Preventing Occupational Injuries

Women's Perception of Risk from Musculoskeletal Exposures

by Lynette G. Landry, PhD, RN

Abstract

Perception of injury risk is associated with an individual's propensity to act. This study examined the relationship between women's demographic, occupational, and risk characteristics, and health and occupational stressors as predictors of their perceptions of injury risk to self and other women from occupational musculoskeletal exposures. This cross-sectional study included a random sample of women who were employed in the 12 months prior to survey administration (N = 123, 27% response rate). A telephone survey consisting of 154 items was administered in English or Spanish. For the perception of injury risk to self, the final multiple regression equation explained approximately 66% of the variance with significant unique contributions identified 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, for perception of injury risk to other women, the final multiple regression equation explained approximately 57% of the variance with significant unique contributions identified for household size, occupational exposure to repetitive hand motion, familiarity of the risk, and perception of injury risk to self. Exposure experiences and risk characteristics were found to increase women's perceptions of risk from occupational musculoskeletal exposures.

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Every day individuals assess the risks and benefits of their activities. Perception of risk guides individuals in making choices about voluntary exposures. Osei, Amoh, and Schandorf (1997) define risk as the probability of an adverse event or 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 subjective properties given the situation. In other words, "facts do not have a uniform existence apart from the individuals 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. This community-based pilot study investigated the relationship among a woman's demographic characteristics, occupational musculoskeletal exposures, health status, and subjective risk characteristics and the perception of risk from occupational exposures.

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. Greening (1997) found that individuals who had witnessed an electrocution accident at a public swimming pool had a higher perception of risk from electrocution than the control group. Cree and Kelloway (1997) reported that previous experience (both direct and vicarious) was significantly associated with increased perception of risk both to

What Does This Mean for Workplace Application?

Multiple messages may need to be developed to assure that workers understand their risk of injury in the workplace. The risk reduction message should include how much is known about the effects of exposure and which strategies are known to reduce the risk from exposure. Additionally, communication about the risk of injury needs to focus on the risk from individual stressors; thus, a message may need to address more than one exposure (e.g., repeated bending and twisting would be included in a message about heavy lifting if the job task required both activities). 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 workplace injury must address these two risk characteristics.

self and others. Additionally, increased risk perception was related to a stated intention to leave work or willingness to participate in a workplace health and safety program. Conversely, Harrell (1990) found that current exposure to workplace hazards was a stronger predictor of increased perception of risk than was previous experience.

As Sahlin and Persson (1994) state, "people are afraid of what they cannot see and what is out of their control" (p. 48). The subjective risk characteristics attributed to an exposure influence how an exposure is believed to affect health. Building on the work of Kraus and Slovic (1988), Benthin, Slovic, and Severson (1993) identified eight subjective risk characteristics among adolescents:

- Voluntariness of the exposure.
- Immediacy of the effects.
- Knowledge related to the risk (either societal or personal).
- Control over the exposure or risk.
- Familiarity of the risk.
- Catastrophic potential of the risk.
- The feeling of dread an exposure evokes.
- Sense of vulnerability to injury from the exposure.

Two particular risk characteristics, control and probability of occurrence, have been hypothesized as influencing risk perception to a greater degree than other characteristics. Fleming et al. (1998) found that oil platform workers in the United Kingdom perceived lower occupational risks when they felt they had control over the job. Control is predictive of the perception of risk (Greening, 1997; Fleming et al., 1998). Perceived probability of an event occurrence and perceived consequences of the occurrence, in combination, influence risk perception more than the other eight risk characteristics combined (Osei et al., 1997). Other characteristics that have been shown to be predictive across multiple studies include knowledge, familiarity, vulnerability, seriousness, equity, and voluntariness (Hallman & Wandersman, 1989; Kraus & Slovic, 1988; Slovic, 1987).

