library occupations and five (13.5%) each worked in management and healthcare support occupations (see figure 4). The occupational distribution for those women who reported being exposed to repetitive hand motion at work was similar to that of the women who were exposed to static postures. Refer to figure 5 for the distribution of exposure. to repetitive hand motion and static postures by occupation

Risk Characteristics

Most women had knowledge about and were familiar with the risk of injury from the musculoskeletal exposures they performed at work, both personal knowledge (n = 80, 66.1%)

Figure 4 Percent occupationally exposed to strenuous physical activity; repeated bending, twisting or reaching; and vibrating tools by occupation

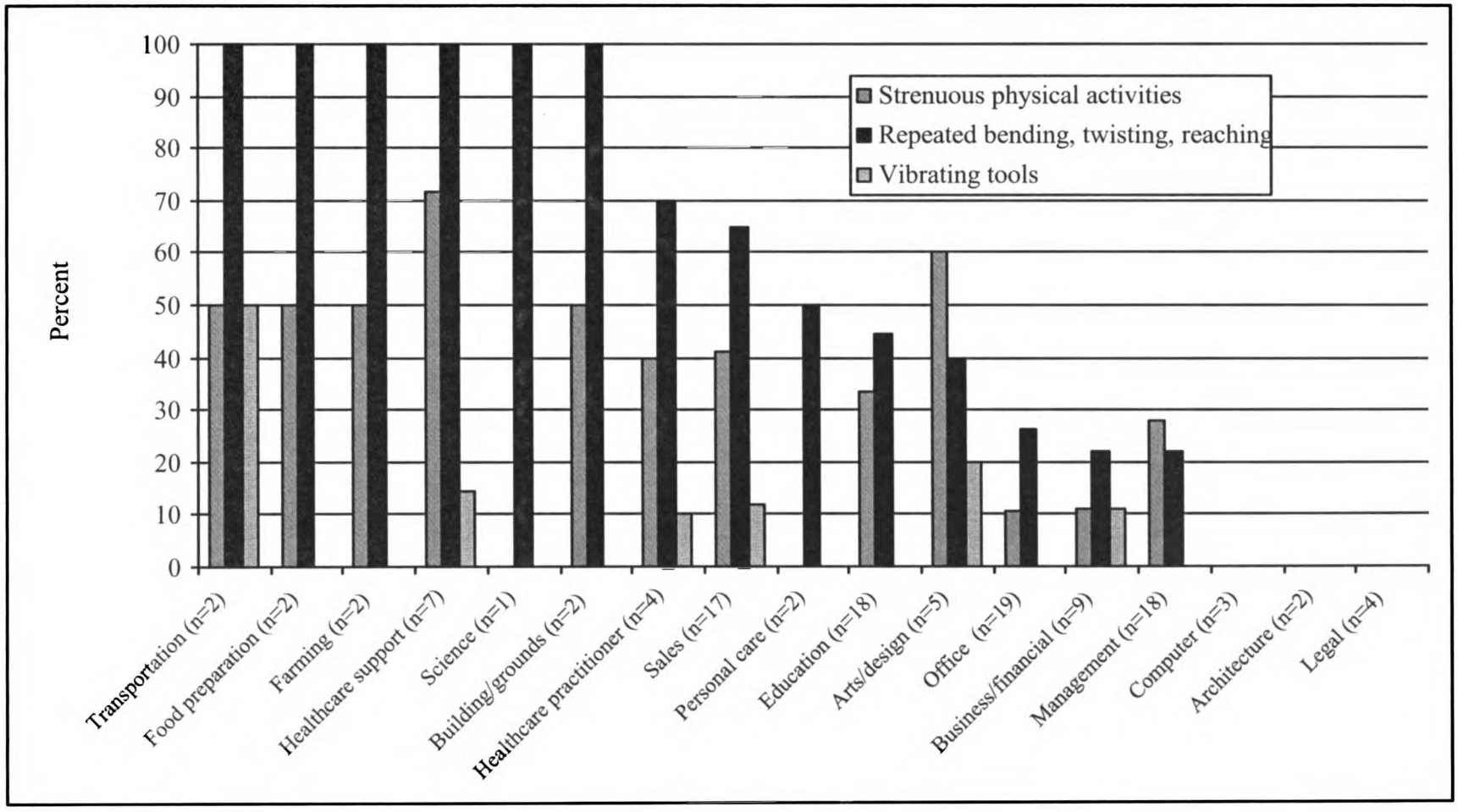


Figure 5 Percent occupationally exposed to repetitive hand motion and static postures by occupation

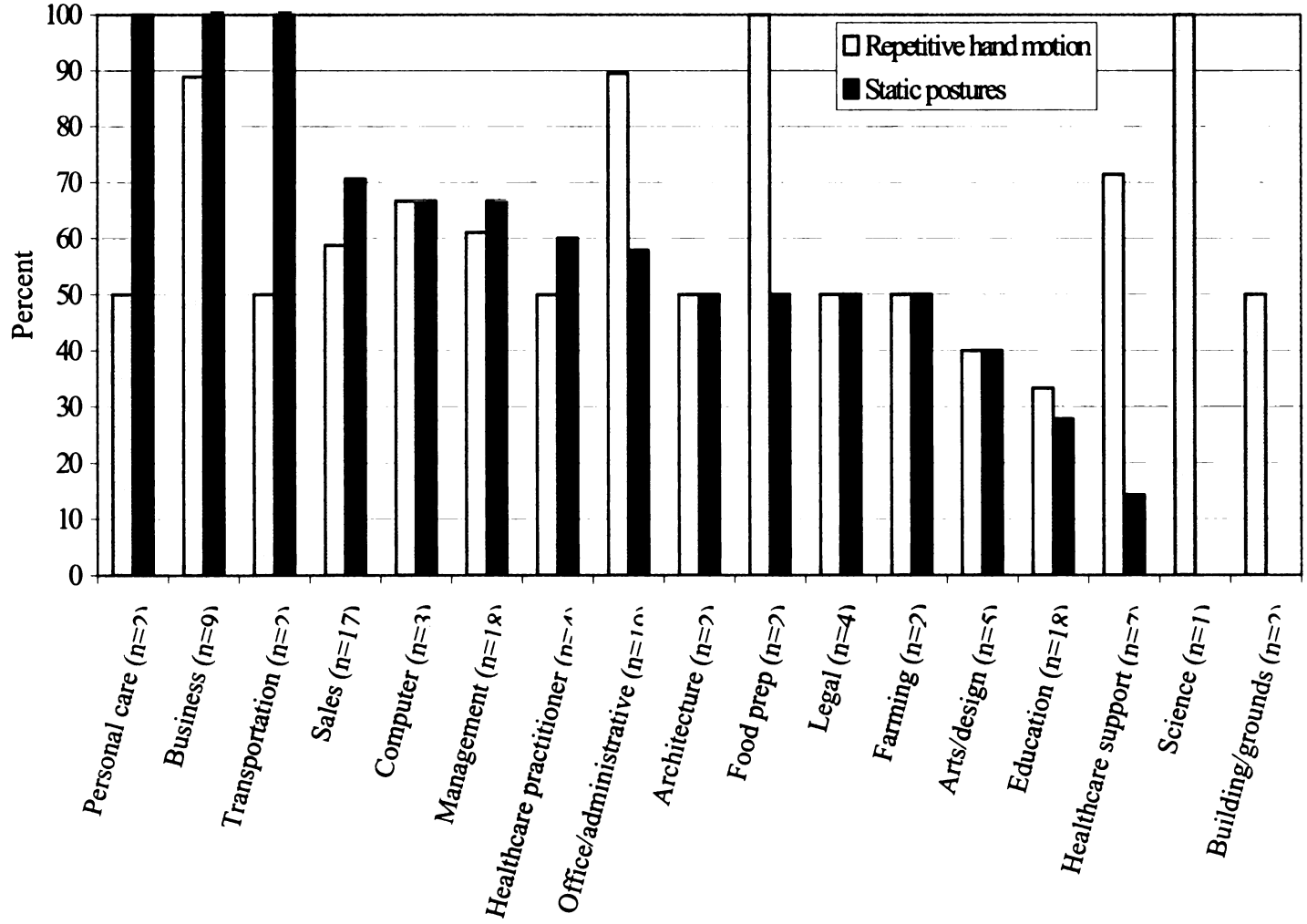


Table 26 Risk characteristics excluding knowledge and familiarity (N=123)

	Mean	Standard Deviation	Minimum	Maximum
Voluntariness*	2.43	1.18	1	4
Immediacy (present)	2.35	1.17	1	4
Immediacy (future)**	2.57	1.11	1	4
Seriousness***	2.23	1.10	1	4
Vulnerability***	1.96	1.05	1	4
Control	2.08	1.15	1	4
Equity	3.05	1.15	1	4

*n=121
**n=120
***n=122

about the health risks associated with the activity and familiarity (n = 81, 66.3%) with the exposure, in that they knew of others who had been injured doing the same types of activities at work (see table 26). These women felt they had "a lot" of control (n=53, 43.1%) or "some" control (n = 30, 22.4%) over the musculoskeletal exposures they had at work. Additionally, many reported they had a choice about whether they were exposed to the musculoskeletal stressor or not, "entirely" (n = 35, 28.9%) and "some" (n = 33, 27.3%). When asked if they thought their musculoskeletal exposures at work were affecting their health now, most of the women (n = 63, 51.3%) responded "not at all" (n = 43, 35.0%) or "a little" (n=20, 16.3%). However, the majority of women thought these same musculoskeletal exposures would affect their health in the future, "some" (n = 39, 32.5%) and "a lot" (n = 29, 24.2%). A large proportion of women (n = 58, 47.5%) felt the musculoskeletal exposures required of them at

work were not a threat to them. Both seriousness (threat) and immediacy (present) are risk characteristics that are bound to the present, so that within this cohort there was not a perception of present risk of injury but a perception of future risk. Likewise, many of the women (n = 42, 34.4%) did not worry that others would be injured as a result of similar musculoskeletal exposures at work. Fifty women (40.7%), in this cohort, believed that women, who did the same type of work as they did, had the same amount of musculoskeletal exposures at work as they did.

Voluntariness

Those women who felt that they had a choice about whether they had the occupational musculoskeletal exposures under study, also felt they had control over the musculoskeletal exposures. The correlation was moderately, positively correlated (r = 0.636, p = 0.000). Voluntariness was not correlated with any of the other risk characteristics (see table 27).

Control

Control was weakly or moderately associated with six of the nine risk characteristic items: immediacy (present) (r = 0.211, p = 0.019), immediacy (future) (r = 0.259, p = 0.004), knowledge (r = -0.254, p = 0.005), familiarity (r = -0.238, p = 0.008), seriousness (r = 0.305, p = 0.001) and vulnerability (r = 0.452, p = 0.000). Women who had knowledge about the risks of injury from their occupational musculoskeletal exposures tended to perceive that they had control over the exposures.

Control was negatively associated with back problems (r = -0.229, p = 0.011) and RSI/CTS (r = -0.329, p = 0.000), such that those women who had back problems or RSI/CTS felt they had less control over the musculoskeletal exposures they had at work.

Table 27 Risk characteristic correlations

	Volun-tariness	Control	Immediacy (present)	Immediacy (future)	Know-ledge	Familiarity	Serious - ness	Vulner - ability	Equity
Voluntariness		$r = 0.636$ $p = 0.000$ $n = 121$	$r = -0.008$ $p = 0.930$ $n = 121$	$r = 0.063$ $p = 0.500$ $n = 118$	$r = -0.062$ $p = 0.502$ $n = 119$	$r = -0.010$ $p = 0.913$ $n = 120$	$r = 0.184$ $p = 0.044$ $n = 121$	$r = 0.144$ $p = 0.117$ $n = 120$	$r = 0.042$ $p = 0.644$ $n = 121$
Control			$r = 0.211$ $p = 0.019$ $n = 123$	$r = 0.259$ $p = 0.004$ $n = 120$	$r = -0.254$ $p = 0.005$ $n = 121$	$r = -0.238$ $p = 0.008$ $n = 122$	$r = 0.305$ $p = 0.001$ $n = 122$	$r = 0.452$ $p = 0.000$ $n = 122$	$r = 0.039$ $p = 0.668$ $n = 123$
Immediacy (present)				$r = 0.678$ $p = 0.000$ $n = 120$	$r = -0.354$ $p = 0.000$ $n = 121$	$r = -0.236$ $p = 0.09$ $n = 122$	$r = 0.303$ $p = 0.001$ $n = 122$	$r = 0.439$ $p = 0.000$ $n = 122$	$r = 0.230$ $p = 0.011$ $n = 123$
Immediacy (future)					$r = -0.391$ $p = 0.000$ $n = 118$	$r = -0.328$ $p = 0.000$ $n = 119$	$r = 0.431$ $p = 0.000$ $n = 119$	$r = 0.473$ $p = 0.000$ $n = 120$	$r = 0.191$ $p = 0.037$ $n = 120$
Knowledge						$r = -0.534$ $p = 0.000$ $n = 120$	$r = -0.366$ $p = 0.000$ $n = 120$	$r = -0.463$ $p = 0.000$ $n = 120$	$r = -0.128$ $p = 0.162$ $n = 121$
Familiarity							$r = -0.541$ $p = 0.000$ $n = 121$	$r = -0.371$ $p = 0.000$ $n = 121$	$r = -0.135$ $p = 0.139$ $n = 122$
Seriousness								$r = 0.551$ $p = 0.000$ $n = 121$	$r = 0.085$ $p = 0.354$ $n = 122$
Vulnerability									$r = 0.193$ $p = 0.033$ $n = 122$
Equity									

Likewise, control was negatively associated with the BP scale of the SF-36 (r = -0.202, p = 0.026), so that women who had more bodily pain were more likely to perceive that they had less control over their occupational musculoskeletal exposures.

Immediacy.

Immediacy (present).

