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Occupational Injury in America: An analysis of risk factors using data from the General Social Survey (GSS)

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ABSTRACT

Introduction: Although much is known about the distribution of occupational injury in terms of various job and employment factors, considerably less is known about other possible risk factors, particularly those involving psychosocial and organizational factors. These factors have not been emphasized in most injury surveillance systems or large scale, population based surveys. *Method:* In this study, data from the 2002 General Social Survey (GSS) and NIOSH Quality of Work Life (QWL) module were used to examine the risk of occupational injury in terms of socio-demographic factors, employment characteristics, and organizational factors. *Results:* The most informative results were obtained from Poisson regression analyses, which identified race, occupational category, and work-family interference as risk factors, and safety climate and organizational effectiveness as protective factors for occupational injury. These results provide guidance for targeting interventions and protective measures to curtail occupational injury in the United States.

1. Introduction

Occupational safety and health remains a significant public health problem. Each year nearly 6,000 workers die and millions of others are injured in the United States alone. The total consequences of occupational injury extend well beyond direct physical injury and include a wide array of social and economic burdens (Anderson, Schulte, Sestito, Linn, & Nguyen, 2010; Boden, Biddle, & Spieler, 2001; Dembe, 2001; Schulte, 2005; Weil, 2001). Although considerable progress has been made in protecting workers from occupational injury and illness, recent progress has been slow and much remains to be done.

Much of what we know about occupational injury has been gathered from existing national data systems, such as those maintained by the Bureau of Labor Statistics. These data sources have been instrumental in documenting the scope and magnitude of work-related injury. Analyses of these data have been particularly useful in delineating injury patterns with regard to socio-demographic factors, occupation types, and industrial sectors. Multiple studies indicate that incidence rates for occupational injury are higher among males than females, younger than older workers, and in industries such as construction, manufacturing, and healthcare (Sestito, Lunsford, Hamilton, & Rosa, 2004; U.S. Department of Labor, 2007).

Population-based surveys have also provided useful insights. For example, Smith et al. (2005) used data from the National Health Interview Survey to examine the contribution of work-related injury to the total injury burden in the United States. Their results show that injuries at work comprise a substantial portion of the total injury burden in the United States and account for almost 50% of all injuries experienced in some age groups. Dembe, Erickson, and Delbos (2004) used data from the National Longitudinal Survey of Youth (www.bls.gov/nls) to compare personal and employment characteristics associated with work-related injuries and illnesses. They found that the incidence of injury was greater among those with low family income, rural residence, and exposure to a variety of hazardous work activities, including high levels of physical effort, using stairs or inclines, and working in awkward postures. Other research in the United Kingdom has shown that injury rates decline with increasing age and income, are higher for males than females, and vary as a function of job type (Simpson, Wadsworth, Moss, & Smith, 2005; Wadsworth, Simpson, Moss, & Smith, 2003). Overall, there is a fairly extensive knowledge base linking job conditions to injury and illness risk (e.g., Dembe, Erickson, Delbos, & Banks, 2005; National Research Council, Institute of Medicine [NRC/IOM], 2001; Sestito et al., 2004; Sorock, Lombardi, Gabel, Smith, & Mittleman, 2001).

Conceptual models of workplace safety and health frequently emphasize the importance of work organization factors in the occurrence of work-related injury and health outcomes (e.g., Burton, 2010; DeJoy & Southern, 1993; Sauter et al., 2002; Smith & Sainfort, 1989). However, direct research on these factors specific to workplace injury has been surprisingly limited. The terms "work

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organization" or "organization of work" are generally used to refer to work processes and related organizational factors (Sauter et al., 2002). What we know about work process and organizational factors pertinent to work injury comes mainly from small-scale studies of single organizations or industries (Barling & Frone, 2004; DeJoy, Wilson, Vandenberg, McGrath-Higgins, & Griffin-Blake, 2010; Landsbergis, 2003; Shannon, Robson, & Sale, 2001; Zacharatos, Barling, & Iverson, 2005), and/or studies that examine a single or a very small subset of work process or organizational variables.