Differences in the perception of risk across demographic characteristics have been noted. Savage (1993) found that women, individuals with lower incomes, individuals with less education, and Black individuals were more likely than White men to perceive each of the four hazards within two risk domains (dread and personal exposure) as risky. Similarly, Flynn, Slovic, and Mertz (1994) found that ethnic minorities (both men and women) tended to rate the threat from different types of hazards as higher than White men did. Non-White women had the highest risk ratings of all the groups studied. These studies indicate that there may be gender differences in the way risk is perceived. Additionally, no previous studies have been conducted that focus on perception of risk of injury from occupational musculoskeletal exposures. The purpose of this study was to describe the exposure characteristics of working women and explore the associations between demographic characteristics, occupational characteristics, 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.

METHODS

Sample Selection

This cross-sectional pilot survey used a simple random sample of currently employed women whose primary language was Spanish or English. This study was approved by the University of California San Francisco Committee on Human Research. A simple random sample of phone numbers in a Northern California county was used for the study. The sample phone number list was matched to contact addresses by purchasing this information from Gannett Telematch of Springfield, VA ("Telematch Consumer List 2002"). Participants were randomly selected from the phone list of more than 9,000 residents using SPSS (Statistical Package for Social Sciences, Chicago, IL). A total of 1,330 letters were mailed in three waves between May 2002 and March 2003. The final sample size was 123 from a total eligible pool of 460, resulting in a 26.7% response rate. Table 1 provides sample demographics. 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 eligible for inclusion in the study.

An introductory letter explaining the study was sent to the address corresponding to 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 introduced the study and invited participation. A follow-up phone call occurred 7 to 10 days later.

Questionnaire

The author-developed survey was pilot tested on 20 English- and Spanish-speaking women using the snowball technique. The telephone survey included questions related to a woman's occupational history, demographic information, perception of health risks from occupational exposures, subjective characteristics of risks specific to oc-

Table 1

Demographics Characteristics (*N* = 123)

	Mean	*Median*	*Standard Deviation*	*Minimum*	*Maximum*
Age (years)	48.30	49	11.23	20	82
Number of children*	1.80	2	1.49	0	8
Education (years)	15.60	16	3.27	3	30
Household size (number 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
Number of wage earners in household†	1.84	2	0.62	0	4

*n = 108
†n = 122

cupational musculoskeletal exposures, and general health status (Table 2). A participant's perception of risk of injury from her own occupational musculoskeletal exposures was determined using one item with a 4-point response scale, ranging from Not Likely to Very Likely, for each type of musculoskeletal exposure the woman reported. The participant was asked to rate the risk from each type of occupational exposure she identified. The participant was also asked to rate the risk of injury to other women for each of those exposures.

Predictor variables included health status, history of work-related injury, occupational history, occupational exposures, and subjective risk characteristics. The general work history questions were adapted from the National Health Interview Survey, Occupational Health Addendum (Centers for Disease Control and Prevention, 1988). There were three open-ended items to identify current occupation. Occupation was coded using a standardized coding scheme used by the Bureau of Labor Statistics (U.S. Department of Labor, 2002) and was based on the information obtained from the general work history section of the survey.

Five types of occupational musculoskeletal exposures were investigated:

Table 2

Sample Survey Questions

Demographic characteristics	What is your marital status? Is it.....? 1. Married 2. Separated/divorced 3. Widowed 4. Never married 5. Unmarried couple 6. Other
Occupational history	What kind of work have you done for the LONGEST? What are your most important activities or duties at that job?
Occupational musculoskeletal exposures	Does your job require you to do REPEATED STRENUOUS PHYSICAL ACTIVITIES such as lifting, pushing or pulling heavy objects? 1. Yes 2. No
	During a typical work day, how many minutes or hours altogether do you spend doing STRENUOUS PHYSICAL ACTIVITIES?
Perception of risk from occupational musculoskeletal exposures	How likely are you to be injured from the STRENOUS PHYSICAL ACTIVITIES you do at work? 1. Not 2. Slightly 3. Somewhat 4. Very
	How likely are women, in general, to be injured from doing STRENOUS PHYSICAL ACTIVITIES at work? 1. Not 2. Slightly 3. Somewhat 4. Very
Subjective risk characteristics	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? 1. Not at all 2. Slight 3. Some 4. Entirely
	Do you think that the physical activity that you do at work is affecting your health now? 1. Not at all 2. Slightly 3. Somewhat 4. A lot
General health characteristics	In general, would you say your health is excellent, very good, good, fair or poor? 1. Excellent 2. Very good 3. Good 4. Fair 5. Poor

Table 3
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

- Physically strenuous work.
- Repeated bending, twisting, lifting.
- Frequent twisting and bending of hands or wrists (repetitive motion).
- Use of hand-held vibrating tools.
- Static postures.