Immediacy (present) was weakly or moderately associated with seven of the nine risk characteristics items: control (as above), immediacy (future) (r = 0.678, p = 0.000), knowledge (r = -0.354, p = 0.0.00), familiarity (r = -0.236, p = 0.009), seriousness (r = 0.303, p = 0.001), vulnerability (r = 0.439, p = 0.000) and equity (r = 0.230, p = 0.011). Those women who felt that the musculoskeletal stressors they were exposed to at work were affecting their health now, also felt that these activities would affect their health in the future, were a threat to them, the risk of injury was equitably distributed and there was a high probability that others would be injured doing the same type of work.

Immediacy (present) was negatively correlated with kidney/bladder problems (r = -0.370, p = 0.000), back problems (r = -0.287, p = 0.001), RSI/CTS (r = -0.283, p = 0.001) and other MSDs (r = -0.227, p = 0.015). Women who felt their health was currently being affected by the musculoskeletal exposures done at work were more likely to have physician diagnosed MSDs. Further, immediacy (present) was negatively associated with PF (r = -0.233, p = 0.010), RP (r = -0.305, p = 0.001), BP (r = -0.421, p = 0.000) and the WRFQ (r = -0.372, p = 0.000). Women with lower scores on all these scales thought their health was currently being affected by the musculoskeletal exposures they did at work.

Immediacy (future).

As with immediacy (present), immediacy (future) was associated with seven of the

nine risk characteristic items: control and immediacy (as above), knowledge (r = -0.391, p = 0.00), familiarity (r = -0.328, p = 0.000), seriousness (r = 0.431, p = 0.000), vulnerability (r = 0.473, p = 0.000) and equity (r = 0.191, p = 0.037). The correlations for immediacy (future) were stronger than for immediacy (present) indicating that if a woman perceived future health risks she was more apt to know of health risks associated with the musculoskeletal exposures she did at work or to know someone who had been injured doing the same type of activity. In addition, she thought there was a greater probability that another woman would be injured as a result of doing the same type of physical activity and that the activity could have serious consequences for her.

Again, immediacy (future) was negatively correlated with back problems (r = -0.188, p = 0.039) and RSI/CTS (r = -0.269, p = 0.003), as with immediacy (present). However, there was no correlation between immediacy (future) and other MSDs. Immediacy (future) was negatively correlated with RP (r = -0.309, p = 0.001), BP (r = -0.429, p = 0.000), and the WRFQ (r = -0.284, p = 0.002). So, women in better health perceived less future risk of injury from their occupational musculoskeletal exposures.

Knowledge

Knowledge of the health risks associated with the exposure was associated with all the risk characteristics except equity. Knowledge and familiarity were moderately, positively correlated (r = 0.534, p = 0.000), thus if a woman knew of health risks associated with the musculoskeletal exposures she had at work, then they also knew someone who had been injured doing the same type of musculoskeletal exposures. Like immediacy (future), knowledge was associated with scores on the RP scale of the SF-36 (r = 0.252, p = 0.006), the BP scale (r = 0.278, p = 0.002) and the WRFQ (r = 0.209, p = 0.024). So, women who

knew someone who had been injured as the result of being exposed to a similar stressor at work were more likely to state they knew about the health risks of the stressor.

Back pain, RSI/CTS and other MSDs were weakly, positively associated with knowledge ($r = 0.287, p = 0.001$; $r = -0.287, p = 0.001$; and $r = 0.227, p = 0.015$, respectively). Women with these physician diagnosed illnesses indicated that they knew of health risks from performing the physicals activities they did at work and knew of other women who had been injured as a result of doing similar activities at work.

Familiarity

As with knowledge, familiarity was associated with all the risk characteristics except equity. However, unlike knowledge, familiarity was only associated with the BP scale of the SF-36 ($r = 0.235, p = 0.009$), so that women who had more bodily pain also knew of someone who had been injured as a result of the musculoskeletal stressor at work. Familiarity was , positively associated with back pain, RSI/CTS/CTS and other MSDs ($r = 0.216, p = 0.017$; $r = -0.232, p = 0.010$; and $r = 0.226, p = 0.017$, respectively).

Seriousness

Perceived seriousness of injury and perceived vulnerability of exposure to the physical activity were moderately positively correlated ($r = 0.551, p = 0.000$). Women who thought other women were at risk of being injured while performing similar activities at work felt that the activities they were doing posed a threat to them. Seriousness was negatively associated with RP ($r = -0.199, p = 0.029$) and BP ($r = -0.277, p = 0.002$), so that women with more bodily pain felt that the occupational stressors were a threat to other women. The perception that other women might be injured doing similar activities at work was negatively associated with both back problems and RSI/CTS ($r = -0.191, p = 0.035$ and $r = -0.259, p =$

0.004, respectively), so that women who had these illnesses tended to worry that other women would be injured as a result of their occupational stressors.

Vulnerability

Perceived vulnerability to the occupational musculoskeletal exposures was weakly, positively correlated with equity ($r = 0.193, p = 0.033$). Women who felt the activities they did at work were a threat also felt that women who did the same type of work did the same amount of activity as they did. As with seriousness, vulnerability was negatively associated with the RP and BP scales of the SF-36 ($r = -0.226, p = 0.013$ and $r = -0.269, p = 0.003$, respectively). Perceived vulnerability of the physical exposure was associated with lower scores on both these scales of the SF-36. Two of the musculoskeletal physician diagnosed illnesses were associated with perceived vulnerability of a woman's exposure. Both RSI/CTS and other MSDs were negatively correlated with perceived vulnerability ($r = -0.370, p = 0.000$; and $r = -0.270, p = 0.029$, respectively). So, women with MSDs perceived that they were vulnerable to injury as a result of occupational musculoskeletal exposures at work.

Equity

Equity was negatively associated with the WRFQ ($r = -0.208, p = 0.023$), such that women who thought other women doing the same job did less physical activity at work than they did tended to have lower scores on the WRFQ items.

Risk Perception

A composite risk score was calculated for each subject. The composite score was the mean score for each subject across the five occupational musculoskeletal exposures. A composite score was calculated for both perception of risk of injury to self and perception of risk of injury to others.

Table 28 Perception of risk to self by physical activity (n=109)

	Mean	Median	Standard Deviation	Minimum	Maximum
Risk to self (total – all exposures)	2.40	2.25	0.99	1	4
Strenuous physical activity (self)	2.89	3.00	0.94	1	4
Repeated bending, reaching and lifting (self)	2.51	2.00	1.02	1	4
Repetitive motion (self)	2.75	3.00	1.02	1	4
Vibration (self)	2.29	2.00	1.25	1	4
Static postures (self)	2.32	2.00	1.12	1	4

Injury to Self

The mean composite score of perception of risk of injury to self was 2.40 (SD = 0.99, range 1-4). Of the thirty-seven women who performed strenuous physical activities (lifting, pushing, pulling heavy objects), the majority believed that they were either somewhat or very likely (n = 25, 67.6%) to be injured doing these activities (see table 28). Of the 76 women who performed repetitive hand motion at work, fifty-five (72.4%) believed they were either somewhat likely to be injured (n = 23, 30.3%) or very likely to be injured (n = 22, 28.9%) as a result of doing this activity. Conversely, the women (n = 55, 44.7%) who reported doing repeated bending, twisting or reaching at work were less likely to perceive a risk of injury from this activity. Of these women, twenty-one (38.2%) believed that the risk of injury was

slight while nine (16.4%) believed there was no risk of injury. Likewise, static postures were thought to be less likely to result in injury to self. Twenty-two (31.9%) of the women who reported having to maintain static postures at work believed that they were not likely to be injured as a result of doing this activity.

Injury to Other Women

The mean composite score for perceived risk of injury to other women was 2.99 (*SD* = 0.76, range 1 - 4) (see table 29). Women in this study who did strenuous physical activities at work, believed that other women doing the same activity were also "somewhat likely" (*n* = 17, 45.9%) or "very likely" (*n* = 11, 29.7%) to be injured. As with strenuous physical activity, women perceived that women who did repeated bending, twisting or reaching at work were at risk of injury. Twenty-five (45.5%) of these women believed that other women

Table 29 Perception of risk to other women by physical activity (*n*=107)

	Mean	Median	Standard Deviation	Minimum	Maximum
Risk to other women (total – all exposures)	2.99	3.00	0.76	1	4
Strenuous physical activity (other women)	2.97	3.00	0.90	1	4
Repeated bending, reaching and lifting (other women)	2.87	3.00	0.77	1	4
Repetitive motion (other women)	3.32	3.00	0.72	1	4
Vibration (other women)	2.86	3.00	1.07	1	4
Static postures (other women)	2.90	3.00	0.90	1	4

were "somewhat likely" to be injured from doing repeated bending, twisting or reaching, while twelve (21.8%) thought other women were "very likely" to be injured. These women also believed that other women were at risk of injury from repetitive hand motions with thirty-two (45.7%) believing that other women were "somewhat likely" to be injured and 34 (45.3%) believing that other women were "very likely" to be injured. In addition, the women in this study believed that other women were at risk of injury from static postures. Forty-nine (72.1%) of the sixty-nine women who maintained static postures at work thought that other women were either "somewhat likely" (n = 31, 45.6%) or "very likely "(n = 18, 26.5%) to be injured as result of this activity.

Bivariate Analysis of Key Dependent Variables

Risk of Injury to Self

Demographic Characteristics

None of the demographic characteristics (age, marital status, number of children, education, income (both household and personal earnings), household size, and number of wage earners) were associated with the perception of risk of injury to self (see table 30).

Acculturation.

There were no significant correlations between any of the acculturation items and the perception of risk of injury to self. Although, the number of foreign born women was small, there was no significant difference in group means between those women and women born in the United States in the perception for risk of injury to self (M = 2.429, SD = 0.991 and M = 1.889, SD = 1.0835) (see table 31). There was a significant difference in group mean scores between women who were born in the United States and foreign born women and the perception of risk of injury to self from repeated bending, twisting or reaching (M = 2.60,

Table 30 Correlation of demographic characteristics with perception of risk of injury to self and perception of risk of injury to other women

	Perception of risk to self	Perception of risk to other women
Age (years)	$r = -0.031$ $p = 0.745$ $n = 109$	$r = 0.159$ $p = 0.102$ $n = 107$
Number of children	$r = -0.060$ $p = 0.536$ $n = 109$	$r = -0.022$ $p = 0.826$ $n = 107$
Education (years)	$r = -0.034$ $p = 0.722$ $n = 109$	$r = -0.055$ $p = 0.571$ $n = 107$
Household size (# of people)	$r = -0.124$ $p = 0.200$ $n = 109$	$r = -0.212$ $p = 0.028$ $n = 107$
Marital status	$r = 0.072$ $p = 0.455$ $n = 109$	$r = 0.030$ $p = 0.756$ $n = 107$
Income (household)	$r = 0.085$ $p = 0.416$ $n = 94$	$r = 0.084$ $p = 0.424$ $n = 93$
Income (personal)	$r = 0.076$ $p = 0.464$ $n = 95$	$r = 0.150$ $p = 0.149$ $n = 94$
# of wage earners	$r = -0.039$ $p = 0.688$ $n = 108$	$r = -0.120$ $p = 0.221$ $n = 106$
Country of origin (United States or other)	$r = -0.125$ $p = 0.199$ $n = 108$	$r = -0.144$ $p = 0.140$ $n = 106$
Acculturation	$r = -0.003$ $p = 0.995$ $n = 7$	$r = -0.407$ $p = 0.365$ $n = 7$
Hierarchy	$r = -0.062$ $p = 0.529$ $n = 106$	$r = -0.157$ $p = 0.110$ $n = 104$
Individualism	$r = 0.071$ $p = 0.477$ $n = 103$	$r = -0.103$ $p = 0.302$ $n = 102$

Table 30 Correlation of demographic characteristics with perception of risk of injury to self and perception of risk of injury to other women (cont.)

	Perception of risk to self	Perception of risk to other women
Egalitarianism	$r = -0.040$ $p = 0.687$ $n = 104$	$r = -0.050$ $p = 0.613$ $n = 103$
Fatalism	$r = 0.117$ $p = 0.230$ $n = 107$	$r = 0.030$ $p = 0.760$ $n = 105$

SD = 0.98 and *M* = 1.00, *SD* = 0.00, respectively). Women who were born in the United States were more likely to perceive a risk of injury from exposure to repeated bending, twisting or reaching than those women not born in the United States. There was no significant difference in group mean scores between women who were born in the United States and those who were not and the perception of risk of injury to self from repetitive hand motion (*M* = 2.79, *SD* = 1.03 and *M* = 2.25, *SD* = 0.96, respectively) or static postures (*M* = 2.31, *SD* = 1.13 and *M* = 2.50, *SD* = 1.29, respectively). No t-test was performed for physical strenuous activity and use of vibrating tools, as no women who were foreign born had these occupational exposures.

Worldview.

There were no significant correlations between any of the worldview scales and the perception of risk of injury to self for either the composite risk score or the perception of risk across individual occupational musculoskeletal exposures.

Health Status

Physician Diagnosed Illness.

Number of physician diagnosed MSDs was significantly correlated with the

Table 31 T-tests comparison for women born in the United States and foreign born women and perception of risk of injury to self (composite score and each occupational musculoskeletal exposure)

	Women born in the United States (n = 102)		Foreign born women (n = 6)				95% CI of the difference	
	Mean	*SD*	Mean	*SD*	*t*	Sig.	Lower	Upper
Perception of injury to self	2.429	0.991	1.889	1.084	1.293	0.199	-0.288	1.369
Repeated bending, twisting or reaching	2.60	0.98	1.0	0	11.801	0.000	0.46	2.74
Repetitive hand motion	2.79	1.03	2.25	0.96	1.024	0.309	-0.51	1.59
Static postures	2.31	1.13	2.50	1.29	-0.321	0.749	-1.35	0.98

composite score for perception of risk to self (r = 0.313, p = 0.001) (See table 32). Likewise, number of MSDs was associated with repeated bending, reaching or twisting (r = 0.266, p = 0.05), and static postures (r = 0.335, p = 0.005). Number of physician diagnosed MSDs was weakly correlated with perception of risk of injury to self from static postures (r = 0.248, p = 0.006). Those women with MSDs perceived their risk of injury as greater than those women who did not have a MSD. There was no correlation between the number of physician diagnosed illnesses (non-musculoskeletal) and the perception of risk of injury to self.

