Risk Factors for Occupational Injuries among Older Workers: An Analysis of the Health and Retirement Study

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ABSTRACT

Objectives. This study examined risk factors for occupational injury among older workers.

Methods. We analyzed data on 6854 employed nonfarmers from the Health and Retirement Study (HRS), a population-based sample of Americans 51 through 61 years old.

Results. Occupational injuries were associated with the following: the occupations of mechanics and repairers (odds ratio [OR] = 2.27), service personnel (OR = 1.68), and laborers (OR = 2.18); jobs requiring heavy lifting (OR = 2.75); workers' impaired hearing (OR = 1.60) and impaired vision (OR = 1.53); and jobs requiring good vision (OR = 1.43). Self-employment was associated with fewer injuries (OR = 0.47).

Conclusions. These results emphasize the importance of a good match between job demands and worker capabilities. (*Am J Public Health.* 1996;86:1306–1309)

Introduction

Over the next decade, the United States work force will age significantly.[1–4] By 2005, the mean age of the work force will have increased from 37 to 41 years and can be expected to continue to increase as the baby boomers, born between 1946 and 1964, reach their 50s and 60s. From 1990 to 2005, the number of working men 55 to 64 years of age will increase by 43%, and the number of working women in that age group will increase by 65%. Older workers will be called on to remain productive later in life and to assume more strenuous jobs. This aging of the work force may have important consequences for workplace injuries.

The relationship between age and occupational injuries is not well understood. A literature review suggested that rates of serious occupational injuries involving death or disability increase with age,[5–8] while rates of less serious occupational injuries decrease.[7–10] However, little is known about the risk factors for occupational injuries among older workers.

Using data from the Health and Retirement Study, a nationally representative sample of older Americans, we assessed potentially important risk factors for occupational injuries among older workers, including both personal characteristics of the workers and characteristics of their jobs.

Methods

Cohort

Designed and carried out by the Institute for Social Research at the University of Michigan, the Health and Retirement Study is a longitudinal investigation of a nationally representative population of older Americans designed to assess the relationship between health, economic factors, and retirement. Selected over 45 weeks beginning in April 1992 from a multistage area probability sample of the continental United States, the study cohort contained 9756 subjects 51 to 61 years of age. Of these, 7089 were employed during the year preceding the interview and, therefore, at risk for occupational injury. Because preliminary analyses suggested that the 235 farmers showed different patterns of risk from the rest of the cohort, they were not included in this analysis.[11]

Variables

The Health and Retirement Study determined occurrences of occupational injuries through the following question: "During the last 12 months, that is since (month) of 1991, have you had any injuries at work that required medical attention or treatment or interfered with your work activities?" The study did not solicit any further information regarding the nature, severity, or circumstances of the injury but did query the number of injuries during the previous year and the date of the most recent injury.

The study also obtained demographic, health, working conditions, financial, and familial composition information. In this analysis, we considered as injury risk factors Health and Retirement Study variables suggested by the literature and other variables deemed as possible risk factors.

Because of the cross-sectional nature of this survey, we separated the independent variables into two groups. First, we consider factors (see Table 1) that were likely to have preceded the occupational injuries and, thus, could be considered as

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potential predictors of injury. Second, we considered factors (see Table 3) that might have predated the injury and predicted it but also might have been a consequence of the injury.

Analysis

We calculated injury rates using the number of occupational injuries as the numerator and the number of individuals who had worked for pay during the year preceding the interview as the denominator, assuming an average of 1 year of exposure per subject. Since only 37 workers had more than one injury, we did not analyze that group separately.

First, we calculated the univariate associations of the potential risk factors with occupational injury. Second, we constructed a logistic regression model to assess the association of the potential predictors in Table 1 with occupational injuries. Using a modeling strategy adapted from Higgins and Koch,[12] we began the model with occupation because both the literature and preliminary analyses suggested a strong association with injury. Choice of subsequent variables relied on Mantel–Haenszel chi-square statistics, divided by their degrees of freedom, as measures of the relative importance of combinations of variables in a multivariate relationship. The variable with the highest chi-square value was chosen next, and the associations with the remaining variables were recalculated, stratified by the variables already chosen. This process continued until no remaining variable was associated with occupational injury at a significance level of $P < .1$. The selected variables were then fit in a logistic regression model by means of a backward elimination process in which variables that did not contribute at the level of $P < .05$ were eliminated. We then considered the addition of interaction terms. In addition, we specified a second model using a forward selection procedure and compared the resulting model with the prior model based on backward selection. We examined the regression residuals and carried out a Hosmer–Lemeshow test of goodness of fit.[13] Third, starting with the multivariate model constructed from the potential predictors that clearly preceded the occupational injury, we added each of the independent variables for which the time sequence was unclear to assess its association with occupational injury after accounting for the potential predictors. To account for the complex sample design, we used SUDAAN[14] software to calculate standard errors.