Each participant was asked to indicate the daily duration of exposure for each type of occupational exposure she reported. Two exposure scores were assigned to each participant, one based on the total number of occupational exposures the participant had (range 1 to 5) and the second based on the duration of the occupational exposures.

Eight risk characteristics, immediacy (measured as present threat, future threat, or both), knowledge, probability, equity, seriousness, dread, and familiarity, were identified from a review of the literature (Benthin et al., 1993; Fleming et al., 1998; Greening, 1997; Osei et al., 1997; Hallman & Wandersman, 1989; Kraus & Slovic, 1988; Slovic, 1987) as key to how risk is perceived. Each participant was asked to rate the risk characteristics of their occupational musculoskeletal exposures. The risk characteristics scale consisted of nine items including two questions to quantify immediacy. Each of the risk characteristics was scored using a 4-point scale (Not At All to A Lot), except the knowledge and familiarity items, which were scored using a Yes or No response. The risk characteristics scale developed for this study demonstrated satisfactory reliability (alpha = .73).

Table 4
Attributed Risk Characteristics Excluding Knowledge and Familiarity (*N* = 123)

	Mean	*SD*
Voluntariness*	2.43	1.18
Immediacy (present)	2.35	1.17
Immediacy (future)†	2.57	1.11
Seriousness‡	2.23	1.10
Vulnerability‡	1.96	1.05
Control	2.08	1.15
Equity	3.05	1.15

Minimum = 1, maximum = 4
*n = 121, †n = 120, ‡n = 122

A rating of general health status was obtained using one item from the National Health Interview Survey (CDC, 1988). In addition, each participant was asked about physician diagnosed illnesses or injuries and use of physician services. Previous or present work-related injuries were identified. To quantify current physical functioning, items from the Short Form Health Survey (SF-36) were used (Ware, 1993). Items from the Work Role Functioning Questionnaire (WRFQ) were chosen as another method of evaluating a participant's physical functioning (Lerner et al., 2001). WRFQ items are focused on ability to perform work activities. The WRFQ has been validated in several studies (Lerner et al., 2001; Lerner, Reed, Massarotti, Wester, & Burke, 2002) that included participants with various chronic health conditions. The next 10 items selected for inclusion in this study focused on work limitations caused by musculoskeletal conditions, for example, ability to lift heavy objects or ability to use hand-held equipment (e.g., computer mouse, pen, phone, keyboard).

Analysis

For initial bivariate analyses of the dependent variables, either a *t* test or analysis of variance (ANOVA) was performed. Those independent variables found to be significantly correlated (alpha = .10) with the dependent variables were then entered into multiple linear regression analysis. Two multiple linear regression equations were constructed, one for each dependent variable. Independent variables were entered into the regression equations in blocks, for example all demographic characteristics were grouped together and then entered into the equation. A significance level of .05 was set for each block to remain in the model.

RESULTS

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%) (Table 3). Fourteen women (11.4%) denied having any of these five occupational musculoskeletal exposures. Most women (n = 76, 61.8%) were exposed to two or more of the occupational musculoskeletal exposures as part of their job.