SF-36 *Scales.*

Several scales from the SF-36 were correlated with the perception of risk of injury to self. The PF scale was not correlated with perception of risk of injury to self. Conversely, the RP scale and the BP scale were negatively, correlated with composite score for perception of risk to self (r = -0.273, p = 0.004 and r = -0.404, p = 0.000). Women scored lower on the RP scale perceived their risk of injury as greater than women who scored higher on the RP scale.

Table 32 Correlation of health status with perception of risk of injury to self and perception of risk of injury to other women

	Perception of risk to self	Perception of risk to other women
PF	$r = -0.041$ $p = 0.672$ $n = 108$	$r = -0.042$ $p = 0.671$ $n = 106$
RP	$r = -0.273$ $p = 0.004$ $n = 109$	$r = -0.161$ $p = 0.098$ $n = 107$
BP	$r = -0.404$ $p = 0.000$ $n = 109$	$r = -0.140$ $p = 0.151$ $n = 107$
GH	$r = 0.032$ $p = 0.741$ $n = 109$	$r = 0.076$ $p = 0.439$ $n = 107$
WRFQ	$r = -0.274$ $p = 0.004$ $n = 106$	$r = -0.085$ $p = 0.388$ $n = 105$
Physician diagnosed illnesses	$r = 0.117$ $p = 0.226$ $n = 109$	$r = 0.187$ $p = 0.054$ $n = 107$
Physician diagnosed MSDs	$r = 0.313$ $p = 0.000$ $n = 109$	$r = 0.262$ $p = 0.007$ $n = 107$
# of physician visits	$r = 0.034$ $p = 0.730$ $n = 107$	$r = 0.055$ $p = 0.578$ $n = 105$
Work-related injury (ever)	$r = -0.235$ $p = 0.014$ $n = 108$	$r = -0.093$ $p = 0.345$ $n = 106$
Recent work-related injury	$r = -0.340$ $p = 0.000$ $n = 109$	$r = -0.196$ $p = 0.043$ $n = 107$

Moreover, women with more bodily pain perceived a higher risk of injury to self. The PF scale was correlated with perception of risk of injury to self from repeated bending, twisting or reaching ($r = -0.297$, $p = 0.029$). Likewise, the RP scale was correlated with perception of risk of injury to self from repeated bending twisting or reaching ($r = -0.339$, $p = 0.011$),

repetitive hand motion (r = -0.245, p = 0.033), static postures (r = -0.387, p = 0.001) and the BP scale was correlated with perception of risk of injury to self from repeated bending, twisting, or reaching (r = -0.404, p = 0.002), repetitive hand motion (r = -0.267, p = 0.02), static postures (r = -0.413, p = 0.000).

Work-related Injury.

Having ever had a work-related injury was significantly correlated with the composite risk perception score for injury to self (r = -0.235, p = 0.014). There was a significant difference in group means between women who had ever had a work related injury and those who had never had a work related injury and the overall perception of risk of injury to self (see table 33). However, there was no difference in group means between women who had ever had a work related injury and those who had never been injured at work and the perception of risk of injury to self from the individual occupational musculoskeletal exposures considered. Having had a work-related injury in the 12 months previous to survey administration was moderately, positively correlated with the composite score for perception of risk of injury to self (r = -0.404, p = 0.003). There was a significant difference in group means between women who had had a recent work related and those that had not and the perception of risk of injury to self (see table 34). In addition, there was a difference in the group means between women who had had a recent work related injury and those who had not recently been injured at work and the perception of risk of injury to self in three of the five occupational musculoskeletal exposures considered - repeated bending, twisting or reaching; repetitive hand motion and static postures. A t-test was not performed for the use of vibrating tools as no women with a recent work related injury were exposed occupationally.

Table 33 T-test comparisons of women who had ever had a worked related injury and women who had never had a work related injury and perception of risk of injury to self (composite score and perceived risk of injury for each occupational musculoskeletal exposure)

	Women with history of work related injury (n = 100)		Women with no history of work related injury (n = 9)				95% CI of the difference	
	Mean	*SD*	Mean	*SD*	*t*	Sig.	Lower	Upper
Perception of injury to self	2.649	0.941	2.186	0.989	2.489	0.014	0.009	0.832
Strenuous physical activity	3.000	1.000	2.710	0.830	0.898	0.375	-0.36	0.93
Repeated bending, twisting or reaching	2.710	1.040	2.250	0.940	1.692	0.096	-.008	1.00
Repetitive hand motion	2.940	0.940	2.590	1.070	1.534	0.129	-0.11	0.82
Vibrating tools	1.000	-	2.500	1.220	- 1.134	0.308	-4.90	1.90
Static postures	2.420	1.060	2.260	1.170	0.615	0.541	-0.38	0.71

Occupational Characteristics

Occupation was coded into five groups using SIC Industry coding categories – administrative, technical, service, education, transportation/farming. The administrative group (n = 40) consisted of the following occupations: management, business/financial, sales/related and office/administrative support. Included in the technical group (n = 4) were computer/technical; architecture/engineering; and life/physical science, while healthcare practitioners/technical; healthcare support; food preparation/serving related; building/grounds

maintenance/cleaning; legal, arts/ design/entertainment; and personal care services were

Table 34 T-test comparisons of women who had a recent worked related injury and women who had not had a recent work related injury and perception of risk of injury to self (composite score and perceived risk of injury for each occupational musculoskeletal exposure)

	Women with recent work related injury (n = 100)		Women without recent work related injury (n = 9)				95% CI of the difference	
	Mean	*SD*	Mean	*SD*	*t*	Sig.	Lower	Upper
Perception of injury to self	3.519	0.664	2.295	0.958	3.742	0.000	0.576	1.872
Strenuous physical activity	3.200	0.840	2.840	0.950	0.787	0.437	-0.56	1.28
Repeated bending, twisting or reaching	3.400	0.890	2.420	0.990	2.122	0.039	0.005	1.91
Repetitive hand motion	4.000	0.000	2.680	1.000	11.145	0.000	1.08	1.56
Static postures	4.000	0.000	2.220	1.070	13.473	0.000	1.52	2.05

grouped into the service category (n =45). The education group (n = 16) consisted of just one group from the BLS SOC groupings – education/training/library. The final group (n = 4), transportation/farming, consisted of two groups from the SOC – farming/fishing/forestry and transportation/material moving.

There was a significant difference ($F(4, 104) = 3.452, p = 0.011$) between occupational group means and the perception of risk of injury to self, using one-way ANOVA analysis. Women employed in technical occupations and transportation/farming

occupations perceived their risk of injury to self for occupational musculoskeletal exposures

Table 35 One-way ANOVA comparison for occupation and perception of risk of injury to self

				95% CI for mean			
	n	Mean	*SD*	Lower	Upper	Min	Max
Administrative	40	2.458	1.097	2.108	2.809	1	4
Technical	4	2.500	0.408	1.850	3.149	2	3
Service	45	2.466	0.139	2.187	2.745	1	4
Education	16	1.734	0.188	1.335	2.134	1	3
Farming/transportation	4	3.525	0.411	2.871	4.179	3	4

$F(4, 104) = 3.452, p = 0.011$

higher than did their counterparts in other occupational groups (see table 35). Post hoc comparisons (using Scheffe methodology) showed a significant difference between the mean scores of women in education and those in transportation/farming (mean difference = -1.791, 95% CI, –3.317 - -0.264).

Perception of risk of injury was correlated with number of hours worked per year ($r = 0.253, p = 0.008$) and number hours worked per week ($r = 0.248, p = 0.009$). The more hours a woman worked, either per week or per year, the higher she perceived her risk of injury from her occupational musculoskeletal exposures.

Occupational Musculoskeletal Exposures.

The number of musculoskeletal exposures a woman did at work was significantly correlated to perception of risk of injury to self ($r = 0.386, p = 0.000$). The greater the

number of occupational musculoskeletal exposures a woman had the more likely she was to perceive a risk of injury to self from those exposures. Likewise maximum number of hours doing any activity and the composite duration score were moderately, positively correlated with perception of risk of injury to self ($r = 0.368$, $p = 0.000$ and $r = 0.476$, $p = 0.000$, respectively), such that with increasing hours of exposure to musculoskeletal stressors at work there was an increased perception of risk of injury to self. Similarly, number of exposures and the duration of exposure were positively correlated to perception of injury to self from three of the occupational musculoskeletal exposures: repeated bending, twisting or reaching; static postures; and repetitive hand motion (see table 36).

Risk Characteristics

The composite score of perception of risk of injury to self was associated with all of the risk characteristics except voluntariness (see table 37). Further, voluntariness was the only risk characteristic that was not associated with perception of risk of injury to self across the individual musculoskeletal exposures.

Risk of Injury to Others

Demographic Characteristics

There were no significant correlations between perception of risk of injury to other women and any of the demographic variables in this study, except household size (see table 30). With decreasing household size there was an increase in the perceived risk of injury to other women from the occupational musculoskeletal exposures ($r = -0.212$, $p = 0.028$). Perception of risk of injury to other women from repetitive hand motion was weakly correlated with age ($r = 0.231$, $p = 0.046$), such that with increasing age there was an increase in the perception of risk of injury. Interestingly, personal earnings and number of wage earners in the

household approached significance in correlation with two musculoskeletal exposures

Table 36 Correlation among occupational characteristics with perception of risk of injury to self and perception of risk of injury to other women

	Perception of risk to self	Perception of risk to other women
# of hours worked/week	r = -0.248 p = 0.009 n = 109	r = -0.107 p = 0.274 n = 107
# of hours worked/year	r = -0.253 p = 0.009 n = 109	r = -0.086 p = 0.380 n = 107
Strenuous physical activity	r = -0.321 p = 0.001 n = 109	r = -0.043 p = 0.657 n = 107
Repeated bending, reaching or twisting	r = -0.127 p = 0.187 n = 109	r = -0.188 p = 0.052 n = 107
Repetitive hand motion	r = -0.240 p = 0.012 n = 109	r = -0.308 p = 0.001 n = 107
Vibration	r = -0.080 p = 0.405 n = 109	r = -0.013 p = 0.891 n = 107
Static postures	r = -0.155 p = 0.107 n = 109	r = -0.090 p = 0.358 n = 107
# of occupational musculoskeletal exposures	r = 0.386 p = 0.000 n =109	r = 0.105 p = 0.283 n = 107
Hours per day exposed to strenuous physical activity	r = 0.400 p = 0.014 n = 37	r = 0.402 p = 0.014 n = 37
Hours per day exposed to repeated bending, lifting or reaching	r = 0.293 p = 0.031 n = 54	r = 0.419 p = 0.002 n = 54
Hours per day exposed to repetitive hand motion	r = 0.406 p = 0.000 n = 76	r = 0.371 p = 0.001 n = 75
Hours per day exposed to vibrating tools	r = 0.784 p = 0.037 n = 7	r = 0.782 p = 0.038 n = 7

Table 36 Correlation of occupational characteristics with perception of risk of injury to self and perception of risk of injury to other women (cont.)

	Perception of risk to self	Perception of risk to other women
Hours per day exposed to static postures	$r = 0.205$ $p = 0.092$ $n = 69$	$r = 0.058$ $p = 0.640$ $n = 68$
Duration of exposure (maximum hours /day of any exposure)	$r = 0.368$ $p = 0.000$ $n = 108$	$r = 0.289$ $p = 0.003$ $n = 106$
# of years in longest held occupation	$r = -0.040$ $p = 0.682$ $n = 109$	$r = 0.200$ $p = 0.038$ $n = 107$

repeated strenuous physical activity ($r = 0.32, p = 0.065$) and repetitive hand motion ($r = -0.223, p = 0.056$), respectively. Those women who had higher personal earnings perceived the risk of injury to other women from repeated strenuous physical activity as higher than women with lower personal earnings. The risk of injury to other women from repetitive hand motion was perceived to greater among women with fewer wage earners in the household.

Acculturation.

There were no significant associations between any of the acculturation items and the composite perception of injury to other women score.

Worldview.

There was no correlation between worldview and the perception of risk of injury to other women, either the composite risk score or the perception of risk across individual occupational musculoskeletal exposures.

Health Status

Table 37 Risk characteristic correlations and perception of risk of injury to self (composite score and perceived risk of injury from exposures).