TABLE 1—Univariate Associations between Risk Factors and Occupational Injuries among 6854 Workers 51 to 61 Years Old in the Health and Retirement Study, 1992 through 1993

Risk Factor	Unweighted No. with Risk Factor	Unweighted No. with Occupational Injuries	Odds Ratio	95% Confidence Interval
Occupation				
Executives, managers, professionals	1974	51	1.00	
Sales personnel	683	19	1.02	0.64, 1.60
Administrative support	1074	35	1.20	0.71, 2.00
Service personnel	1242	76	2.32	1.62, 3.32
Mechanics and repairers	804	73	3.83	2.53, 5.80
Operators and assemblers	492	36	3.12	1.73, 5.60
Laborers	577	54	3.96	2.42, 6.49
Age (55–61 y vs 51–54 y)	3733	173	0.82	0.66, 1.01
Male (vs female)	3584	202	1.38	1.06, 1.79
Black (vs non-Black)	1097	60	1.23	0.93, 1.63
Hispanic (vs non-Hispanic)	524	31	1.21	0.74, 1.98
Education ($\leq$12 y vs more)	4045	242	1.78	1.38, 2.29
Rural area[a]	1668	87	1.16	0.92, 1.48
Obesity[b]	1707	101	1.29	1.01, 1.65
Alcohol dependence[c]	449	39	1.95	1.27, 2.99
Disabled from work (self-reported)	696	47	1.54	1.02, 2.33
Sight[d]	649	55	2.01	1.49, 2.72
Hearing[d]	837	74	2.08	1.59, 2.71
Job requirements[e]				
Physical effort	2579	182	2.45	1.89, 3.18
Stooping or kneeling	1712	129	2.23	1.76, 2.83
Heavy lifting	2891	219	3.40	2.55, 4.53
Good vision	3439	183	1.28	0.94, 1.73
Concentration	3117	166	1.09	0.84, 1.42
Good people skills	2314	128	1.24	0.97, 1.59
Years of experience (>3 vs $\leq$3)	1125	47	0.75	0.53, 1.05
Self-employment	1079	26	0.44	0.30, 0.66

[a]Nonstandard metropolitan area counties vs standard metropolitan area counties.
[b]Quetelet score of $\geq$30 vs <30.
[c]3 or 4 positive answers on the CAGE screen vs fewer positive answers.[18]
[d]Self-reported as poor or fair with glasses or hearing aid vs others.
[e]Self-report of job requirement occurring all or most of the time vs others.

Results

Table 1 reports the results of the univariate analyses. Occupation was the strongest predictor of occupational injuries. Service workers, mechanics, machine operators, and laborers had significantly elevated odds ratios for occupational injury in comparison with professionals. Other predictors of increased injury risk included male gender, less education, obesity, alcohol abuse, disability, self-report of impaired hearing or sight, and several job requirements. Those who were self-employed had a lower risk of injury.

Table 2 shows the results of multivariate modeling. Examination of the residuals suggested two persons as possible outliers. We repeated the analysis after removing these two subjects and found the results substantially unchanged. The Hosmer–Lemeshow[13] test suggested a good fit ($P = .60$).