Table 5
Health Status Measures and *t*-test with SF-36* Published Norms (*N* = 123)

	Mean	Median	SD	Minimum	Maximum	Norm mean (N = 1,412)	p value	t	95% CI
General health status	2.21	2	1.02	1	5	—	—	—	—
Number of physician visits in the past year	3.79	2	4.77	0	30	—	—	—	—
Physical function (SF-36)†	87.55	95	20.82	0	100	81.47	.002	3.21	2.33 to 9.83
Role physical (SF-36)‡	78.55	100	34.27	0	100	77.77	.801	0.25	−5.36 to 6.92
Bodily pain (SF-36)‡	68.49	71	24.48	0	100	73.59	.023	−2.30	−9.49 to −0.71
General health (SF-36)‡	76.06	82	21.98	10	100	70.61	.007	2.70	1.51 to 9.39
Work role functioning§	39.71	43	8.18	3	45	—	—	—	—

*A sample of healthy women from the general population was used to develop normative scores on the SF-36 scales. Normative scores are indicative of what would be expected in a sample of healthy working women.
†n = *121*, ‡n = *122*, §n = *119*

In considering the attributed risk characteristics assigned to musculoskeletal exposure by this cohort of women, most had knowledge about and were familiar with the risk of injury from the musculoskeletal exposures at work, both personal knowledge (n = 80, 66.1%) about the health risks associated with the activity and familiarity (n = 81, 66.3%) with the exposure—they knew of others who had been injured doing the same types of activities at work (Table 4). These women felt they had A Lot of control (n = 53, 43.1%) or Some control (n = 30, 22.4%) over occupational musculoskeletal exposures. Additionally, many reported they had a choice about whether they were exposed to the musculoskeletal stressor, 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 currently, 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 the women (n = 58, 47.5%) felt the musculoskeletal exposures at work were not a threat to them. Both seriousness (threat) and immediacy (present) are risk characteristics that are bound to the present, so this cohort did not have 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.

Approximately 76% of the women (n = 94) stated they had two 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 or carpal tunnel syndrome (n = 36, 29.3%) and other musculoskeletal disorders (MSDs) (n = 33, 26.8%).

Scores on three of four scales from the SF-36 were significantly different from that of the published norms (Table 5) (Ware, 1993). Women who reported having a MSD scored lower on all SF-36 function scales than did their counterparts without MSDs. Scores on the WRFQ ranged from 3 to 45 (out of a total possible of 45), where a lower score indicates more limitations in the ability to perform activities at work. Forty-eight (40.3%) of the women in the total sample experienced no limitation in ability to perform musculoskeletal tasks at work. As with the scales of the SF-36, MSDs were positively correlated with limitations in ability to perform activities at work.

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 the risk characteristic of vulnerability (threat) were not included in the final regression equation because these two variables were highly correlated with other dependent variables in the equation. Thus, the final regression equation consisted of 18 independent variables:

- Number of MSDs.
- Work-related injury (at any time).
- Bodily pain scale of the SF-36.
- Role physical scale 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 activity.
- Exposure to repetitive hand motion.
- Seven risk characteristic items (i.e., control, immediacy [present and future], knowledge, familiarity, seriousness, equity).
- Perception of risk of injury to self.

Predictor variables were entered into the regression equation in a hierarchical manner. The final regression equation, with all 18 variables in the equation, explained approximately 67% (R^2 = 0.669, F (18, 80) = 8.99, p = 0.000) of the variance in perception of risk of injury to self (Table 6).

Seventeen independent variables were significantly correlated with the perception of risk of injury to other

Table 6
Regression Equation for Perception of Risk of Injury to Self

	Cumulative R^2	*R^2 Change*	sr^2	*beta*	df	F *change*	p *value*
Health status	.217	.217			5,93	5.165	.000
Number of musculoskeletal disorders			.011	.125	1,93	1.141	.257
Role physical			.009	−.119	1,93	−1.036	.303
Bodily pain*			.048	−.323	1,93	−2.382	.019
Work Role Functioning Questionnaire			.001	.053	1,93	0.383	.703
Work-related injury			.013	−.120	1,93	−1.226	.223
Occupational Characteristics	.396	.177			5,88	5.205	.000
Hours worked per year			.009	.114	1,88	1.168	.246
Exposure to repeated strenuous physical activity*			.048	−.231	1,88	−2.633	.010
Exposure to repetitive hand motion*			.032	−.193	1,88	−2.161	.033
Current occupation (SIC code)			.005	.071	1,88	0.813	.418
Duration of exposure			.023	.183	1,88	1.806	.074
Risk Characteristics	.561	.169			7,81	4.450	.000
Immediacy (present)			.020	.196	1,81	1.907	.060
Immediacy (future)			.002	.071	1,81	0.658	.512
Knowledge			.015	−.151	1,81	−1.673	.098
Familiarity			.000	.011	1,81	0.111	.912
Seriousness*			.038	.247	1,81	2.642	.010
Control*			.023	−.178	1,81	−2.039	.045
Equity			.001	.030	1,81	0.368	.714
Perception of risk of injury to other women	.669	.108			1,80	26.148	.000