	Volun - tariness	Control	Immediacy (present)	Immediacy (future)	Knowledge	Familiarity	Serious - ness	Vulner - ability	Equity
Composite risk score	$r = -0.092$ $p = 0.343$ $n = 108$	$r = -0.368$ $p = 0.000$ $n = 109$	$r = 0.506$ $p = 0.000$ $n = 109$	$r = 0.459$ $p = 0.000$ $n = 106$	$r = -0.432$ $p = 0.000$ $n = 107$	$r = -0.361$ $p = 0.000$ $n = 108$	$r = 0.527$ $p = 0.000$ $n = 109$	$r = 0.611$ $p = 0.000$ $n = 108$	$r = 0.199$ $p = 0.038$ $n = 109$
Strenuous physical activity	$r = -0.236$ $p = 0.160$ $n = 37$	$r = -0.420$ $p = 0.010$ $n = 37$	$r = 0.246$ $p = 0.143$ $n = 37$	$r = 0.342$ $p = 0.044$ $n = 35$	$r = -0.148$ $p = 0.383$ $n = 37$	$r = -0.053$ $p = 0.759$ $n = 36$	$r = 0.191$ $p = 0.256$ $n = 37$	$r = 0.542$ $p = 0.001$ $n = 37$	$r = -0.045$ $p = 0.49$ $n = 37$
Repeated bending, twisting or reaching	$r = -0.063$ $p = 0.647$ $n = 55$	$r = -0.222$ $p = 0.103$ $n = 55$	$r = 0.466$ $p = 0.000$ $n = 55$	$r = 0.499$ $p = 0.000$ $n = 53$	$r = -0.343$ $p = 0.010$ $n = 55$	$r = -0.223$ $p = 0.101$ $n = 55$	$r = 0.462$ $p = 0.000$ $n = 55$	$r = 0.468$ $p = 0.000$ $n = 55$	$r = 0.266$ $p = 0.050$ $n = 55$
Repetitive hand motion	$r = -0.058$ $p = 0.621$ $n = 76$	$r = -0.304$ $p = 0.008$ $n = 76$	$r = 0.518$ $p = 0.000$ $n = 76$	$r = 0.454$ $p = 0.000$ $n = 73$	$r = -0.358$ $p = 0.002$ $n = 75$	$r = -0.284$ $p = 0.013$ $n = 76$	$r = 0.400$ $p = 0.000$ $n = 76$	$r = 0.539$ $p = 0.000$ $n = 75$	$r = 0.260$ $p = 0.023$ $n = 76$
Vibrating tools	$r = -0.612$ $p = 0.144$ $n = 7$	$r = -0.762$ $p = 0.046$ $n = 7$	$r = 0.523$ $p = 0.228$ $n = 7$	$r = 0.711$ $p = 0.073$ $n = 7$	$r = -0.452$ $p = 0.308$ $n = 7$	$r = -0.428$ $p = 0.338$ $n = 7$	$r = 0.908$ $p = 0.005$ $n = 7$	$r = 0.649$ $p = 0.115$ $n = 7$	$r = 0.359$ $p = 0.428$ $n = 7$
Static postures	$r = -0.038$ $p = 0.761$ $n = 68$	$r = -0.038$ $p = 0.761$ $n = 68$	$r = 0.473$ $p = 0.000$ $n = 69$	$r = 0.345$ $p = 0.004$ $n = 68$	$r = -0.358$ $p = 0.003$ $n = 67$	$r = -0.316$ $p = 0.008$ $n = 69$	$r = 0.359$ $p = 0.002$ $n = 69$	$r = 0.525$ $p = 0.000$ $n = 69$	$r = 0.212$ $p = 0.080$ $n = 69$

Physician Diagnosed Illness.

Number of physician diagnosed MSDs was weakly correlated to the composite score for perception of risk of injury to other ($r = 0.262, p = 0.006$), so that with increasing numbers of MSDs there was an increase in the perception of risk of injury to other women. Perception of risk of injury to other women from repetitive hand motion was weakly correlated with age ($r = 0.231, p = 0.046$), such that with increasing age there was an increase in the perception of risk of injury. Interestingly, personal earnings and number of wage earners in the household approached significance in correlation with two musculoskeletal exposures repeated strenuous physical activity ($r = 0.32, p = 0.065$) and repetitive hand motion ($r = -0.223, p = 0.056$), respectively. Those women who had higher personal earnings perceived the risk of injury to other women from repeated strenuous physical activity as higher than women with lower personal earnings. The risk of injury to other women from repetitive hand motion was perceived to greater among women with fewer wage earners in the household.

Number of physician diagnosed MSDs was weakly correlated to the composite score for perception of risk of injury to other ($r = 0.262, p = 0.006$), so that with increasing numbers of MSDs there was an increase in the perception of risk of injury to other women. Number of physician diagnosed illness was correlated with the perception of risk of injury to others from strenuous physical activities ($r = 0.338, p = 0.041$) (see table 32).

SF-36 *Scale and Work Role Functioning Questionnaire.*

Only RP was correlated with the perception of risk of injury to other women from static postures ($r = -0.272, p = 0.025$). No other correlations between scales of the SF-36 and perception of risk of injury to other women were significant. The WRFQ was not correlated

to perception of risk of injury to other women.

Work-related injury.

Physical limitations resulting from a work-related injury were strongly, negatively associated with the composite score for perception of risk to others (r=-0.837, p=0.005). However, there was no significant difference in group mean scores between women who had ever had a work related injury and those women who had never had a work related injury in terms of the perception of risk of injury to other women (see table 38). Additionally, there was no difference in group means between women who had ever had a work related injury and those who had never had a work related injury in terms of the perception of risk of injury to other women from any of the five occupational musculoskeletal exposures, individually. Women who had had a work related injury tended to perceive the risk of injury to other women from the use of hand-held vibrating tools as higher than did women who had never had a on the job injury.

There was a significant difference in group mean scores between women who had had an on the job injury within the 12 months prior to survey administration and those who had not had a recent on the job injury in terms of the perception of risk of injury to other women (see table 39). Those women with a recent work related injury perceived the risk of injury from occupational musculoskeletal exposures as higher than those women who had not had a recent work related injury. Additionally, there was a significant difference in group means between women who had had a recent work related injury and those who had not had a recent work related injury and the perception of risk of injury to other women from exposure to repetitive hand motion and static postures. Women who had had a recent work related injury perceived the risk to other women from static postures as higher than

Table 38 T-tests comparisons of women who had ever had a worked related injury and women who had never had a work related injury and perception of risk of injury to other women (composite score and perceived risk of injury for each occupational musculoskeletal exposure)

	Women with history of work related injury (n =98)		Women with no history of work related injury (n = 9)				95% CI of the difference	
	Mean	*SD*	Mean	*SD*	*t*	Sig.	Lower	Upper
Perception of injury to other women	3.0753	0.695	2.936	0.806	0.949	0.345	-0.152	0.429
Strenuous physical activity	3.170	0.780	2.640	1.010	1.80	0.081	-0.006	1.13
Repeated bending, twisting or reaching	3.000	0.770	2.710	0.750	1.404	0.166	-0.13	0.71
Repetitive hand motion	3.370	0.650	3.280	0.780	0.576	0.566	-0.24	0.43
Vibrating tools	1.000	-	3.17	0.750	- 2.665	0.045	-4.26	-0.007
Static postures	2.970	0.810	2.850	0.990	0.528	0.599	-0.32	0.56

did women who had not had a recent work related injury. There was no significant difference in group means in the perception of risk to other women from the remaining occupational musculoskeletal exposures. A t-test was not performed for the use of vibrating tools as no

women with a recent work related injury were exposed occupationally.

Table 39 T-tests comparisons of women who had a recent worked related injury and women who had not had a recent work related injury and perception of risk of injury to other women (composite score and perceived risk of injury for each occupational musculoskeletal exposure)

	Women with history of work related injury (n =98)		Women with no history of work related injury (n = 9)				95% CI of the difference	
	Mean	*SD*	Mean	*SD*	*t*	Sig.	Lower	Upper
Perception of injury to other women	3.482	0.664	2.951	0.751	2.046	0.043	0.001	1.045
Strenuous physical activity	3.600	0.550	2.880	0.910	1.726	0.093	-0.13	1.58
Repeated bending, twisting or reaching	3.200	0.840	2.840	0.770	0.995	0.324	-0.37	1.09
Repetitive hand motion	4.000	0.000	3.280	0.720	8.397	0.000	0.55	0.89
Static postures	3.750	0.500	2.840	0.890	1.997	0.050	0.00005	1.81

Occupational Characteristics

There was a significant difference (F (4,102) = 3.115, p = 0.018) between occupational group means and the perception of risk of injury to other women from occupational musculoskeletal exposures (see table 40). As with perception of risk of injury to

self, those women who were in technical occupations and transportation/farming occupations

Table 40 One-way ANOVA occupation and perception of risk of injury to other women

				95% CI for mean			
	n	Mean	*SD*	Lower	Upper	Min	Max
Administrative	38	3.170	0.824	2.899	3.441	1	4
Technical	4	3.625	0.479	2.863	4.387	3	4
Service	45	2.851	0.656	2.654	3.048	1	4
Education	16	2.682	0.763	2.276	3.089	1	4
Farming/transportation	4	3.575	4.35	2.883	4.267	3	4

$F(4, 102) = 3.115, p = 0.018$

perceived the risk of injury to other women as higher than did their counterparts in other occupations.

Perception of risk of injury to other women from occupational musculoskeletal exposures was correlated with the number of years at the longest held occupation ($r = 0.20, p = 0.038$). The longer a woman had been in her longest held occupation the more likely she was to perceive a risk of injury to other women from each of the five occupational musculoskeletal exposures considered.

Occupational Musculoskeletal Exposures.

The number of hours a woman was exposed to musculoskeletal hazards at work was correlated with perception of risk to other women ($r = 0.289, p = 0.003$). So, women who were exposed to the musculoskeletal stressors for more hours per day perceived the risk of injury to other women as higher than did women who were exposed for fewer hours.

However the number of different types of musculoskeletal exposures experienced at work was not correlated with the composite perception of risk of injury to others score (see table 36).

Risk Characteristics

Seven of the nine risk characteristic items – control, immediacy (both present and future), familiarity, seriousness and vulnerability - were significantly, positively correlated with the composite score for perception of risk of injury to other women. Refer to table 41 for the correlations of the risk characteristics with the perception of risk of injury to other women from each of the individual occupational musculoskeletal exposures considered.

Multivariate Analysis

The dependent variables in the multiple regression analysis were the composite scores of perception of risk of injury, both to self and to others. Two regression equations were constructed, one for each of the dependent variables. Only those items that were correlated to the dependent variables at $\alpha \leq 0.10$ in bivariate analysis were entered into each of the regression equations, respectively.

Risk of Injury to Self

Twenty-two independent variables were significantly associated with the perception of risk of injury to self in bivariate analysis. Number of hours worked per week and number of hours worked per year were both correlated with the perception of risk of injury to self. However, since these two variables were measuring the same concept only one was entered into the regression equation. Number of hours worked per year was selected because there were several women (n = 15, 13%) who worked less than 12 months a year and it was felt that total hours worked in a year was a more accurate measure of actual exposure to risk. Similarly, the number of occupational musculoskeletal exposures was correlated with each of

Table 41 Risk characteristic correlations and perception of risk of injury to other women

	Volun-tariness	Control	Immediacy (present)	Immediacy (future)	Knowledge	Familiarity	Serious-ness	Vulner-ability	Equity
Composite risk score	$r = 0.012$ $p = 0.900$ $n = 107$	$r = -0.259$ $p = 0.007$ $n = 107$	$r = 0.288$ $p = 0.003$ $n = 107$	$r = 0.273$ $p = 0.005$ $n = 105$	$r = -0.192$ $p = 0.049$ $n = 105$	$r = -0.477$ $p = 0.000$ $n = 106$	$r = 0.413$ $p = 0.000$ $n = 107$	$r = 0.385$ $p = 0.000$ $n = 107$	$r = 0.024$ $p = 0.802$ $n = 107$
Strenuous physical activity	$r = -0.248$ $p = 0.140$ $n = 37$	$r = -0.276$ $p = 0.098$ $n = 37$	$r = 0.135$ $p = 0.425$ $n = 37$	$r = 0.277$ $p = 0.107$ $n = 35$	$r = -0.011$ $p = 0.950$ $n = 37$	$r = -0.152$ $p = 0.375$ $n = 36$	$r = 0.154$ $p = 0.363$ $n = 37$	$r = 0.304$ $p = 0.068$ $n = 37$	$r = -0.201$ $p = 0.232$ $n = 37$
Repeated bending, twisting or reaching	$r = -0.128$ $p = 0.350$ $n = 55$	$r = -0.295$ $p = 0.029$ $n = 55$	$r = 0.293$ $p = 0.030$ $n = 55$	$r = 0.426$ $p = 0.001$ $n = 53$	$r = -0.214$ $p = 0.116$ $n = 55$	$r = -0.258$ $p = 0.058$ $n = 55$	$r = 0.321$ $p = 0.017$ $n = 55$	$r = 0.292$ $p = 0.030$ $n = 55$	$r = 0.170$ $p = 0.215$ $n = 55$
Repetitive hand motion	$r = 0.186$ $p = 0.109$ $n = 75$	$r = -0.186$ $p = 0.110$ $n = 75$	$r = 0.366$ $p = 0.001$ $n = 75$	$r = 0.245$ $p = 0.037$ $n = 73$	$r = -0.081$ $p = 0.495$ $n = 74$	$r = -0.353$ $p = 0.002$ $n = 75$	$r = 0.163$ $p = 0.161$ $n = 75$	$r = 0.271$ $p = 0.019$ $n = 75$	$r = 0.020$ $p = 0.868$ $n = 75$
Vibrating tools	$r = -0.193$ $p = 0.679$ $n = 7$	$r = -0.596$ $p = 0.158$ $n = 7$	$r = 0.710$ $p = 0.074$ $n = 7$	$r = 0.896$ $p = 0.006$ $n = 7$	$r = -0.766$ $p = 0.045$ $n = 7$	$r = -0.548$ $p = 0.203$ $n = 7$	$r = 0.710$ $p = 0.074$ $n = 7$	$r = 0.741$ $p = 0.057$ $n = 7$	$r = 0.773$ $p = 0.042$ $n = 7$
Static postures	$r = -0.078$ $p = 0.530$ $n = 68$	$r = -0.295$ $p = 0.015$ $n = 68$	$r = 0.267$ $p = 0.028$ $n = 69$	$r = 0.208$ $p = 0.092$ $n = 67$	$r = -0.242$ $p = 0.050$ $n = 66$	$r = -0.428$ $p = 0.000$ $n = 68$	$r = 0.439$ $p = 0.000$ $n = 68$	$r = 0.424$ $p = 0.000$ $n = 68$	$r = 0.186$ $p = 0.128$ $n = 681$

the individual exposures. Thus, only the individual exposures that were significantly correlated with the perception of risk in bivariate analysis were entered into the regression equation. In addition, ever having had a work-related injury and having had a recent work related injury were both correlated with the perception of risk of injury to self. Since both variables were measuring history of work-related injury only ever having had a work related injury was entered into the regression equation. Likewise, the risk characteristic – vulnerability (threat) – was highly correlated with the dependent variable. Wording of both items was reviewed and the variable was not entered into the regression equation because it was felt to also be measuring perception of risk. Thus the final regression equation consisted of 19 independent variables – number of MSDs, work-related injury (at any time), the BP and RP scales of the SF-36, the WFRQ scale, hours worked per year, duration of exposure, current occupation (dichotomized into blue collar and white collar occupations), occupational exposure to strenuous physical and repetitive hand motion; eight risk characteristic items (control, immediacy (present and future), knowledge, familiarity, seriousness, vulnerability and equity) and perception of risk of injury to self.

