BLS develops measure of job risk by occupation

New statistic relates injury incidence and employment by occupation within economic sectors and industry divisions; such data should help target those workers most prone to job-related accidents and illnesses

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As one might expect, blue-collar workers generally experience more job-related injuries[1] than white-collar employees, in both relative and absolute terms. What is surprising, however, is the magnitude of this difference between the two groups. A new injury index by occupation indicates that laborers had injuries at a level almost four times the average while operatives and craftworkers incurred injuries at about one-and-a-half times the norm. On the other hand, professional and technical workers, managers and administrators, salesworkers, and clerical workers were subject to injuries at a level about one-fourth the average. However, a number of white- and blue-collar occupations had indexes different from those of the broad occupational group to which they belong.

Since the inception of the Supplementary Data System (SDS) program in 1976, there has been a demand for injury incidence rates by occupation, which are more accurate measures of risk than simple frequencies because they eliminate the effects of employment size. The absence of occupational exposure data, differences in State workers' compensation coverage and reporting requirements,[2] and the lack of a complete universe of States in SDS program prevented the development of occupational incidence rates comparable to the industry incidence rates derived from the Bureau of Labor Statistics' Annual Survey of Occupational Injuries and Illnesses.[3]

In lieu of an injury incidence rate for occupations, the Bureau has developed an index that is a relative measure of occupational risk based on the percent distributions of employment and injuries. Although it does not have the precision of an incidence rate, the index provides a valid measure of hazardousness for an occupation in an industry.

Scope and method of the analysis

The 1978 work injury data for this study were obtained from 25 States which provided current case information from their workers' compensation records for the Supplementary Data System.[4] (A current case involves an injury or illness which occurred or was reported during the reference year.) The data are not strictly additive because of variations in State laws regarding workers' compensation coverage and reporting requirements. The primary difference is that some States require employers to report all work-related injuries regardless of severity while other States require reports only of injuries involving some minimum number of days of disability, ranging from 1 to 8. Despite the resulting differences in the numbers of cases among States the percentage distributions of injuries and affected oc-

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cupations are relatively consistent across the States—patterns we have observed in 3 consecutive years of data from nearly 30 States and statistically tested for this analysis.[5] Our observations and tests, and the geographic and industrial diversity of the States included in this study, support our thesis that these data are representative of the national experience.

The employment counts are from the Bureau's 1978 National Industry Occupational-Employment Matrix, which identifies wage-and-salary workers in the private sector by occupation.[6] The wage-and-salary worker group corresponds most closely to the class of employee covered under State workers' compensation laws. Railroad and maritime-related occupations are excluded from the data because they generally are not covered by State workers' compensation laws. Similarly, farming and private household occupations are excluded because of large coverage gaps in many States.

The percentage distributions of injuries and of employment by occupation for a given industrial category are used in computing the ratio index. The formula is: percentage of injuries accounted for by the occupation divided by the corresponding percentage of employment. The universe totals—all injuries and all employment within the industrial category—are 100 percent each, and yield an index of 1. An occupational index greater than 1 indicates that the percentage of injuries is greater than the percentage of employment in the job, and a ratio smaller than 1 indicates the opposite. Thus, the index measures injury experience for a worker group against the base of 1 for all occupations in the given industry division or sector.

Because absolute numbers are not used, the discrete indexes are valid only within each industrial category. For example, an index of 4.11 for laborers in manufacturing does not mean that these workers are more than twice as likely to have injuries than laborers in construction with an index of 1.78. Construction as a whole has a higher injury incidence rate than that for manufacturing, but because the total index for each of these industry divisions is equal to 1, the indexes of component occupations do not reflect general differences in risk between the divisions. In other words, a job with an index of 1 has an incidence rate equal to that of the industrial category in which it is located; an index of 4 would indicate that the occupation is experiencing work injuries at a level four times the rate for the overall category.

To be included in this analysis, the unweighted mean percentage of injuries for an occupation had to be 0.25 or greater. Additionally, the occupation had to account for at least 0.1 percent of weighted injuries and 0.1 percent of employment. (State injury data were weighted by their respective total employments.) Standard deviations on the weighted mean percentages were used to eliminate those occupations with overly wide dispersions. Because there was not a complete universe of States, the study was further restricted to those occupations showing the strongest similarity of injury and employment distributions among the 25 States for which data were available.[7]

Private sector patterns

Application of the ratio index procedure to data for the private nonfarm sector provides additional evidence that the number of injuries alone is not indicative of the relative hazardousness of an occupation. For example, "all other clerical workers" accounted for 3 percent of all injuries in 1978, but their injury index 0.17 was one-sixth of the private industry base of 1. On the other hand, shipping and receiving clerks, who recorded 0.80 percent of all injuries, had an index of 1.21—one-fifth higher than the private sector base. (See table 1.)

As previously indicated, blue-collar workers generally experienced more job-related injuries than white-collar employees. Blue-collar workers—craftworkers, operatives, and laborers—made up 40 percent of employment but accounted for 77 percent of the injuries. Conversely, white-collar employees—professionals and technicians, managers, salesworkers, and clerical workers—made up 48 percent of employment but accounted for only 12 percent of the injuries. (The corresponding proportions for service workers were 12 and 11 percent, respectively.) Some blue-collar workers experienced injuries up to 18 times more frequently than white-collar workers, underscoring the more hazardous characteristics of blue-collar jobs.