In one departure from this pattern, Lowe, Schellenberg, and Shannon (2003) analyzed data from a nationally representative sample of 2,500 employed Canadians. The major dependent variable in this study was the extent to which respondents perceived their work environment to be healthy. Their results indicated that psychosocial or work organization factors were the strongest predictors of a healthy work environment. In particular, communication and social support accounted for 27% of the variance in respondents perceptions of a healthy work environment. Job demands were also a significant predictor, in this case negatively related to perceiving a healthy workplace. In addition, workers who perceived their work environments to be healthy had significantly higher levels of job satisfaction, commitment and morale, and lower absenteeism and turnover intention.

In 2002, a quality of work life (QWL) module was added to the General Social Survey (GSS), which is a personal interview survey of American households. The GSS is administered on a biannual basis and contains a standard core of demographic and attitudinal variables, plus certain topics of special interest called "topical modules." The QWL module was developed by NIOSH with contributions and advice from a panel of experts in occupational safety and health, organizational behavior, human resources, psychology, and sociology. The QWL module contains 76-items, which assesses an array of factors associated with work organization, supervision, workplace climate and culture, and injury and health outcomes (Murphy, 2002). As such, the GSS with the QWL module added provides a unique opportunity to examine the contribution of work organization factors to work-related injury in a nationally representative sample of working Americans.

Thus far, only a very few researchers have used this data source to examine predictors of work-related safety and health outcomes, and these studies have been limited to either specific health-related outcomes or specific subgroups of workers. Waters, Dick, Davis-Barkley, and Krieg (2007) examined risk factors associated with musculoskeletal symptoms including low back pain and upper extremity pain. In another study, Murphy (2006) identified job stress predictors within healthcare workers. The present investigation was designed to provide a more broad-based examination of work-related injury in this national sample of working adults. Principal interest was with assessing the contribution of work organization factors beyond that accounted for by traditional socio-demographic and employment characteristics.

2. Methods

2.1. Design and sample

This cross-sectional study utilized data from the 2002 General Social Survey (GSS) and the NIOSH Quality of Work Life (QWL) module. The General Social Survey was administered throughout the continental United States in 2002 by NORC, the National Opinion Research Center. Full probability sampling was employed, which provided each individual adult in each household in the continental United States an equal probability for inclusion in the survey (Golden & Wiens-Tuers, 2006; McCready, 2006). The QWL module was administered as part of GSS in households throughout the United States during face-to-face 90-minute interviews. Complete details about sample selection, interviewing, and data collection procedures for the GSS are described by Davis, Smith, and Marsden (2003).

The target population for the GSS in 2002 was non-institutionalized, English-speaking adults aged 18 years or older. A total of 2,765 individuals responded to the survey, representing a 70% response rate. For the purposes of this study, the sample was restricted to adults who were currently employed, worked 20 hours or more per week, and were not self-employed. Out of the total sample of respondents (2,765), 988 (35.7%) were currently unemployed. From the 1,777 (64.3%) working adults, a total of 252 (14.2%) were either self-employed or worked less than 20 hours per week. The final sample for the study consisted of 1,525 individuals. Tables 1 and 2 summarize the characteristics of this sample.

2.2. Measures

The principal dependent variable in this study was occupational injury. A single item was utilized to measure the work injury experience of respondents. Respondents were asked to indicate how many times they had been injured on the job during the past 12 months. The question did not limit respondents to reporting only injuries that were reported to their employer, medically treated, or resulted in lost workdays. Injury classification or body part affected were not included as part of this item.

Three sets of independent variables were examined: socio-demographics, employment characteristics, and work organization factors. The socio-demographic and employment characteristics variables were represented by sets of categorical variables. The work organization variables were represented by brief scales consisting of two to four items each. All of the measures are described below.

2.2.1. Socio-demographic

Five socio-demographic variables were included in the analyses: sex, age, marital status, education, and race. Respondents self-identified as being either male or female. They reported their age in years and were grouped into the following six age categories: 18 to 24, 25 to 34, 35 to 44, 45 to 54, 55 to 64, and 65 or older. For marital status, respondents were classified into the following three categories: married, never married, or separated, divorced or widowed. To assess racial group membership, surveyors asked respondents to identify their race: "what race do you consider yourself to be?" For

Table 1
Worker Injury Rate by Socio-Demographic Factor.