The final regression equation, with all 19 variables in the equation, explained approximately 67% (R^2 = 0.669, F (18, 80) = 8.994, p = 0.000) of the variance in perception of risk of injury to self. The addition of each block of variables to the equation resulted in a significant change in the explained variance of the perception of risk of injury to self. No outliers were identified and the histogram of the residuals approached a normal distribution (see table 42).

The optimum combination of the five health status variables explained approximately 21% (R^2 = 0.217, F (5, 93) = 5.165, p = 0.000) of the variance in the perception of risk of

Table 42 Regression equation perception of risk of injury to self

		Cumulative R^2	R^2 Change	sr^2	beta	df	F change	p value
Health Status		**0.217**	**0.217**			**5,93**	**5.165**	**0.000**
	Number of musculoskeletal disorders			0.011	0.125	1,93	1.141	0.257
	Role physical (RP)			0.009	-0.119	1,93	-1.036	0.303
	Bodily pain (BP)			0.048	-0.323	1,93	-2.382	0.019
	Work Role Functioning Questionnaire			0.001	0.053	1,93	0.383	0.703
	Work-related injury			0.013	-0.120	1,93	-1.226	0.223
Occupational Characteristics		**0.396**	**0.177**			**5,88**	**5.205**	**0.000**
	Hours worked per year			0.009	0.114	1,88	1.168	0.246
	Exposure to repeated strenuous physical activity			0.048	-0.231	1,88	-2.633	0.010
	Exposure to repetitive hand motion			0.032	-0.193	1,88	-2.161	0.033
	Current occupation (SIC code)			0.005	0.071	1,88	0.813	0.418
	Duration of exposure			0.023	0.183	1,88	1.806	0.074

Table 42 Regression equation perception of risk of injury to self (cont.)

		Cumulative R^2	R^2 Change	sr^2	beta	df	F change	p value
Risk Characteristics		**5.61**	**0.169**			**7,81**	**4.450**	**0.000**
	Immediacy (present)			0.020	0.196	1,81	1.907	0.060
	Immediacy (future)			0.002	0.071	1,81	0.658	0.512
	Knowledge			0.015	-0.151	1,81	-1.673	0.098
	Familiarity			0.000	0.011	1,81	0.111	0.912
	Seriousness			0.038	0.247	1,81	2.642	0.010
	Control			0.023	-0.178	1,81	-2.039	0.045
	Equity			0.001	0.030	1,81	0.368	0.714
Perception of risk of injury to other women		**0.669**	**0.108**			**1,80**	**26.148**	**0.000**

injury to self. Within this block, only bodily pain had a significant unique contribution to the variance in the perception of risk, while controlling for other variables in the equation.

The occupational variables were entered into the equation as the second block. The optimal combination of the six occupational variables explained approximately an additional 18% (R^2 = 0.392, F (5, 88) = 5.071, p = 0.000) of the variance in the dependent variable. Both exposure to strenuous physical activity and repetitive hand motion had significant unique contributions on the perception of risk of injury to self, while controlling for other variables in the equation. Although, not having a significant unique contribution to the variance in perception of risk to self, duration of exposure contributed 2.3% to the explained variance of the dependent variable.

The third block of variables entered into the regression equation was the risk characteristics. The addition of risk characteristics to the equation resulted in an increase in explained variance in the dependent variable of approximately 17% (R^2 = 0.561, F (7, 81) = 4.450, p = 0.000). So the optimal combination of the seven risk characteristics explained a significant portion of the total variance in the perception of injury to self. Two risk characteristics – seriousness and control - had significant unique contributions to the variation in the perception of risk of injury to self. In addition, immediacy (present) contributed 2% to the variation in the dependent variable. Perception of risk of injury to other women increased the explained variance in the dependent variable by approximately 11% (R^2 = 0.669, F (1, 80) = 26.148, p = 0.000).

Risk of Injury to Others

Seventeen independent variables were significantly correlated with the perception of risk of injury to other women in bivariate analysis. As with perception of risk of injury to

self, vulnerability was not entered into the regression equation because of the high correlation with perception of risk. Thus, the final equation consisted of 16 predictor variables. Predictor variables were entered into the regression equation in a hierarchical manner. The first block, demographic characteristics, consisted solely of one predictor variable – household size. Health status was entered into the equation as the second block and included the following variables –number of MSDs, number of physician diagnosed illness, recent work related injury, and the RP scale of the SF-36. The third block, occupational characteristics, included number of years in longest held occupation; repeated bending, twisting or reaching; repetitive hand motion; and duration of exposure. Block four consisted of seven risk characteristics, excluding equity, vulnerability and voluntariness. Finally, perception of risk of injury to self was entered in as the last block.

The final regression equation, with all 16 variables in the equation, explained approximately 57% ($R^2 = 0.574$, F (16, 84) = 7.087, $p = 0.000$) of the variance in perception of risk of injury to other women (see table 43). The addition of each group of variables to the equation resulted in a significant change in the explained variance of the perception of risk of injury to self, except health status. However, the regression equation remained significant with the addition of each block of variables. No outliers were identified and the histogram of the residuals approached a normal distribution.

Household size only explained approximately 4% ($R^2 = 0.041$, F (1, 99) = 4.205, $p = 0.043$) of the variance in the perception of risk of injury to other women. When health status was added to the equation, the explained variance in the dependent variable increased to approximately 12% ($R^2 = 0.122$, F (4, 95) = 2.184, $p = 0.076$). The change in explained variance with the addition of the health status predictors was not significant.

Table 43 Regression equation perception of risk of injury to other women

		Cumulative R^2	R^2 Change	sr^2	beta	df	F change	p value
Demographic Characteristics		**0.041**	**0.041**			**1,99**	**4.205**	**0.043**
	Household size			0.041	-0.202	1,99	4.025	0.043
Health Status		**0.122**	**0.081**			**4,95**	**2.187**	**0.076**
	Number of physician diagnosed illness			0.009	0.111	1,95	0.983	0.328
	Number of musculoskeletal disorders			0.025	0.181	1,95	1.653	0.102
	Role physical (RP)			0.000	-0.012	1,95	-0.106	0.916
	Recent work related injury			0.007	-0.094	1,95	-0.865	0.389
Occupational Characteristics		**0.299**	**0.177**			**4,91**	**5.741**	**0.000**
	Number of years in longest held occupation			0.041	0.129	1,89	1.352	0.180
	Exposure to repeated bending, twisting or reaching			0.025	0.167	1,89	1.803	0.075
	Exposure to repetitive hand motion			0.071	-0.290	1,89	-3.035	0.003
	Duration of exposure			0.025	0.177	1,89	1.806	0.074

Table 43 Regression equation perception of risk of injury to other women (cont.)

		Cumulative R^2	R^2 Change	sr^2	beta	df	F change	p value
Risk Characteristics		**0.449**	**0.150**			**6,85**	**3.869**	**0.002**
	Immediacy (present)			0.000	0.015	1,85	0.123	0.903
	Immediacy (future)			0.002	0.060	1,85	0.511	0.610
	Knowledge			0.006	0.094	1,85	0.970	0.335
	Familiarity			0.067	-0.332	1,85	-3.202	0.002
	Seriousness			0.014	0.145	1,85	1.467	0.146
	Control			0.012	-0.135	1,85	-1.384	0.170
Perception of risk of injury to self		**0.574**	**0.125**			**1,84**	**24.744**	**0.000**

The occupational variables were entered into the equation as the third block. The optimal combination of the four occupational variables explained approximately an additional 18% (R^2 = 0.299, F (4, 91) = 5.741, p = 0.000) of the variance in the dependent variable. Exposure to repetitive hand motion at work had a unique significant contribution to the explained variance in the perception of risk of injury to other women, while controlling for other variables in the equation.

The fourth group of variables entered into the regression equation was the risk characteristics. The addition of risk characteristics to the equation resulted in an increase in explained variance in the dependent variable of approximately 15% (R^2 = 0.449, F (6, 85) = 3.869, p = 0.002). So the optimal combination of the six risk characteristic variables explained a significant portion of the variation in the perception of risk of injury to other women. One risk characteristic – familiarity – had a significant unique contribution to the perception of risk of injury to other women. Perception of risk of injury to self increased the explained variance in the dependent variable by approximately 13% (R^2 = 0.574, F (1, 84) = 24.744, p = 0.000). Thus, both regression equations explained greater than 50% of the variance in the dependent variables, with both overall models achieving significance.

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Women have entered the work force . . . partly to express their feelings of self-worth . . . partly because today many families would not survive without two incomes, partly because they are not at all sure their marriages will last. The day of the husband as permanent meal-ticket is over, a fact most women recognize, however they feel about "women's liberation."
Robert Neelly Bellah (1985)

Introduction

This study was conducted to identify the relationship between characteristics of women workers and their perception of risk. Understanding how risk is perceived is important in designing effective communication regarding workplace health and safety. The theoretical framework put forward for this study hypothesized that there was a relationship between a woman's demographic characteristics, her occupational characteristics, her health status, and the characteristics she assigned to her occupational musculoskeletal exposures and her perception of risk of injury to self or other women from those exposures. This chapter will explore the relationships between the variables of interest within the framework. In addition, the chapter will include a discussion of the strengths and limitations of the study identifying steps needed to further explore the perception of risk from occupational exposures to reduce risk taking in the work place and implications of study results for nursing practice.

Perception of Risk of Injury

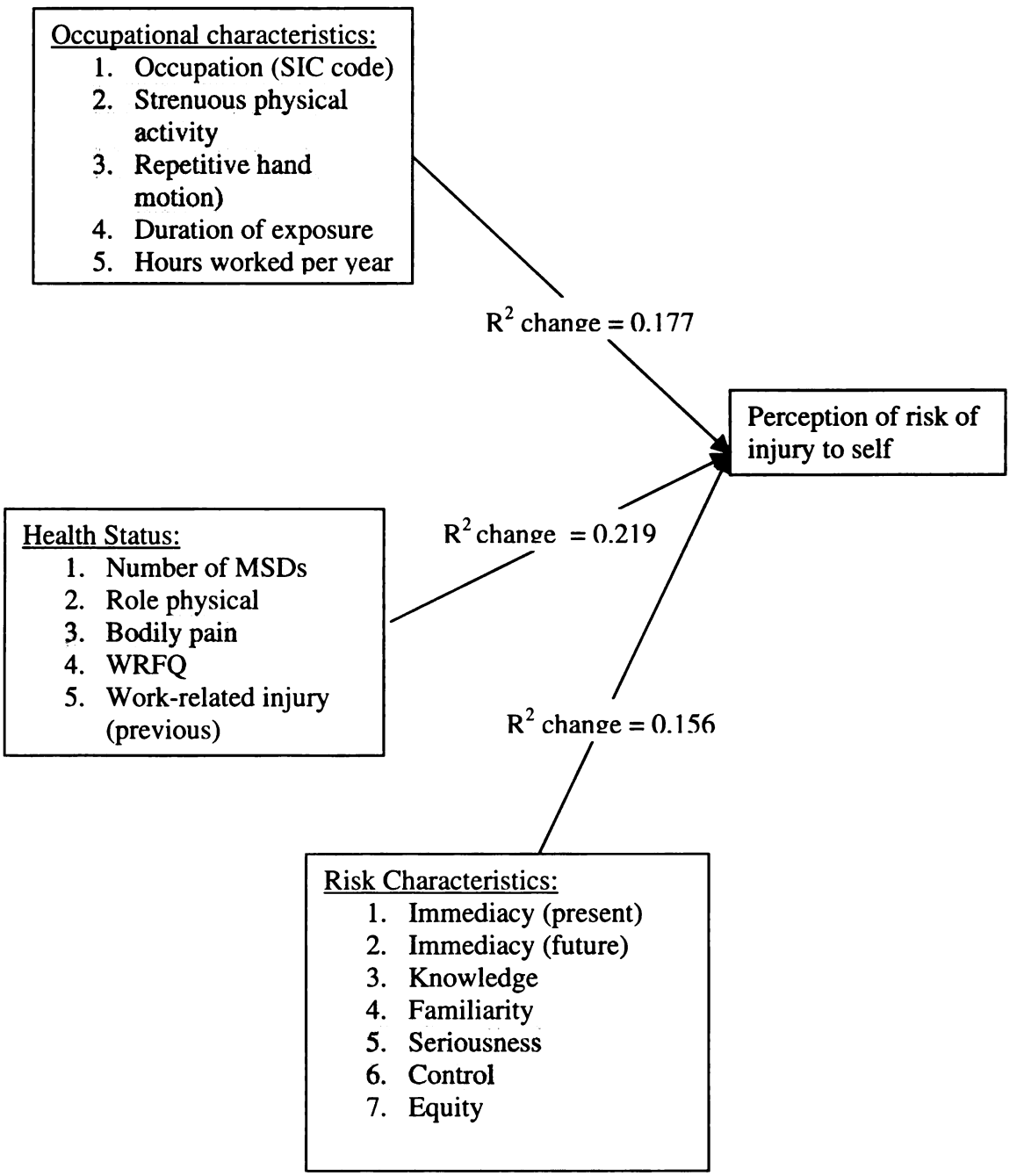
Perception of risk of injury to self from occupational musculoskeletal exposures was found to be influenced by a woman's occupational characteristics, health status and the characteristics attributed to the risk by the woman. The theoretical model was robust for both the perception of risk of injury to self and the perception of risk of injury to other women. Both regression equations explained greater than 55% of the variance in the dependent

variable, however only a few of the predictor variables had a significant unique contribution to the explained variance. As hypothesized the risk characteristics a woman assigned to her musculoskeletal exposures, her occupational characteristics, and her health were significant factors in the perception of risk (see Figure 1 and Figure 2). However a woman's demographic characteristics only influenced the perception of risk of injury to other women, then only for size of her household. Thus the perception of risk is multifaceted and communication strategies designed to reduce the risk of injury need to consider the multidimensionality of perceived risk.