Table 3 presents the results of adding the variables for which the time sequence was unclear to the base model one at a time. Depressive symptoms, several impairments, and poor emotional health were associated with occupational injury,

TABLE 2—Logistic Regression Model of Risk Factors Predicting Occupational Injuries among 6370 Workers 51 to 61 Years Old in the Health and Retirement Study, 1992 through 1993

Risk Factor	Odds Ratio	95% Confidence Interval
Occupation		
Executives, managers, and professionals	1.00	. . .
Sales personnel	1.01	0.62, 1.66
Administrative support	1.19	0.69, 2.04
Service personnel	1.68	1.18, 2.39
Mechanics and repairers	2.27	1.49, 3.46
Operators and assemblers	1.70	0.93, 3.09
Laborers	2.18	1.29, 3.67
Heavy lifting	2.75	2.00, 3.78
Self-employment	0.47	0.32, 0.69
Poor hearing	1.60	1.11, 2.30
Poor sight	1.53	1.11, 2.09
Job requirement of good vision	1.43	1.04, 1.98

Note. The difference between the sample used here and that used in Table 1 stems from missing data on specific risk factors.

TABLE 3—Logistic Regression Analyses of Risk Factors Associated with Occupational Injury after Control for Occupation, Heavy Lifting, Self-Employment, Poor Sight and Hearing, and Jobs Requiring Good Vision, among Workers 51 to 61 Years Old in the Health and Retirement Study, 1992 through 1993

Risk Factor	Odds Ratio	95% Confidence Interval
Income (≥ $44 000 vs < $44 000)	0.97	0.71, 1.33
High depression[a]	1.47	1.17, 1.85
Some difficulty with[b]		
Getting up after sitting	1.54	1.22, 1.94
Stooping	1.93	1.45, 2.57
Pushing large objects	1.50	1.04, 2.17
Lifting 10 lb	1.73	1.28, 2.35
Walking 1 block	1.44	0.86, 2.42
Walking several blocks	1.37	1.04, 1.80
Worse state of health	1.31	0.91, 1.88
Poor emotional health[d]	1.45	1.08, 1.96
Dissatisfaction with[e]		
House	1.03	0.68, 1.56
Neighborhood	0.94	0.64, 1.40
Health	1.77	1.31, 2.38
Finances	1.37	1.07, 1.77
Friendships	1.46	0.95, 2.25
Marriage	1.33	0.71, 2.52
Job	1.44	1.02, 2.05
Family life	1.00	0.67, 1.48
Way problems are handled	1.21	0.87, 1.69
Life overall	1.53	1.05, 2.24

[a]The 30% with the most CES-D scale symptoms[19] vs the other 70%.
[b]Self-report of some difficulty with the task vs no difficulty.
[c]Self-report of health worse 1 year ago vs health same or better.
[d]Self-report of emotional health fair or poor vs better.
[e]Self-report as somewhat or very dissatisfied vs more satisfied.

as were dissatisfaction with one's health, finances, job, and life overall.

Discussion

Type of occupation, a marker for job-specific exposures, was associated with rate of occupational injuries. After controlling for occupation, we found that a job with worker-reported heavy lifting was the factor most strongly associated with occupational injury. We offer two potential explanations for this association. It may be that workers were accurately reporting those jobs within each occupation that required the most heavy lifting. Alternatively, the workers' perceptions may have reflected not just the amount of lifting their job required, but also the match between their own capabilities and their job requirements. For example, a strong worker capable of lifting 70 lb (31.5 kg) might not perceive a job that required lifting 20-lb sacks as requiring "heavy lifting," while a colleague capable of only lifting 30 lb might think that the same job required "very heavy lifting." Keyserling et al.[15] suggested that such mismatches between workers' capabilities and job demands are associated with increased rates of occupational back pain. This might be a special problem for older workers who remain in physically demanding jobs while their physical capabilities begin to decline.

We found that self-employed people had significantly lower injury rates than those who worked for others. This contrasts markedly with their recently reported increased risk for occupational fatalities,[16] a difference in part explained by the fact that farmers accounted for 30% of the fatalities among self-employed individuals. Farmers were excluded from our cohort partly because self-employment was an injury risk factor for them but was protective for all other occupations.

Regarding the association between occupational injury and impaired hearing, in a study of Dutch shipyard workers, Moll van Charante[17] also found an association between traumatic injury and impaired hearing.

This study involved several strengths. It analyzed a large, nationally representative sample. The survey had a good participation rate (82%), arguing for generalizing these results to the entire population of older American workers. The breadth of variables collected permitted consideration of both job-related and worker-related risk factors for occupational injuries.