Variable	N	Injury Rate	Std Error	p-value
Sex				0.0036
Male	732	0.274	0.033	
Female	793	0.154	0.025	
Age				0.0161
18–24	167	0.331	0.074	
25–34	407	0.296	0.052	
35–44	379	0.173	0.034	
45–54	336	0.170	0.040	
55–64	177	0.107	0.027	
65 +	51	0.098	0.051	
Marital Status				.5849
Married	714	0.189	0.027	
Never Married	461	0.234	0.038	
Separated, Divorced or Widowed	350	0.230	0.051	
Education				.3214
Less Than High School	146	0.269	0.071	
High School	839	0.237	0.029	
Junior College	134	0.209	0.065	
Bachelor	270	0.135	0.042	
Graduate	136	0.154	0.072	
Race				0.0198
Black	242	0.133	0.042	
Other	100	0.400	0.123	
White	1182	0.212	0.023	

Table 2
Worker Injury Rate by Employment Characteristics.

Variable	N	Injury Rate	Std Error	p-value
Work Arrangement				0.6599
Permanent Job	1428	0.214	0.022	
Temporary Job	97	0.177	0.066	
Occupation				< .0001
Precision Production, Craft or Repair	142	0.507	0.099	
Service	229	0.346	0.067	
Farming, Forestry & Fishing	13	0.308	0.237	
Operators, Fabricators and Laborers	195	0.306	0.068	
Technicians and Related Support	69	0.275	0.129	
Professional Specialty	259	0.170	0.050	
Sales	159	0.075	0.023	
Exec, Administrative or Managerial	236	0.068	0.033	
Administrative Support or Clerical	211	0.057	0.020	
Industry				0.0832
Agriculture, Forestry and Fishing	13	0.462	0.268	
Construction	79	0.423	0.118	
Public Administration	100	0.360	0.114	
Transportation and Public Utilities	136	0.244	0.075	
Wholesale and Retail Trade	289	0.208	0.039	
Manufacturing	210	0.195	0.053	
Services	590	0.171	0.032	
Finance, Insurance and Real Estate	85	0.095	0.063	
Mining	4	0.000	0.000	
Current Job Tenure (years)				0.5340
≤ 1	424	0.242	0.041	
2	192	0.240	0.063	
3–4	236	0.225	0.053	
5–7	217	0.247	0.063	
8–10	118	0.128	0.049	
11–19	208	0.192	0.058	
20+	128	0.102	0.033	
Respondent's Income (Yearly)				0.0059
< $15,000	283	0.138	0.027	
$15,000 - $19,999	110	0.400	0.121	
$20,000 - $24,999	143	0.329	0.084	
$25,000+	799	0.187	0.027	
Usual Work Schedule				0.2730
Day Shift	1104	0.187	0.023	
Afternoon Shift	73	0.342	0.114	
Night Shift	116	0.259	0.070	
Split Shift	43	0.186	0.090	
Irregular Shift/On-call	101	0.200	0.080	
Rotating Shifts	83	0.361	0.139	
Work at Home				0.1398
Never	1028	0.246	0.027	
A Few Times a Year	150	0.173	0.063	
About Once a Month	82	0.244	0.123	
About Once a Week	84	0.083	0.035	
More Than Once a Week	157	0.103	0.029	
Mainly Work at Home	22	0.045	0.045	
Second Work				0.1590
Yes	257	0.276	0.052	
No	1266	0.199	0.022	
Extra Work				0.1304
No	562	0.173	0.030	
Yes, Mandatory	293	0.290	0.056	
Yes, Voluntary	651	0.213	0.032	

analysis purposes, respondents were categorized as: White, Black, or Other. Those responding as neither White nor Black were assigned to the Other category. For the most part, these respondents identified with a race such as American Indian or Alaskan Native, Hispanic, or Asian. Respondents reported their years of formal education by identifying their highest degree attained. Responses were categorized into: less than high school, high school graduate, junior college, bachelor's degree, and graduate-level education.