**Variables had a significant unique contribution to the explained variance in perception of risk of injury to self.*

Cumulative R^2 describes how well the information about the independent variables is able to predict dependent variable with 1 indicating prefect prediction (Glantz & Slinker, 1990). R^2 change indicates how much of the change in the value of R^2 can be attributed to each group of independent variables in the equation. The p value indicates the level of significance of the relationship between the independent variable and the dependent variable.

women in bivariate analysis. As with perception of risk of injury to self, vulnerability (threat) 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 independent variables in the final regression equation were:

- Household size.
- Number of MSDs.
- Number of physician-diagnosed illness.
- Recent work-related injury.
- The role physical scale of the SF-36.
- Number of years in longest held occupation.
- Repeated bending, twisting, or reaching.
- Repetitive hand motion.
- Duration of exposure.
- Six risk characteristics (i.e., immediacy present, immediacy future, knowledge, familiarity, seriousness, control).
- Perception of risk of injury to self.

The final regression equation, with all 16 variables in the equation, explained approximately 57% ($R^2 = 0.57$, $F(16, 84) = 7.09$, $p = 0.000$) of the variance in perception of risk of injury to other women (Table 7).

DISCUSSION

The pilot study provided detailed information about a select group of working women in Northern California, including their health status, their occupations and occupational musculoskeletal exposures, and the attributes they assigned to their occupational stressors. Additionally, detailed information about the musculoskeletal exposures of these women was obtained, enabling the researcher to describe the exposures of these working women and help identify the association between the exposures and the perception of risk of injury.

Despite a changing economy, women still tend to be clustered in jobs that have traditionally been occupied by women (U.S. Department of Labor, 2004), making their employment patterns different from those of men (Messing, Tissot, Saurel-Cubizolles, Kaminski, & Bourgine, 1998; Stellman, 1999). Women's work has been traditionally viewed as "safe," and therefore has often been excluded from studies of occupational diseases and injuries (Messing, 1997). Most women in this cohort were employed in occupations traditionally considered women's work and thus generally considered to be "safe work." Nonetheless, their exposures clustered either as physically strenuous (e.g., health professional) or static (e.g., sales, clerical).

The results of this study indicate that the eight risk characteristics identified by Slovic (1987) are useful for the

Table 7

Regression Equation for Perception of Risk of Injury to other Women

	Cumulative R^2	R^2 *Change*	sr^2	*beta*	df	F *change*	p *value*
Demographic characteristics	.041	.041			1,99	4.205	.043
Household size*			.041	−.202	1,99	4.025	.043
Health status	.122	.081			4,95	2.187	.076
Number of physician diagnosed illness			.009	.111	1,95	0.983	.328
Number of musculoskeletal disorders			.025	.181	1,95	1.653	.102
Role physical			.000	−.012	1,95	−0.106	.916
Recent work related injury			.007	−.094	1,95	−0.865	.389
Occupational Characteristics	.299	.177			4,91	5.741	.000
Number of years in longest held occupation			.041	.129	1,89	1.352	.180
Exposure to repeated bending, twisting, or reaching			.025	.167	1,89	1.803	.075
Exposure to repetitive hand motion*			.071	−.290	1,89	−3.035	.003
Duration of exposure			.025	.177	1,89	1.806	.074
Risk characteristics	.449	.150			6,85	3.869	.002
Immediacy (present)			.000	.015	1,85	0.123	.903
Immediacy (future)			.002	.060	1,85	0.511	.610
Knowledge			.006	.094	1,85	0.970	.335
Familiarity*			.067	−.332	1,85	−3.202	.002
Seriousness			.014	.145	1,85	1.467	.146
Control			.012	−.135	1,85	−1.384	.170
Perception of risk of injury to self	.574	.125			1,84	24.744	.000