Risk Characteristics

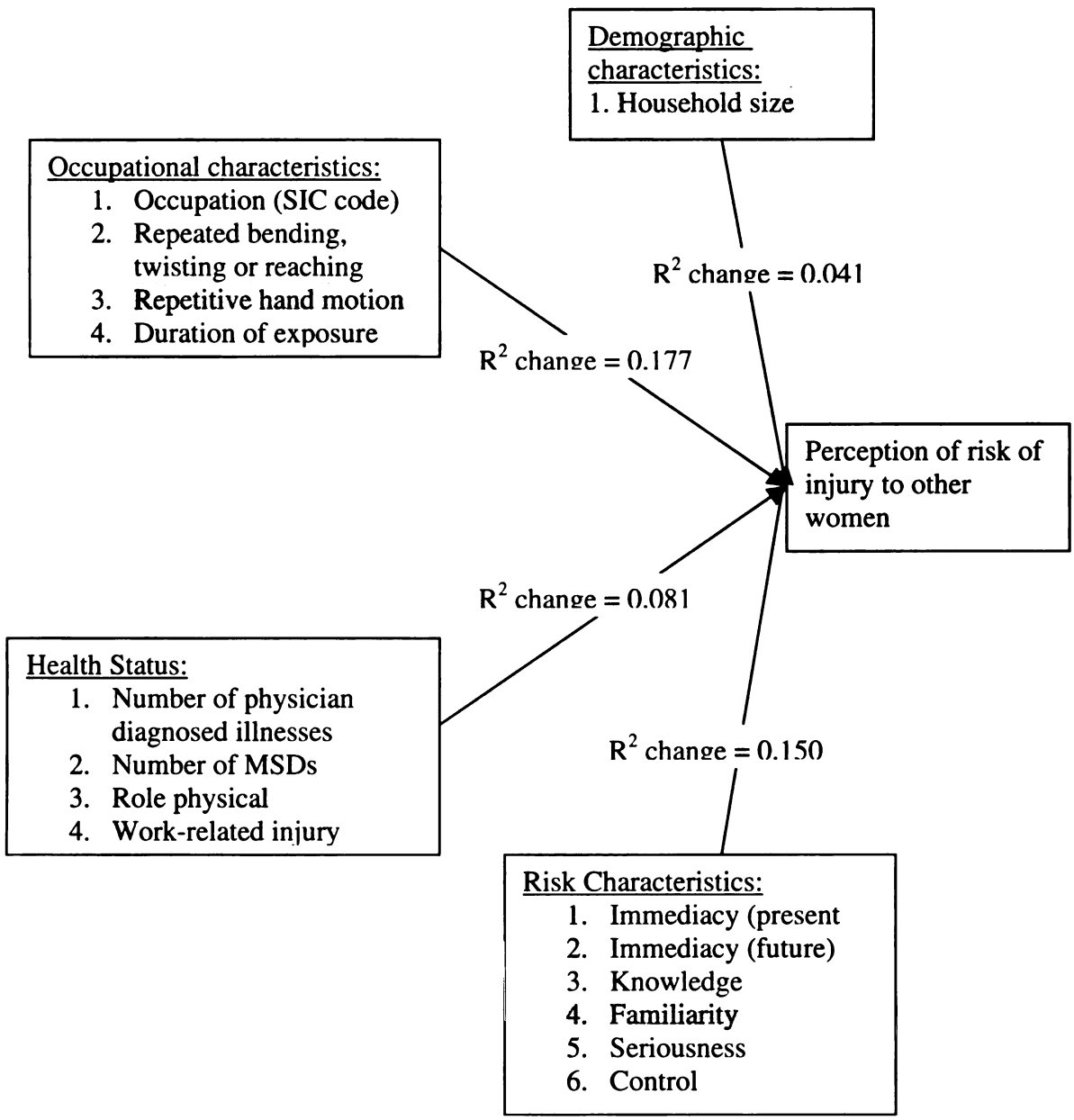
Of all the predictor variables in the model, risk characteristics had the greatest influence on perceived risk. As a block, seven of the nine risk characteristics were found to influence the perception of risk of injury to self. The relationship between the block of risk characteristics and the perception of risk of injury to self was in the hypothesized direction. Two risk characteristics, seriousness (how wide spread the risk is perceived to be) and control, each had a significant unique contribution to the variance in the perception of risk of injury to self while controlling for all the other variables in the equation. Thus, the optimal combination of the seven risk characteristics influenced the perception of risk of injury to self with a significant unique contribution to the variance from the two risk characteristics, seriousness and control. In addition, immediacy (present) had a unique contribution of 2% of the explained variance, while controlling for other variables in the equation, however the unique contribution did not reach the level set for significance. The high inter-item correlations between the 7 risk characteristics

Figure 6 Associations in the perception of risk of injury to self theoretical framework*



*shading indicates the predicator variable had a significant unique contribution to the variance in the dependent variable while controlling for other variables in the equation.

Figure 7 Associations in perception of risk of injury to other women theoretical framework*



*shading indicates the predicator variable had a significant unique contribution to the variance in the dependent variable while controlling for other variables in the equation.

variables in the equation may have resulted in an inability to detect a significant unique contribution to the perception of risk of injury to self by immediacy (present).

Seriousness is a measure of how wide spread the risk is perceived to be, so that with increased seriousness there is a perception that many people are at risk from the exposure. Seriousness, as in previous research (Benthin, Slovic, & Severson, 1993; Hallman & Wandersman, 1989; Kraus & Slovic, 1988; Osei, Amoh, & Schandorf, 1997), is related to the catastrophic potential of the hazard. The hazard in the model is thought to be serious if it poses a risk to many people or to the environment. The more the hazard is thought to have serious consequences, the greater the perceived risk. Consequently, if a woman perceives that the occupational stressor poses a risk to many people, she perceives that she is also at risk from the stressor.

Control is the perception one has about the ability to "exercise restraining or directing influence" (*Webster's Ninth Collegiate Dictionary*, 1985) over the hazard. Research in risk perception has shown that perceived control is influential in the perception of risk (Kraus & Slovic, 1988; Sjoberg, 1999). Thus, control can be viewed as whether a person feels they can take steps to mitigate the risks posed by the exposure. So that, if a woman feels she has no control over her occupational musculoskeletal exposures then she perceives that the exposures pose a risk of injury to her.

Immediacy (present) reflects a core dimension in the perception of risk. Risk is time dependent.

> "Risk and time are opposite sides of the same coin, for if there were no tomorrow there would be no risk. Time transforms risk and the nature of risk is shaped by the time horizon; the future is the playing field." (Bernstein,

1998) p.15

When considered along a time continuum, those hazards that pose an immediate risk evoke more dread because the outcome of the exposure may change the future. Thus, an occupational exposure that is perceived to cause injury in the present may also be perceived as having long-term consequences for the worker and her family.

Factor analysis demonstrated that the risk characteristics in this study loaded on three factors, unlike the risk perception model posited by Slovic (1987), which consisted of two factors (dread and unknown). Knowledge, familiarity, seriousness and vulnerability loaded on factor 1. Factor one reflects what the woman knows and feels about the exposure. Using Slovic typology this could be considered the unknown factor. So there is a relation between knowledge about the exposure and feelings that the exposure has consequences to the woman and other women. Both immediacy items (present and future affects from the exposure) and equity loaded onto factor 2. For this group of women there was a relationship between how equitable the exposure was perceived to be and whether the health effects were immediate or delayed. There is no relationship between this factor and the Slovic model. Finally, voluntariness and control loaded onto factor 3. Thus, there was a relationship between the choice to be exposed to the stressor and feelings of control over the stressor. Again, there is no relationship between this factor and the Slovic model.

Therefore, results of this study suggest that occupational exposures that evoke feelings of concern about the consequences of the exposure are important. Women have knowledge about the health affects of their exposures, this knowledge leads them to perceive of their exposures as risky. That most women in this cohort were employed in occupations traditionally considered women's work and had exposures that were clustered either as

physically strenuous or static suggests that despite the job being thought of as "safe", these physical exposures are perceived of as risky because of the perceived consequences from the exposure.

Six of the nine risk characteristics were found to influence the perception of risk of injury to other women. Familiarity had a significant unique contribution to the variation in the perception of risk of injury to other women while controlling for all the other variables in the equation. Hence, if a woman knew someone who had been injured as a result of exposure to the stressor she was more likely to believe that other women were at risk of injury from the exposure. As with perception of risk of injury to self, knowledge was important in the perception of risk to other women in this study.

Furthermore, seriousness and control contributed 1.5% and 1.4% to the explained variance in perception of risk to other women, but this did not reach the level set for significance. As with perception of risk to self, the high inter-item correlations between the 6 risk characteristics in the regression equation for perception of risk to others may have limited the ability to detect a significant unique contribution from seriousness and control. These risk characteristics may well influence the perception of risk to other women much in the same way as they influence the perception of risk to self. Equity and voluntariness did not influence the perception of risk of injury to other women. The equal distribution of an exposure may not be important in the perception of risk of injury to others.

Occupation

The optimal combination of five occupational characteristics (strenuous physical activity, repetitive hand motion, current occupation [blue collar/white collar], hours worked per year, and duration of exposure) influenced the perception of risk to self. On the other

hand, the optimal combination of four different occupational characteristics (repetitive hand motion; repeated bending, twisting, or reaching; duration of exposure and length of time in longest held occupation) influenced the perception of risk of injury to other women. Strenuous physical activity had a unique contribution to the perception of risk to self while controlling for the other variables in the equation. Likewise, repetitive hand motion had a significant unique contribution to the perception of risk to other women while controlling the other variables in the equation.

Occupational Musculoskeletal Exposures.

Of the occupational characteristics studied, two exposures – strenuous physical activity and repetitive hand motion had a unique significant contribution on the variation in perception of risk of injury to self and other women, after controlling for the other variables in the equation. As expected, those women who were exposed to strenuous physical activity and repetitive hand motion at work were more likely to perceive a risk of injury to self than less exposed women. Principal component analysis showed that there were two clusters of occupational activities in this group of women. One group was exposed to strenuous physical activity; repeated bending, twisting and reaching and use of hand-held vibrating tools. The other group was exposed to repetitive hand motion and static postures. The clustering of exposures may explain why only one exposure out of each group had an association with the dependent variable.

As with the perception of risk of injury to self, exposure to repetitive hand motion influenced the perception of risk of injury to other women. Additionally, repeated bending, twisting or reaching influenced how women perceived the risk of injury to other women from occupational musculoskeletal exposures. Thus, exposure to specific musculoskeletal

activities in the work place may heighten the perception of risk of injury both to self and to other women from their exposures. Based on the assumption that the perception of risk provokes action to minimize the risk from an exposure, it may be important to identify those occupational exposures that are known to increase the risk of injury but are not perceived as risky by those engaged in the activity in order to develop effective methods of communication about the risk of injury from occupational musculoskeletal exposures. Previous research has shown that exposure to vibrating tools can cause tissue injury (Rempel, 1999); however, the number of women exposed to vibrating tools, in this sample, was small. Therefore, the study did not have had the power to detect a relationship between exposure to vibrating tools and the perception of risk of injury to self from the exposure.

That current exposures at work influence risk perception has been previously shown (Harrell, 1990). The interaction between a worker's current exposures and their previous experience may increase the perception of risk from an exposure. Therefore, in addition to gathering information about the exposures a worker currently has, information about previous experience needs to be gathered to assure that intervention programs capitalize on this interaction and tap into the heighten awareness of risk.

Occupational Characteristics.

Women who worked in blue-collar occupations were more apt to perceive a risk of injury both to self and to other women from their occupational musculoskeletal exposures even after controlling for the extent of exposure. Women in blue-collar occupations had more occupational musculoskeletal exposures than women in white-collar occupations. In addition, women in blue-collar occupations were exposed to strenuous physical activities and repeated bending, reaching or twisting more frequently than woman in white-collar occupations, as

would be expected. The duration of exposure among women in blue-collar occupations was also longer than that of women in white-collar occupations. Therefore, the type, number and duration of exposures blue-collar workers have may make them more likely to perceive a risk of injury to self and a risk of injury to other women from occupational stressors.

Work culture varies across occupations and industries, as does the attitude toward work place health and safety. Size of the organization may also influence management attitude toward improving work place safety. So that, the health and safety information provided to blue-collar workers may be different than that given to white-collar workers. Therefore, white-collar workers may feel more empowered to control their own health and safety than blue-collar workers. However, blue-collar workers may have increased knowledge (in comparison to white-collar workers) about the risks posed by their occupational stressors. For example, white-collar workers may perceive their job as safe while blue-collar workers have a more realistic perception of the hazards posed by their exposure.

Duration of exposure to a stressor during the workday influenced both perception of risk to self and to others. The longer a woman was exposed to a musculoskeletal stressor during the day, the higher the perceived risk. Moreover, number of hours worked per year was found to influence the perception of risk of injury to self only. The greater the number of hours worked per year, the greater the perception of risk of injury from occupational musculoskeletal exposures. Women who are exposed for a shorter duration perceive their risk of injury as low: yet, there exists a risk from exposures of a short duration. The association between duration of exposure and perception of risk was in the hypothesized direction.