2.2.2. Employment characteristics

Nine measures were used to characterize the employment circumstances of the respondents. The following measures were included: work arrangement (either permanent or temporary job), occupation, industry, tenure in current job, yearly income, usual work schedule, frequency of working at home, secondary employment or work and extra work. Respondents were asked to describe the current work arrangements for their principal or main job; they were classified as either having a permanent or temporary job. Respondents were also classified as working in one of nine different occupational categories (based on the 1980 U.S. Census Occupation Code). These categories are listed in Table 2. Based on their current primary employment, respondents were classified into one of nine industry codes (based on the 1980 U.S. Census Industry Code.) These categories are also listed in Table 2. Job tenure was assessed in terms of the number of years that respondents had held their current job. Job tenure was coded into the following categories: 1 year or less, 2 years, 3 to 4 years, 5 to7 years, 8 to 10 years, 11 to 19 years, and 20 or more years. Annual income level was categorized using four income levels: less than $15,000, $15,000 to $19,999, $20,000 to $25,000, and greater than $25,000. Work schedule was assessed using the following categories: day shift, afternoon shift, night shift, split shift, and irregular shift/on-call or rotating shifts. The amount of time that respondents work at home was assessed by asking respondents "how often do you work at home as part of your job?" Respondents identified with one of the following categories: never, a few times a year, about once a month, about once a week, more than once a week, and mainly work at home. Respondents were asked whether they had a second job (yes or no), and whether they were required to perform extra work for their main employer. Responses were categorized as no, yes – mandatory or yes – voluntary.

2.2.3. Work organization

The NIOSH QWL Module was constructed with the intent to capture a number of different constructs related to work processes and organizational factors. The intent was to include multi-item scales to the extent possible. As the development process proceeded and the total number of items had to be reduced, preference was given to dropping items within constructs rather than dropping constructs (Murphy, 2002). Nine constructs were included in the present analyses: participation, work-family interference, management-employee relations, organizational effectiveness, safety climate, job content, advancement potential, resource adequacy, and supervisor support. These scales were included based on their potential relevancy to safety-related outcomes and their inclusion in prior safety-related research. All scale items were answered using a 4-point Likert-type rating scale. The anchors used for the four scale points varied from measure to measure, but were uniform within the scale. For the purposes of this study, the items within the work organization scales were re-coded so that in all instances higher scores reflect more positive work and organizational circumstances.

2.2.3.1. Participation. The participation scale assessed the extent to which respondents had opportunities to participate in job-related decisions. The scale consisted of two items: "in your job, how often do you take part with others in making decisions that affect you," and "how often do you participate with others in helping set the way things are done on your job" ($\alpha = .78$). Response options were: 1 (never) to 4 (often).

2.2.3.2. Work-family interference. This scale assessed mutual interference between job and family demands. The two items included in this scale were: "how often do the demands of your family interfere with your work on the job," and "how often do the demands of your job interfere with your family life?" ($\alpha = .63$). Respondents answered "never" to "often."

2.2.3.3. Management-Employee relations. The management-employee relations scale assessed respect and trust within the organization. This scale included the following items: "I trust management at the place where I work," and "at the place where I work, I am treated

with respect" ($\alpha = .71$). The items comprising this construct were rated using a 1 (strongly disagree) to 4 (strongly agree) scale.

2.2.3.4. Organizational effectiveness. The organizational effectiveness scale also consisted of two items designed to assess constraints on work performance. The two scale items were "conditions on my job allow me to be about as productive as I could be," and "the place where I work is run in a smooth and effective manner" ($\alpha = .71$). The items were rated using a "strongly disagree" to "strongly agree" scale.

2.2.3.5. Safety climate. The safety climate scale focused on respondent perceptions concerning the importance of safety in their work organization. This scale contained four items ($\alpha = .90$). Sample items were: "safety and health conditions where I work are good," and "safety of workers is a high priority with management where I work." This scale also used a "strongly disagree" to "strongly agree" format. The safety climate items were based on those used in the NIOSH Short Safety Climate Scale (Hahn & Murphy, 2008).

2.2.3.6. Job content. The job content scale emphasized task variety and employee learning opportunities. The two items in this scale were: "I get to do a number of different things on my job" and "my job requires that I keep learning new things" ($\alpha = .63$). Again, responses were made using the "strongly disagree" to "strongly agree" scale.

2.2.3.7. Advancement potential. This measure addressed opportunities for job advancement. The two items comprising this scale were: "the chances for promotion are good," and "promotions are handled fairly" ($\alpha = .63$). Each item was rated on a 4-point scale ranging from 1 (not at all true) to 4 (very true).

2.2.3.8. Resource adequacy. Resource adequacy examined the extent to which respondents had sufficient resources to perform their jobs. The following two items were rated "not at all true" to "very true:" "I have enough information to get the job done" and "I have enough help and equipment to get the job done" ($\alpha = .66$).

2.2.3.9. Supervisor support. The supervisor support scale focused on the level of assistance and concern provided by workplace supervisors. The items comprising this scale were: "my supervisor is concerned about the welfare of those under him or her," and "my supervisor is helpful to me in getting the job done" ($\alpha = .74$). Each item was rated on "not at all true" to "very true" scale.