The study also involved several limitations. Most important is the possibility of recall bias, since the data on risk factors and occupational injuries were collected in the same questionnaire. This bias could occur in two ways. First, the occurrence of an occupational injury could make subjects more likely to remember certain risk factors. To minimize this, we focused our primary analysis on potential risk factors whose reporting, we believed, was less likely to be influenced by injury history. In addition, the Health and Retirement Study was not cast as an injury study. Thus, most of the risk factor questions appeared in different parts of the questionnaire, far removed from the injury questions. This should have decreased the amount of recall bias. However, we realize that the potential problem of recall bias remains and can be fully assessed only in a subsequent longitudinal cohort study. Second, certain risk factors could make subjects more likely to remember occupational injuries. This study was also limited by the absence of data on the nature, severity, or circumstances of injuries. Thus, we could not investigate whether more severe injuries involved the same risk factors as less severe injuries. Also, we could not exclude the possibility that the workers were injured while working a second job in a different occupation.

Our data suggest the importance of a good match between the capabilities of the worker and the demands of the job. This may be especially important among older workers, who may require special accommodations because of disabilities such as impaired hearing and sight. □

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References

1. Johnston WB, Parker AH. *Workforce 2000: Work and Workers for the 21st Century.* Indianapolis, Ind: Hudson Institute; 1987;3.
2. Fullerton HN. New labor force projections spanning 1988 to 2000. *Monthly Labor Rev.* 1989;112:3–12.
3. Fullerton HN. Labor force projections: the baby boom moves on (outlook: 1990–2005). *Monthly Labor Rev.* 1991;114:31–44.
4. Fullerton HN. Another look at the labor force: the American workforce, 1992–2005. *Monthly Labor Rev.* 1993;116:31–40.
5. *Fatal Injuries to Workers in the United States, 1980–1989: A Decade of Surveillance.* Washington, DC: US Dept of Health and Human Services; 1993. DHHS publication NIOSH 93–108.
6. Goldberg RL, Bernstein L, Garabrant DH, Peters JM. Fatal occupational injuries in California: 1972–1983. *Am J Ind Med.* 1989;15:177–185.
7. Root N. Injuries at work are fewer among older employees. *Monthly Labor Rev.* 1981; 104:30–34.
8. Myers JR. National surveillance of occupational fatalities in agriculture. *Am J Ind Med.* 1990;18:163–168.
9. Landen DD, Hendricks SA. Estimates from the National Health Interview Survey on occupational injury among older workers in the United States. *Scand J Work Environ Health.* 1992;18(2):18–20.
10. Zwerling C, Sprince NL, Wallace RB, Davis CS, Whitten PS, Heeringa SG. The effect of recall period on the reporting of occupational injuries in the Health and Retirement Study. *Am J Ind Med.* 1995;28: 583–590.
11. Zwerling C, Sprince NL, Wallace RB, Davis CS, Whitten PS, Heeringa SG. Occupational injuries among agricultural workers 51 to 61 years old: a national study. *J Agricultural Safety Health.* 1995;1:273–281.
12. Higgins JE, Koch GG. Variable selection and generalized chi-square analysis of categorical data applied to a large cross-sectional occupational health survey. *Int Stat Rev.* 1977;45:51–62.
13. Hosmer DW, Lemeshow S. *Applied Logistic Regression.* New York, NY: John Wiley & Sons Inc; 1989:140–145.
14. Shah BV, Barnwell BG, Hunt PN, La Vange LM. *SUDAAN User's Manual. Professional Software for Survey Data Analysis for Multi-Stage Sample Design. Release 6.30.1.* Research Triangle Park, NC: Research Triangle Institute; 1992.
15. Keyserling WM, Herrin GD, Chaffin DB. Isometric strength testing as a means of controlling medical incidents on strenuous jobs. *J Occup Med.* 1980;22:332–336.
16. Personick ME, Windau JA. Self-employed individuals fatally injured at work. *Monthly Labor Rev.* 1995;118:24–29.
17. Moll van Charante AW, Mulder PGH. Perceptual acuity and the risk of industrial accidents. *Am J Epidemiol.* 1990;131:652–663.
18. Bush B, Shaw S, Cleary P, Delbanco TL, Aronson MD. Screening for alcohol abuse using the CAGE questionnaire. *Am J Med.* 1987;82:231–235.
19. Radloff LS. The CES-D scale: a self-report depression scale for research in the general population. *Appl Psychological Meas.* 1977; 1:385–401.