The number of years a woman had been in her longest held occupation was associated

with the perception of risk of injury to other women. This suggests that women who have been in an occupation for a longer period time have had experience with the exposure (either personal or shared) and more fully understand the risks associated with workplace exposures.

Health Status

The final model for the perception of risk of injury to self included five health status predictors – ever having had a work related injury, number of physician diagnosed musculoskeletal disorders (MSDs), the role physical (RP) and the bodily pain (BP) scales from the SF-36 and the Work Role Functioning Questionnaire (WRFQ). The optimal combination of the five predictor variables explained a significant portion of the variation in perception of risk of injury to self. Bodily pain had a significant unique contribution to perception of risk to self while controlling for the other variables in the equation.

Two of these were also found to influence the perception of risk of injury to other women, the RP scale of the SF-36 and number of MSDs. In addition, number of physician diagnosed illnesses and the occurrence of a recent work related injury influenced the perception of risk of injury to other women. The optimal combination of the four health status predicator variables explained a significant portion of the variance in perception of risk of injury to other women. However, no single predictor variable had a significant unique contribution to the variance in perception of risk to others above and beyond that of the combination of the four variables. Thus, a woman's overall perception of her health status influences her perception of risk of injury from musculoskeletal exposures at work, both to self and to other women.

The more MSDs a woman has the more likely she is to feel that the musculoskeletal exposures she has at work are likely to result in an injury. Also, the presence of MSDs

influences a women's perception of risk to others. That the number of MSDs had a relationship with the perception of risk to self and the number of physician diagnosed illnesses did not may be reflective of the cause of the MSDs rather than solely the presence of disease. The cause of the MSD was not determined, in this study; however, given the large number of women who had back problems and RSI/CTS, it is likely that some of these women may have had an exposure at work that precipitated the disorder. Consequently, having a MSD may reflect previous experience with similar exposures in addition to raising concerns about functional status.

Musculoskeletal disorders may affect ability to perform every day activities to a greater degree than organic illnesses such as hypertension or diabetes mellitus, such that with MSDs there is a decrease in ability to perform every day activities. Presence of MSDs influenced the perception of risk more than presence of non-musculoskeletal illness. Additionally, women who felt they had problems doing daily activities as a result of their physical health, either at work or at home, perceived a risk of injury to both self and to other women from occupational musculoskeletal exposures.

Another factor in perceived risk may be the presence of bodily pain. Often musculoskeletal injuries result in chronic pain, so that there may have been an increased prevalence of chronic pain in this cohort. Though the chronicity of a woman's pain was not determined, it may be that those women who have chronic pain perceive themselves as more vulnerable to injury than women who do not have chronic pain; thereby, potentially overestimating the risk of injury to self.

Work-related Injury.

Women who had suffered a work-related injury in the last year had increased

perceptions about the level of risk to self or others posed by their exposures. A woman's perception about risk to self was further increased if she had ever had a work related injury. Within this cohort all of the injuries experienced during the year prior to the survey were musculoskeletal in nature. Thus, there may be a relationship between a person's previous experience with the stressor and the perception of risk of injury, such that those who have experienced an injury may be more likely to perceive future exposures as risky. Furthermore, the recency of the experience is more important in how risk is perceived relative to others than ever having had an injury. This could be because the influence of personal experience on the perception of risk of injury to other women fades faster than the influence of personal experience on the perception of risk of injury to self.

The findings of this study support results from previous studies, which have found an association between a previous experience with the exposures, either personal or shared, and the perception of risk of injury to self (Cree & Kelloway, 1997; Greening, 1997). As with earlier studies, having had a previous injury or being aware of someone else being injured as a result of the exposure heightens the perception of risk of injury both to self and to other women from the exposure.

No data were collected on the cause or type of work-related injury if the injury occurred more than 12 months prior to survey administration. As the type of previous work-related injury experienced was not known, this would seem to indicate that any work-related injury, regardless of type influences how risk to self is perceived.

Demographic Characteristics

According to the theoretical model used for this study, there was a hypothesized relationship between the demographic characteristics of a woman and the way in which she

perceives risk. Yet, none of the demographic characteristics of this sample influenced how the risk of injury to self was perceived. Therefore, the hypothetical relationship between a woman's demographic characteristics and her perception of risk of injury to self from occupational musculoskeletal exposures was not supported.

Household size was found to influence the perception of risk of injury to other women in this cohort. The smaller the woman's reported household size the more likely the woman was to perceive other women to be at risk of injury from occupational musculoskeletal exposures. It was hypothesized that women who lived in larger households would perceive the risk of injury to other women as higher than women who lived in smaller households. That most women in this study were over 45 years of age and many of them women had adult children who no longer lived at home, the perception of risk to others may be a reflection of maternal or mature concern about the welfare and safety of others. The association between household size and perception of risk to others may also be reflective of more experience in the work place, so that there is an increased awareness about the risks from exposure to occupational stressors.

A relationship may exist between the demographic characteristics of women and their perception of risk to self from their occupational musculoskeletal exposures but because of the homogeneity of the sample in this study the relationship could not be satisfactorily investigated. However, a relationship between a woman's demographic characteristics and her perception of risk may not exist for musculoskeletal occupational exposures. Much of the previous research identifying demographic characteristics as influencing perceived risk has centered on gender differences (Barke, Jenkins-Smith, & Slovic, 1997; Flynn, Slovic, & Mertz, 1994; MacGregor, Slovic, & Malmfors, 1999; O'Connor, Bord, & Fisher, 1998;

Savage, 1993), age (O'Connor et al., 1998; Savage, 1993) and ethnic differences (Bontempo, 1997; Flynn et al., 1994; Savage, 1993). Thus, demographic characteristics other than age, gender and ethnicity may not influence the perception of risk among women.

Perception of Risk of Injury

Even after considering the impact of other predictors, the perception of risk of injury to other women influenced the perception of risk of injury to self. Likewise, women, in this sample, tended to perceive a risk of injury to other women if they perceived they were at risk from their occupational musculoskeletal exposures. Nonetheless, the mean score for the perception of risk to other women was higher than the mean score for the perception of risk of injury to self, as was the median. Therefore, though women may perceive themselves at risk from their occupational musculoskeletal exposures they perceive other women to be at even higher risk.

Though heuristics were not studied (see Chapter 2), the association of perceived risk to self with perceived risk to others may be the result of the mental models a woman uses when she considers the risk of exposure. Two heuristics have been noted in the literature as influencing the perception of risk – affect and availability. The affect heuristic is based on the emotional, rather than cognitive, judgment of risk. In other words, if a person has a positive feeling about the event or exposure the perceived benefits will outweigh the perceived risk (Finucane, Alhakami, Slovic, & Johnson, 2000). Using time-pressure conditions to determine the degree to which subjects use affect in determining risks in hypothetical situations, these researchers found that subjects having a positive affect about a given risk tended to maximize the benefit and minimize the risk.

The availability heuristic is defined as the remembered frequency and/or lethality of an event or occurrence (Slovic, 1987). "Increasing familiarity with a source of danger can influence perceptions of personal risk"(Harrell, 1990, p. 1351). The availability heuristic results in overestimation of rare causes of death or injury and underestimation of common causes of death or injury as the result of a biased perception of risk based on previous experience (Slovic, 1982). Thus, either the availability or the affect heuristic may be a dimension in the perception of risk that is being measured when a women is asked whether she perceives a risk of injury to herself or other women.

Women who felt that they were at risk of injury from their occupational exposures may have been more willing to participate in this study. Though there is a risk of injury from the exposures studied, the women in this study may have had an heightened sense of risk because of a general personality trait that made them more anxious about their health and the exposures at work they felt were affecting their well-being. Thus the estimation of risk of injury to self or to other women could have been exaggerated resulting in the large percentage of explained variance in the dependent variables of each equation from the perception of risk variable. Additionally, the strong association between the last variable in the equation and the dependent variable may be because of this heighten sense of anxiety about occupational exposures, so that not only is the risk fear provoking but women who are anxious are able to generalize the risk to others. Therefore it may be important to future research to explore the influence of personality traits on the perception of risk.

Summary of Theoretical Relationships

The results of this study indicate that the perception of risk of injury from occupational musculoskeletal exposures is multidimensional. A relationship exists between a

woman's occupational characteristics, health status and the risk characteristics she assigns to her musculoskeletal exposures and her perception of risk of injury, both risk to self and risk to others. Though, the theoretical framework for this study hypothesized a relationship between the demographic characteristics of a woman and her perception of risk – both to self and to other women – that relationship was not shown to exist in this sample with the exception of the influence of household size on the perception of risk of injury to other women. However, given the unique characteristics of this sample of women, more research is needed to further define the relationships within the proposed model.

Other Findings

Demographic Characteristics

Worldview.

None of the worldview scales were associated with either perception of risk of injury to self or perception of risk of injury to other women. The inability to detect a relationship between worldview and the perception of risk of injury in this study may have been limited due to the low reliability scores of the scales. Additionally, the number of women with a predominant worldview was small, which could have resulted in an inability to discern a relationship between worldview and the perception of risk of injury. The percentage of women in this study who had a predominant worldview (31.8%) was strikingly similar to the percentage (32%) of subjects who had a predominant worldview in a study of influence of cultural theory (worldview) and the risk characteristics and the perception of risk in a convenience sample of 129 people in England by (Marris, Langford, & O'Riordan, 1998). Moreover, as with the Marris study, the majority of women in this study with a predominant worldview were egalitarians with the fewest women in both studies identifying themselves as

fatalists. The issue could be that the scales adapted by Marris et al. (1998) from the (Dake, 1990) study do not adequately discriminate between the four worldviews, resulting in the inability to identify a woman's predominant worldview.

It may also be as suggested by Sjoberg (1999) and Boholm (1996) that people do not have an innate worldview but rather use multiple strategies to assess their exposure risk. Sjoberg (1999) points out that more of the variation in risk perception can be obtained using five "explanatory risk factors" – attitude, risk sensitivity, specific hazard risk factors, other factors such as trust or whether the activity is seen as tampering with nature – than either risk characteristics or worldview. His explanatory risk factors explained approximately 60% of the variance in perception of risk in the siting of nuclear waste compared to 20% explained variance by risk characteristics and approximately 5% explained variance by worldview. However, the "other factors" described by Sjoberg may be another way to measure risk characteristics. For example, trust and activities seen as tampering with nature could be reflective of the two domains identified by (Slovic, 1987) – dread and unknown. Although, risk characteristics appear important to risk perception worldview does not.

Health Status

General Health Status.

Older women, in this study, were more functional than their younger counterparts as shown by scores on the PF scale of the SF-36. The positive correlation between age and the PF scale may have been the result of including only working women in the sample, so that older women who participated were still actively engaged in the work place. This active engagement in activities outside the home may be because they have fewer co-morbidities than same aged peers and therefore actually have fewer limitations. Or these high scores

could be reflective of an attitude that keeps these women engaged despite having illnesses that may have forced others out of the workplace. In either case they may represent a healthy worker effect.

Women, in this study, had multiple physician diagnosed illnesses and MSDs. However, they tended to rate their overall functioning as high, while reporting more bodily pain, than the normative sample. The rates of illness, MSDs and bodily pain may be because the median age of the sample was 49 years old. Alternatively, high number of MSDs in this group of women could suggest selection bias, in that those women who had experienced a musculoskeletal injury were more willing to participate in the study.

Musculoskeletal Disorders.

The prevalence of back problems in this sample was 41.4%. It is estimated that approximately 80% of all workers will experience low back pain at some time during their working life (Armstrong et al., 1993; Levy, 1995). The distribution of back problems by age category with occupational categories showed an increase in the number of women who reported having a back problem with increasing age across all occupations. Thus, susceptibility to experiencing a back problem increases with age and may be the result of the cumulative effect of a woman's occupational and non-occupational exposures. Previous research has shown that exposure to heavy lifting, repeated bending, twisting or reaching and static postures are risk factors in the development of back problems (Alcouffe, Manillier, Brehier, Fabin, & Faupin, 1999; Bigos et al., 1992; Macfarlane et al., 1997; Ono, Lagerstrom, Hagberg, Linden, & Malker, 1995; Smedley, Egger, Cooper, & Coggon, 1995). The majority of women in this study were exposed to at least one of these stressors at work. Thus, this sample included women who were at increased risk of experiencing back problems

as a result of their occupational exposures.

The prevalence of RSI/CTS was 29.3%, in this study. This is higher than the annual incidence rate in 1998 by occupation reported by Mani (2000) of 0 – 9.9. However, the distribution of disease noted by age seen with back problems was not noted for RSI/CTS. Thus, there was a more even distribution within occupational categories by age of RSI/CTS. This even distribution of the RSI/CTS by age group may be the result of non-biomechanical factors as well as biomechanical factors , such as repetitive hand motion, related to occupational tasks performed by women in this study. In a review of the literature by Faucett (1999), personal factors such as systemic disorders, vitamin B6 deficiency, pregnancy, or body mass index were found to be associated with the risk of experiencing CTS. Several authors Ashbury (1995) and Mani (2000) have noted an increase in the prevalence of RSI/CTS over the last 15 years. Thus, the high prevalence of RSI/CST in this study may be the result of increased awareness about the risk factors and symptomology rather than an actual increase in disease, although again, it may represent sample selection bias.

Among the MSDs reported by this cohort of women, arthritis ranked second to back problems in frequency. The prevalence in this study (34.9%) was higher than the estimated prevalence in the general population for osteoarthritis of 10-20%. The question used to identify women with physician diagnosed arthritis did not differentiate between types of arthritis; therefore some of the women in the sample may have had rheumatoid or other types of arthritis. Because the relationship between physical activities and the development of osteoarthritis remains unclear, no analysis of either physical activities or occupation and arthritis was performed.

Likewise, questions about the other MSDs item elicited a wide variety of responses.