2.3. Data analysis

Two sets of analyses were performed. First, univariate analyses were performed to assess the relationship of each variable within the three groups of independent variables (i.e., socio-demographic, employment characteristics, and work organization) to the dependent variable, occupational injury. Subsequently, a Poisson regression analysis was performed using the variables that were significant in the univariate analyses. Poisson regression was used for this analysis because the dependent variable, number of injuries sustained, was a count of relatively infrequent events. Poisson distributions can be expected when the probability of occurrence of an outcome is small. Injury measures typically assume a Poisson distribution (Janicak, 2008). Detailed descriptions of Poisson methodologies can be found in Agresti (2002) and Arminger, Clogg, and Sobel (1995). The analyses were completed using SPSS 16.0.

Listwise deletion, which omitted those respondents with missing data, was used in the regression analyses. Most of the categorical variables had less than 1% missing data. The income variable 'respondent income' had the most missing data ($n = 190$). There was little missing data for the work organization measures. Even with listwise deletion, all the scales had in excess of 1,500 respondents, except safety climate and advancement potential, which had 1,499 and 1,441 respondents, respectively.

3. Results

Of the 1,525 survey respondents who met the inclusion criteria, 172 respondents reported one or more injuries suffered at work during the past year. The overall injury rate for this sample was 11.3 per 100 workers. Although the majority of respondents (88%) reported zero injuries, 116 respondents (7.64%) reported one injury, 20 respondents (1.32%) reported two injuries, 14 respondents (0.92%) reported three injuries, and 22 (1.44%) reported four or more injuries at work during the past 12 months. Injury data were missing for six respondents.

3.1. Socio-demographic factors

Univariate results for the socio-demographic variables are summarized in Table 1.

Statistically significant differences in injury rates were obtained for sex, age, and race. Males reported significantly more work-related injuries than females and injury rates declined with increasing age. Whites had higher injury rates than Blacks, but both groups had lower injury rates than those reporting their race as Other. Respondents in the Other category included, but were not limited to, Hispanics, American Indians or Alaskan Natives, Chinese, Filipino, Japanese, and Vietnamese. Many of these same groups of workers are often over-represented in high hazard occupations.

3.2. Employment characteristics

Table 2 presents the univariate results for the employment characteristics variables. Statistically significant differences were obtained for only 2 of the 10 variables in this category: occupation and income. Respondents working in precision production, craft and repair were most likely to report being injured at work. Service works had the second highest injury rate; followed by those working in farming, forestry, and fishing. The results for the farming, forestry, and fishing category should be interpreted with caution, since this group contained only 13 respondents. Workers in administrative, support, or clerical positions had the lowest injury rate. Injury rates varied somewhat by industry type, but these differences fell short of statistical significance ($p = .0832$). Respondents earning between $15,000 and $19,999 per year reported the most injuries, followed by those earning $20,000 to $24,999. Injury rates declined substantially for those earning more than $25,000. Those earning less than $15,000 reported the fewest injuries.

3.3. Work organization

In contrast to the findings for employment characteristics, seven of the nine work organization variables showed significant differences with occupational injury (see Table 3). The strongest effects were obtained for work-family interference, organizational effectiveness, and safety climate (all $p < .0001$). For work-family interference, workers reporting the greatest amount of interference had the highest injury rate and workers with the least interference had the lowest injury rate. Similarly, work injuries were most frequent among those who reported the lowest levels of organizational effectiveness where they work. As can be seen in Table 3, injury frequency declined consistently with increased organizational effectiveness. For safety climate, those reporting the poorest safety climate had substantially more injuries than the other three categories. Like safety climate, respondents reporting the poorest levels of management-employment relations, advancement potential, and resource adequacy had the

Table 3
Work Organization Factors and Associated Worker Injury Rates.