**Variables had a significant unique contribution to the explained variance in perception of risk of injury to other women.*

Cumulative R^2 describes how well the information about the independent variables is able to predict dependent variable with 1 indicating perfect prediction (Glantz & Slinker, 1990). R^2 change indicates how much of the change in the value of R^2 can be attributed to each group of independent variables in the equation. The p value indicates the level of significance of the relationship between the independent variable and the dependent variable.

study of the perception of risk from occupational musculoskeletal exposures. No previous research has looked at the perception of risk from occupational musculoskeletal exposures. This study provides a framework for future research as to how the risks of injury are perceived in occupational settings.

As hypothesized, the risk characteristics a woman assigned to musculoskeletal exposures, occupational characteristics, and health were significant factors in the perception of personal risk. The characteristics of risk had the greatest influence on participants' perceptions of risk. Two risk characteristics, seriousness (how widespread the risk is perceived to be) and control, contributed the most to the observed variance in the dependent variable in this sample of women. Seriousness is related to the catastrophic potential of the hazard (Benthin et al., 1993; Hallman & Wandersman, 1989; Kraus & Slovic, 1988; Osei et al., 1997). It is a measure of how widespread the risk is perceived to be, so with increased seriousness there is a perception that many individuals are at risk from the exposure. The more the hazard is thought to have serious and widespread consequences, the greater the perceived risk. Consequently, if a woman perceives that the occupational stressor poses a risk to most individuals, 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 over" (Miriam-Webster Online, 2005) the hazard. Research in risk perception has shown that perceived control is influential in the perception of risk (Kraus & Slovic, 1988; Sjoberg, 1999). Thus, if a woman believes she can take steps to mitigate the risks posed by the exposure, then she perceives that the exposure poses a lesser risk of injury to her.

Immediacy (present) was shown to be another important dimension in the perception of risk to self. 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 (Slovic,

1987). 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. Therefore, results of this study suggest that occupational exposures that evoke feelings of concern about the consequences of the exposure are important to risk perception. When women understand the potential health effects of occupational exposures, they are more likely to perceive their exposures as risky.

Six of the nine risk characteristics were found to influence the perception of risk of injury to women in general (i.e., familiarity, seriousness, control, immediacy [present and future], knowledge). Of the six risk characteristics, familiarity (knowledge of someone who had been injured as a result of the exposure) had the most influence on the perception of risk of an exposure to women in general. 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 women in general were at risk of injury from the same exposure. As with perception of risk of injury to self, knowledge was important in the perception of risk to other women in this study.

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 any explanation of the study could be given. Additionally, refusal cards may have been received from individuals 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 used, 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 this Northern California county was older, better educated, and had higher incomes than the general population of the county. Women who were foreign-born, particularly of Hispanic descent, were under-represented in the sample, despite the availability of a Spanish-speaking interviewer. Thus, the low response rate and the selection bias of this study may limit the generalizability of the results to the general population of working women.

Understanding how risk is perceived is important in developing injury prevention strategies within a given workplace. According to Fischhoff, Bostrom, and Quadrel (1993), the choice of information selected for a risk reduction program is important. The risk reduction message should include how much is known about the effects of exposure and what strategies could reduce the risk from exposure. This study provides the framework for the development of communication strategies to reduce the risk of injury among working women. For example, it is 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 types of exposures.

Gauging how risk characteristics follow from a worker's musculoskeletal exposures may be an important aspect of developing communication strategies that will change 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 workplace injury should address these two risk characteristics.

CONCLUSION

This study provides 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 an individual's demographic characteristics, health status, occupational characteristics, attributed risk characteristics, and the perception of risk. Also, further research focusing on a more representative population of working women including women in non-traditional 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 workplace should also include men to provide comparisons. Understanding how risk is perceived across occupations (including both men and women) may facilitate the development of effective intervention strategies to reduce occupational injury.

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