Some of the reported MSDs in this category could have been the result of an occupational musculoskeletal exposure: back strain, knee injury, tendinitis, shoulder pain, neck problems, sciatica, and elbow pain with hand numbness. However, many of the MSDs could have been the result of non-occupational factors. It was beyond the scope of this study to identify any associations between reported MSDs and occupational exposures.

Occupational Characteristics

Results from this study validate previous findings by Messing, Tissot, Saurel-Cubizolles, Kaminski, and Bourgine (1998) and Stellman (1999) that women tend to be clustered into occupations that have traditionally been considered women's occupations. None of the women in this study were employed in construction, production or maintenance/repair occupations and few were employed in farming/fishing or transportation/material moving. Additionally, most of the women reported they were exposed to repetitive hand motion and static postures – exposures that are reflective of "safe" women's work. However, the occupational groupings in this study may be indicative of women who volunteered.

Risk Characteristics

The differences in the factor loadings of the risk characteristics in this study from the Slovic (1987) model may have been the result of differences in item wording. The items developed for the instrument used in this study may not have conveyed the concepts in the same manner as the item wording used in the previous studies, as they were developed solely for this instrument. For example, in a study by McDaniels (1995), the item to measure equity was worded "Please rate the equity of each event in terms of whether those who receive the benefits are the same people who incur the costs." The equity item in this study was worded "Do you think that women who do the same type of work as you, do the same amount of

physical activity as you do?" There has been no previous research looking at the perception of risk of injury from occupational musculoskeletal exposures. However, as with previous research using the risk characteristics developed by Slovic (1987) characteristics assigned by a woman to her occupational musculoskeletal exposures influenced how she perceived the risk of injury, both to self and to others.

Strengths

This study used scales that proved to be psychometrically reliable. Consequently, the measurement of acculturation and health status was consistent and stable. The exception, as discussed previously, was the low reliability of the worldview scales, particularly hierarchy and fatalism, which may have resulted in the inability to detect a relationship between worldview and the perception of risk.

The study was able to provide detailed analysis of a select group of working women in Sonoma County, including their health status, their occupations and occupational musculoskeletal exposures and the attributes they assigned to their occupational stressors. Results of previous research into women's occupations was validated, particularly occupations in which women are employed. Women in this study tended to be clustered into traditional women's occupations. Additionally, detailed information about the musculoskeletal exposures of these women was obtained enabling the researcher to describe the exposures of these working women and identify the association between the exposures and the perception of risk of injury.

Likewise, the results of this study indicate that the risk characteristics identified by Slovic (1987) can be used in the study of the perception of risk from occupational exposures. No previous studies have been conducted that focused on perception of risk of injury from

occupational musculoskeletal exposures. Therefore, this study provides a framework for future research as to how the risks of injury are perceived in occupational settings, particularly the risks from musculoskeletal stressors.

Limitations

The response rate of 27% was a conservative estimate of the actual response rate. Included in the eligible group were women who hung up before to any explanation of the study could be given. Additionally, refusal cards may have been received from people who were not eligible for inclusion in the study. However, the low response rate affects the validity of the study such that study results may only be applicable to this sample of women. Additionally, though a random sampling strategy was utilized, self selection into the study by women who had either experienced an occupational injury or who perceived their risk of injury as high may have resulted in an overestimation of risk of injury, both to self and to other women. This random sample of women living in Sonoma County was older, better educated, and had higher incomes that the general population of Sonoma County. This sample of working women had a higher prevalence of women with a MSDs than the general population. Additionally, the women in this sample tended to represent white-collar occupations, so that women who may be at the greatest risk of having an occupational musculoskeletal injury were under-represented. Thus the low response rate and the selection bias of this study limit the generalizability of the study results to the general population of working women.

Few of the women in this cohort were foreign born or worked in blue-collar occupations. Women who were foreign born, particularly of Hispanic descent, were also under-represented in the sample, despite the availability of a Spanish-speaking interviewer. Given

that many recent immigrants work in blue-collar occupations, e.g. farming, production lines, housekeeping, etc. the inability to enroll foreign born women may have been associated with the lack of representation of these occupations in this sample.

The difficulty in enrolling low-income women, women employed in blue-collar occupations and Hispanic women may have been the result of the sampling methodology used in this study. Many of these women may be working two jobs, have small children at home or otherwise perceived themselves to be too busy to participate in the study. Another factor could have been the lack of a home phone, particularly for low-income women and recent immigrants such that face to face enrollment at their workplace, in a community clinic or church may have been more effective.

The recent increase in media coverage and legislative action regarding telemarketing and privacy issues may also have reduced participation in the study. The high number of potential subjects who were never contacted could have been the result of call screening. Additionally, some of the women who were contacted may have felt that any survey over the phone was for sales purposes or was too intrusive not understanding the intent of the call was about health care research.

Implications for Nursing Practice

Understanding how risk is perceived is important in developing injury prevention strategies within a given workplace. As stated by Fischhoff (1993), the choice of information that is selected for a risk reduction program is important. The choice of information for the risk reduction message should include how much is known about the affects of exposure and what strategies are known to reduce the risk from exposure. Therefore, it may be important to target messages based on the types of exposure, the number of exposures and the duration of

exposure to the stressor. Multiple messages may be needed to effectively communicate with workers throughout the given workplace. Communication about the risk of injury needs to focus on the risk from individual stressors. For instance, if a group of workers is exposed to strenuous physical activity and repeated bending, twisting or reaching, the health and safety communication strategy designed for these workers should include information about the risk reduction strategies for both exposures.

Gauging how risk characteristics are ascribed to a worker's musculoskeletal exposures may be an important aspect in developing communication strategies that will affect a change in behavior. The results of this study indicate that perceived control and seriousness (widespread consequences of the exposure) are the risk characteristics most strongly associated with the perception of risk. Any intervention to reduce work place injury must address these two risk characteristics.

Understanding the relationship between previous experience and the perception of risk has implications in the development of communication strategies designed to reduce workplace injuries. As Bernstein states in his book, *Against the Gods. The Remarkable Story of Risk*, (Bernstein, 1998) "sometimes we make decisions on the basis of past experience, out of experiments we or others have conducted in the course of our lifetime" (p. 69). Therefore, a health and safety program should tap into the shared experiences of the workgroup. The program should include examples from recent exposures rather than injuries that occurred in the distant past. In this way, the risk of injury from an exposure can be discussed relative to self and others.

Moreover, if a woman perceives her health as good then she may not perceive a risk from the musculoskeletal exposures she has. As a result, it may be more difficult to

communicate effectively about workplace hazards to women who perceive themselves to be healthy. Accordingly, in designing effective communication strategies about the risk of occupational musculoskeletal activities it is important to consider the perceived health status of the target work force. A variety of messages may need to be developed to assure that workers along a continuum of wellness understand their risk of injury in the workplace.

Developing effective communication strategies about work place safety can help to reduce work place injuries. Fischhoff (1993) identified three models that can effectively be used to communicate about the risks of injury from exposure. The first model, which Fischhoff has labeled mental model analysis involves bridging the gap between what an individual understands as the risk and what is know by expert as the risk from the exposure. Thus, the strategy aims to fill in the gaps in knowledge among workers about the exposure.

The second model for risk communication, labeled by Fischhoff as calibration analysis, is aimed at identifying overestimation or underestimation in the degree of risk posed by the exposure. In this model, the health and safety communication strategy would be aimed at providing the worker with an accurate assessment of the risk posed by the exposure. The third model posed by Fischhoff and labeled value of information analysis involves identifying the most significant piece of information that is needed to convey to actual risk from the exposure. Thus, the strategy would be to target the communication to have impact on the perception of risk of injury.

Understanding how risk is perceived is key to the development of work place programs to minimize the risk from occupational musculoskeletal exposures. Based on results from this study the most effective strategies should incorporate the risk characteristics assigned the exposure by the work group as well as the type and duration of exposure.

Future Research

This study has provided the framework for further research into the perception of risk of injury from occupational musculoskeletal exposures. Further research is needed to more fully explore the relationship between a person's demographic characteristics including acculturation and worldview, health status particularly presence of MSDs, occupational characteristics and attributed risk characteristics and the perception of risk. Also, further research that focuses on a more representative population of working women including women in non-traditional occupations and blue-collar occupations is needed. Differences in the perception of risk of injury across occupations need further clarification.

This study focused on working women because of the paucity of research on women's occupational musculoskeletal exposures and their perception of risk from those exposures. Further research into perceived risk from musculoskeletal exposure in the work place should also include men, so that comparisons between the groups can be made. Understanding how risk is perceived across occupations (including both men and women) can facilitate the development of effective intervention strategies to reduce occupational injury. One method of gaining a wider understanding of the perception of risk of injury from occupational exposures would be to include measures similar to those used in this study as an addition to the National Health Information Survey, Occupational Health Addendum and other national surveys.

Conclusions

This study found that there was a relationship between a woman's health status, occupational characteristics and the risk characteristics she attributed to her occupational exposures and her perception of risk of injury, both to self and to other women. The results of

the study have implications for nursing practice. Results of this study indicate that specific communication strategies should be considered in order to effectively reduce workplace injury. However, more research is needed to clearly define the hypothetical relationship in the theoretical framework.

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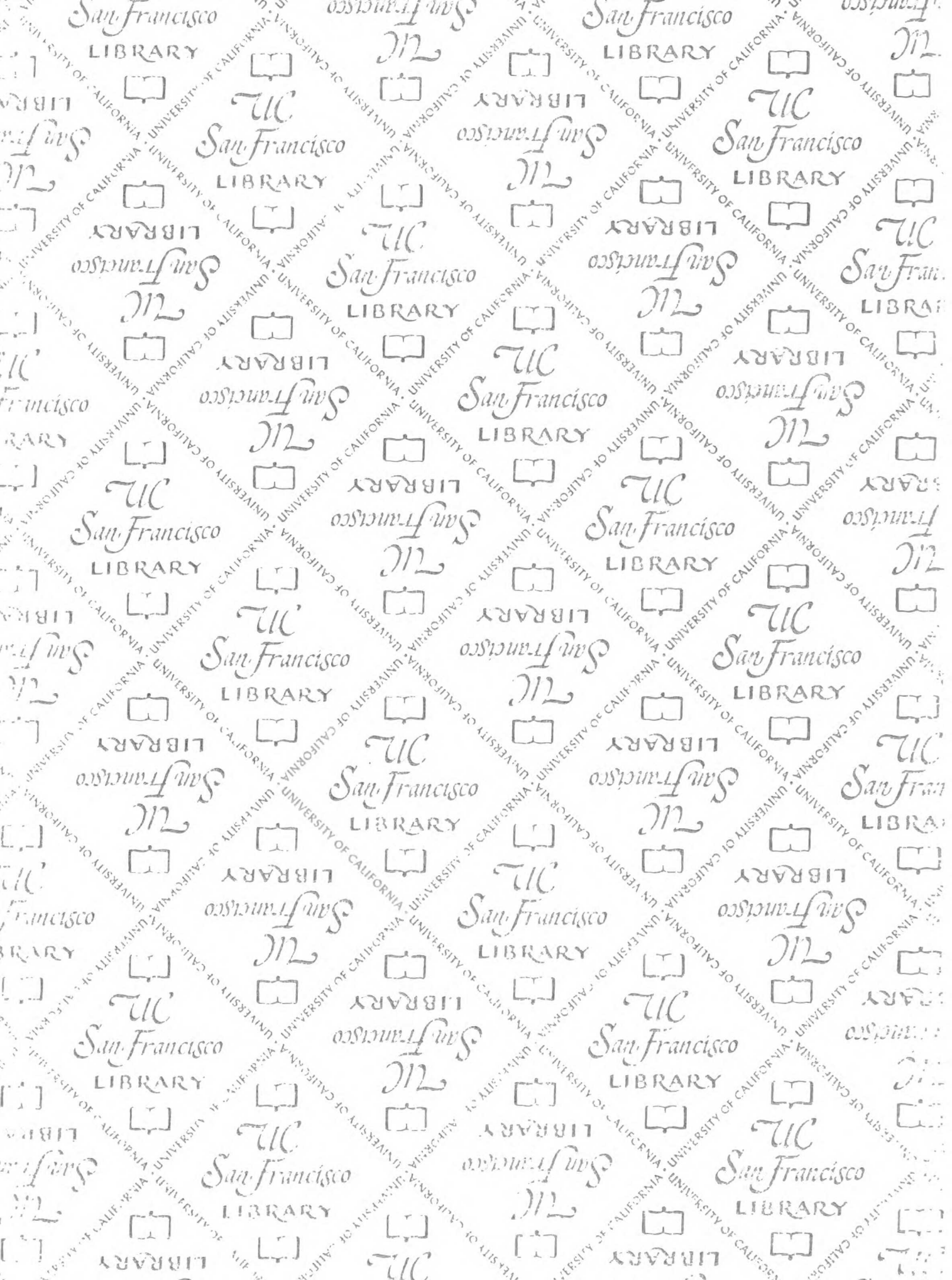
Risk Characteristics Items

1. When you think about the physical activities that you do at work, do you think you have any choice about whether you do these activities or not?
2. Do you think that the physical activity that you do at work is affecting your health now?
3. Do you think that the physical activity that you do at work will affect your health in the future?
4. Do you know if there are any health risks associated with the physical activities you do at work?
5. Do you know anyone who has been injured as a result of doing the same type of physical activities at work as you do?
6. When you think about the physical activities that you do at work, do you worry that others may be injured when they do the same type of work?
7. Do you think that the physical activities that you do at work pose a threat to you?
8. Do you have control over the physical activities that you do at work?
9. Do you think that women who do the same type of work as you, do the same amount of physical activity as you do?

Items 1 – 3 and 6 – 9 used a 4-point Likert scale ("Not at all", "Slightly" "Somewhat" and "A lot"). Items 4 and 5 used a "yes" or "no" response.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