Variable	N	Injury Rate	StdErr	p-value
Participation				0.0543
8	514	0.205	0.036	
7	249	0.249	0.061	
6	397	0.131	0.023	
5-2	363	0.285	0.049	
Work-Family Interference				<0.0001
8-6	364	0.370	0.059	
5	255	0.236	0.057	
4	417	0.154	0.029	
3-2	486	0.132	0.025	
Management-Employee Relations				0.0003
8	346	0.116	0.029	
7	235	0.158	0.041	
6	572	0.199	0.034	
5-2	360	0.361	0.056	
Organizational Effectiveness				<0.0001
8-7	418	0.081	0.016	
6	616	0.176	0.029	
5-2	482	0.375	0.051	
Safety Climate				<0.0001
16	359	0.106	0.024	
15-13	386	0.189	0.040	
12	484	0.171	0.032	
11-4	270	0.478	0.075	
Job Content				0.3953
8	432	0.227	0.043	
7	322	0.169	0.037	
6	505	0.250	0.040	
5-2	263	0.168	0.038	
Advancement Potential				0.0015
8-7	425	0.113	0.024	
6	348	0.242	0.049	
5	255	0.165	0.043	
4-2	413	0.322	0.050	
Resource Adequacy				0.0004
8	580	0.114	0.020	
7	340	0.235	0.046	
6	403	0.254	0.045	
5-2	200	0.372	0.083	
Supervisor Support				0.0041
8	559	0.142	0.026	
7	319	0.254	0.052	
6	333	0.181	0.039	
5-2	293	0.342	0.062	

Significant p-values ($p<0.050$) indicate significant differences in injury rate between categories for each construct.

highest levels of injury experience. The results for the participation measure fell just short of statistical significance ($p=.0543$), but were less straightforward. Those reporting the fewest opportunities for participation had the highest levels of injury, but for this measure, those in the second lowest category of participation actually reported the lowest levels of injury. Job content did not impact work injury in the study sample.

3.4. Poisson regression analyses

A Poisson regression analysis was completed to predict the risk of occupational injury adjusting for sex, age, race, occupation, and the following organizational constructs: work-family interference, management-employee relations, organizational effectiveness, safety climate, advancement potential, resource adequacy, and supervisor support. Each of these had each been statistically significant in the univariate analyses. Income was not included in this analysis because of missing data and because of the significant association between income and occupation (*Cramer's V* = .232, $p=0.000$). Rate ratios (RR) and 95% confidence intervals (95% CI) were used to describe the associations with worker injury (see Table 4). Rate ratios (RR) provided an illustration of risk factors and protective factors.

Table 4
Multiple Poisson Regression Analysis and Adjusted Risk Ratio Values.

Risk Factor	Category	Adjusted Risk Ratio[a]	Confidence Interval (95%)	p-value
Sex	Male	1.17	(.89 – 1.53)	.063
	Female	1		
Age	18-24	2.06	(.81 – 5.25)	.129
	25–34	1.58	(.65 – 3.91)	.327
	35–44	0.90	(.36 – 2.27)	.822
	45–54	1.08	(.43 – 2.73)	.868
	55–64	0.78	(.28 – 2.14)	.625
	65+	1		
Race	Black	0.59	(.40 – .88)	.009
	Other	1.58	(1.06 - 2.23)	.024
	White	1		
Occupation	Precision Production, Craft or Repair	6.60	(3.46 – 12.58)	.000
	Service	4.39	(2.36 – 8.17)	.000
	Farming, Forestry & Fishing	4.34	(1.38 – 13.66)	.012
	Operators, Fabricators and Laborers	4.57	(2.40 – 8.70)	.000
	Technicians and Related Support	3.19	(1.45 – 7.00)	.004
	Professional Specialty	2.31	(1.21 – 4.42)	.012
	Sales	1.26	(.55 – 2.87)	.579
	Exec, Administrative or Managerial	1.19	(.55 – 2.56)	.658
	Administrative Support or Clerical	1		
Organizational Factors[b]	Work-Family Interference	1.49	(1.29 – 1.71)	.000
	Management-EE Relations	.93	(.74 – 1.17)	.532
	Organizational Effectiveness	.62	(.49 – .79)	.000
	Safety Climate	.68	(.55 – .84)	.000
	Advancement Potential	.86	(.74 – 1.01)	.065
	Resource Adequacy	1.03	(.84 – 1.26)	.772
	Supervisor Support	1.13	(.96 – 1.34)	.141

a. Adjusted risk ratios provide an illustration of risk factors (>1.00) and protective factors (<1.00), when significant.
b. Organizational factors results were derived from the original continuous scale data in the analysis.

Adjusting for all other variables, the effects of sex and age were diminished in the Poisson regression analysis. The risk of injury was 1.17 (RR = 1.17) times greater for males than females when adjusting for the variables in the model. However, the 95% CI contained the value 1.0, indicating a non-significant difference. There were no significant differences for age after adjusting for the other factors in the model. The significant differences between race categories were retained in the multivariate analyses. With Whites as a comparison group, the risk of injury was nearly 58% higher for workers in the Other race category compared to workers in the White category (RR = 1.58, CI = 1.06 – 2.23). Black as a race category was deemed to be protective as Black respondents were more than 40% less likely to report being injured (RR = 0.59, CI = 0.40 – 0.88). Risk factors associated with occupations were identified in the analyses. Administrative support and clerical workers reported the lowest injury mean and served as the comparison group for occupation. The occupation of precision production, craft or repair worker was found to be the riskiest as they were nearly 6.6 times more likely to be injured. Other occupations at greater risk included operators, fabricators, and laborers (RR = 4.57, 95% CI = 2.40 – 8.70); service workers (RR = 4.39, 95% CI = 2.36 – 8.17); farming, forestry and fishing workers (RR = 4.34, 95% CI = 1.38 – 13.66); technicians and related support personnel (RR = 3.19, 95% CI = 1.45 – 7.00); and professional specialty workers (RR = 2.31, 95% CI = 1.21 – 4.42).

Among the work organization variables, work-family interference was significant when controlling for the other factors in the model

(RR = 1.49, 95% CI = 1.29 – 1.71). There was nearly a 49% increase of injury for each incremental increase of work-family interference. Two other work organization factors were found to be protective in the multivariate analyses. Both organizational effectiveness and safety climate reduced injury experience. For each incremental increase in organizational effectiveness, there was a 38% reduction in injury (RR = .62, 95% CI = .49 - .79); for each incremental increase in safety climate, there was a 32% decrease in injury (RR = 0.67, 95% CI = .55 - .84). The other organizational constructs, including management-employee relations, advancement potential, resource adequacy, and supervisor support were not significant predictors of injury in the multivariate model.

4. Discussion

4.1. Key findings & implications

This study examined relationships between occupational injury and various socio-demographic variables, work characteristics, and work organization factors. Primary interest was with exploring the contribution of work organization factors. The NIOSH quality of work life module provided a rare opportunity to assess these factors in a nationally representative sample of workers in the continental United States.

The multivariate results (Poisson regression) showed that both organizational effectiveness and safety climate operated as protective factors for occupational injury. Logically, employees should find it easier to perform their jobs in a safe manner when the overall organization operates in a smooth, predictable, and efficient manner. A well run operation should result in fewer worker errors and require fewer deviations from safe work practices in achieving production and quality requirements (Smith, Karsh, Carayon, & Conway, 2003). Indeed, organizational effectiveness should minimize a wide array of workplace stressors (Goetsch, 2008) that have been linked to occupational injury in previous research (Krause, Ragland, Fisher, & Syme, 1998; Simpson et al., 2005; Wadsworth et al., 2003). Well-organized and effective organizations not only enhance productivity, but also result in safer workplaces. This beneficial by-product has long been an implicit assumption of many safety practitioners.

Positive perceptions of organizational climate and/or safety climate have been linked to safe work practices in a number of studies (Cooper & Phillips, 2004; Morrow et al., 2010; Neal & Griffin, 2006; Neal, Griffin, & Hart, 2000, Seo, 2005; Zohar, 1980). However, the present study is one of the first to examine this relationship in a diverse sample of occupations and worker groups. It appears that worker perceptions about the importance of safety are relevant to a wide variety of work settings and workers. Supervisor support, resource adequacy, and advancement potential were not significant predictors of injury in this study. That these constructs were each significantly correlated with safety climate though (supervisor support, $r = .434$; resource adequacy, $r = .401$; advancement potential, $r = .374$; all $p = 0.000$) suggests that they may be expressing their importance indirectly. These finding are generally consistent with recent safety climate research that highlights the importance of social and support-related constructs in the formation of safety perceptions (DeJoy, Della, Vandenberg, & Wilson, 2010; Hofmann & Morgeson, 1999; Mearns & Reader, 2008; Zacharatos et al., 2005).

In contrast to the protective factors identified in this study, work-family interference posed a significant risk for occupational injury. Previous research has shown that work-family interference or conflict is often predictive of poor work-related role performance (Frone, 2003; MacEwen & Barling, 1994). This diminished work-related role performance may certainly extend to safety-related behaviors within the work environment. The impact of work-family interference on injury may also be the result of stress, negative health behaviors, or diminished physical and mental health (Allen, Herst, Bruck, & Sutton, 2000; Frone, 2000, 2003; Frone, Russell, & Barnes, 1996; Hammer, Bauer, & Grandey, 2003; Kossek & Ozeki, 1998). Human resource policies and programs that curtail interference may produce beneficial effects on safety performance as well as other business-related outcomes. This is further support for taking a comprehensive or integrated approach to safety. These findings also encourage more research in this emerging area of occupational safety and health. Particularly, researchers need to conduct research to examine injury relationships between both dimensions of work-family interference (Frone, 2003) and explore the indirect effects of work-family interference or conflict on injury.

Finally, the multivariate results from this study showed that injury risk differs as a function of race. With regard to race, workers categorized as Other had a significantly higher adjusted rate ratio in comparison to Whites. Workers categorized as Black had a significantly lower adjusted rate ratio (see Table 4). Cross tabulation of the occupation and race categories revealed that those classified as Other were overrepresented in the occupations reporting the highest injury rates. Approximately one-third of the respondents classified as Other worked in the two occupations responsible for the greatest worker injury rates (11% in Precision Production, Craft and Repair, and 21% in Service occupations). These occupations had the highest and second highest injury rates, respectively.

The Other category mostly included adult workers who identified themselves as Hispanic (47%), American Indian or Alaska Native (12%), Chinese (11%), and Filipino (9%). Cross tabulations showed that that respondents who self-identified as Hispanic reported the greatest number of occupational injuries with seven respondents reporting one or more injuries. Approximately 15% of Hispanic respondents reported suffering one or more injuries at work. Other races though emerged as having even higher percentages of respondents injured, including Chinese (36% or 4 of 11 respondents reporting one or more injuries) and American Indian or Alaska Native (33% or 4 of 12 respondents reporting one or more injuries). These percentages should be interpreted with caution in view of the very small sample sizes involved.

Although the results of this study point to potential racial disparities, previous research has not always yielded similar findings. For example, Smith et al. (2005) found that non-Hispanic White adults reported higher work-related injury rates than non-Hispanic Black adults and Hispanic adults, although the differences were small and non-significant. Dembe et al. (2004) reported that respondents reporting injury were predominantly non-Black and non-Hispanic. These divergent findings may be attributed to the fact that respondents in this study were asked to specifically report the number of injuries suffered on the job, not work-related injuries and illnesses. Further, the specificity of the question likely minimized limitations that may impact other occupational injury studies that extract occupational injury estimates from general injury surveillance data. Lastly, the present survey only sampled English speaking adults. It is possible that lower injury rates may have occurred for those in the Other category if data had been collected from non-English speaking adults as these individuals, particularly immigrant laborers, tend to underreport work-related incidents, including injury (Azaroff, Levenstein, & Wegman, 2002).

4.2. Limitations

The findings and interpretation of this study need to be evaluated with the concept that some limitations potentially exist in the study. The cross-sectional study format, with all data collected during the same time period, limits the extent to which causal inferences can be made. The survey data were collected during interviews with respondents. With this format, it is possible that respondents may have felt the need to respond in a socially acceptable manner. With regard to worker injury responses, there are some limitations to

note. Worker perceptions after suffering a work injury may influence their perceptions of organizational factors. Retrospective data collection, though common, is a limitation in safety studies that examines occupational injury outcomes (Clarke, 2006). An additional limitation associated with retrospective data collection is with injury recall, especially over the 12-month time frame. It is also possible that injury experience could have been affected by the respondents' work history during the 12-month time period for which they were to recall injuries as respondents may not have been working the entire 12 months, may have changed jobs, may have been promoted or demoted or may have worked differing hours than what was collected. Lastly, this model examined various scales and constructs in the examination of organizational factors. With some scales having few variables there is a potential limitation associated with construct underrepresentation (Messick, 1995) and coefficient alphas that are slightly lower than some organizational factor scales comprised of multiple items.

5. Conclusion

This is one of very few studies that have examined work organization factors and injury outcomes in a representative and diverse sample of American workers. These results add to a growing body of research showing the importance of organizational factors to safety performance. More specifically, results point to the importance of good management practices and safety climate to injury reduction in a variety of different work settings and employment contexts.

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