Members of the major white-collar groups in the private sector generally experienced injuries about one-fourth as often as all workers. Shipping clerks and stock clerks within the clerical category were the most notable exceptions to this rule, with indexes of 1.21 and 1.13, respectively. Among the major blue-collar occupational groups, nonfarm laborers had the highest index (3.70), followed by transport equipment operators (2.09); operatives, except transport (1.79); and craftworkers (1.40).

Indexes for more specific blue-collar occupations ranged widely—from 0.79 for blue-collar supervisors to 9.95 for warehouse laborers. The following ("all other" categories are not considered) had indexes of 2 or more: carpenters, millwrights, roofers and slaters, sheetmetal workers, structural metal craftworkers, assemblers, meat cutters and butchers, welders and flame cutters, machine operatives, truckdrivers, construction laborers, freight and material handlers, and warehouse laborers. Blue-collar groups with indexes ranging from 1.5 to less than 2 included: mechanics and repairers, plumbers and pipefitters, press operators and plate printers, cutting and miscellaneous operatives, delivery and route drivers,

Table 1. Occupational injury ratio indexes for the private nonagricultural sector, 1978

Occupations [1]	Weighted percent injuries	Percent employment	Ratio index [2]
All occupations	100.00	100.00	1.00
Professional, technical, and kindred workers	2.37	11.04	.21
Registered nurses	.53	1.08	[3].49
Engineering and science technicians	.38	1.15	.33
All other	1.46	8.81	.17
Managers and administrators, except farm	2.91	10.41	.28
Restaurant, bar managers	.29	.60	[3].48
Sales managers and department heads, retail	.48	.49	[3].98
All other	2.14	9.32	.23
Salesworkers	2.11	7.47	.28
Clerical and kindred workers	4.59	19.31	.24
Shipping, receiving clerks	.80	.66	[3]1.21
Stock clerks, storekeepers	.72	.64	[3]1.13
All other	3.07	18.01	.17
Craft and kindred workers	20.76	14.88	1.40
Carpenters and apprentices	2.70	1.34	2.01
Electricians and apprentices	.92	.72	1.28
Electric power line and cable installers and repairers	.22	.16	[3]1.38
Excavating, grading, and road machine operators (except bulldozer)	.34	.28	[3]1.21
Blue-collar supervisors, n.e.c.	1.76	2.23	.79
Machinists and apprentices	.94	.67	1.40
Mechanics and repairers	6.52	3.97	1.64
Automobile body repairers	.29	.22	1.32
Automobile mechanics and apprentices	1.70	1.20	1.42
Heavy equipment mechanics	1.54	1.30	[3]1.18
All other	2.99	1.25	2.39
Millwrights	.36	.14	[3]2.57
Painters, construction or maintenance	.45	.42	1.07
Plumbers, pipefitters, and apprentices	.91	.51	1.78
Press operators, plate printers, and apprentices	.36	.23	1.57
Roofers, slaters	.41	.13	[3]3.15
Sheetmetal workers and apprentices	.56	.20	2.80
Structural metal craftworkers	.39	.11	[3]3.55
All other	3.92	3.77	1.04
Operatives, except transport	27.35	15.31	1.79
Assemblers	3.51	1.70	[3]2.06
Cutting operatives, n.e.c.	.63	.38	[3]1.66
Garage workers, gas station attendants	.73	.60	[3]1.22
Meat cutters, butchers, except manufacturing	.60	.27	2.22
Packers, and wrappers, except retail	1.13	.98	[3]1.15
Welders and flame cutters	2.11	.92	2.29
Machine operatives, miscellaneous specified	4.82	2.12	[3]2.27
Miscellaneous operatives	2.73	1.64	[3]1.66
All other	11.09	6.70	1.66
Transport equipment operatives	8.61	4.12	2.09
Delivery and route drivers	1.44	.81	1.78
Forklift, tow motor operators	.94	.52	1.81
Truckdrivers	5.75	2.32	2.48
All other	.48	.47	1.02
Laborers, except farm	20.29	5.49	3.70
Construction laborers	2.59	.98	[3]2.64
Freight, material handlers	2.92	1.11	2.63
Stock handlers	1.99	1.30	[3]1.53
Warehouse laborers, n.e.c.	1.99	.20	9.95
All other	10.80	1.90	5.68
Service workers, except private household	10.98	11.99	.92
Cleaning service workers	2.36	2.63	.90
Food service workers	5.00	5.43	.92
Nursing aides, orderlies, and attendants	1.79	1.03	1.74
Practical nurses	.35	.55	.64
Guards and watchmen	.40	.57	.70
All other	1.08	1.78	.61 dn

[1] Excludes data for agriculture, forestry, and fisheries; private households; and the public sector.

[2] The indexes are derived from the following formula: percent injuries divided by percent employment. Injury and illness data are the mean percents from 25 States weighted for their respective employments. Employment data are percents of private wage-and-salary workers from the Bureau of Labor Statistics 1978 National Industry Occupational-Employment Matrix.

An index was considered publishable only if data for the occupation met the following criteria:

– Injury and illness data for the occupation were available from five or more States.
– The unweighted mean percentage of injuries was 0.25 or greater.
– The weighted mean percent of injuries was 0.1 or greater.
– Occupational employment was 0.1 or more of the total.
– The standard deviation of the injury mean was 0.5 or less, except as specified in footnote 3.

[3] Indicates a standard deviation of unweighted mean percentage of injuries of between 0.25 and 1.75.

n.e.c. = not elsewhere classified

forklift operators, and stock handlers.

Indexes for the service industries were generally somewhat below the all occupation base of 1, with the exception of that for nursing aides (1.74).[8]

The indexes for the major occupational groups indicate that pay is not always commensurate with risk, as is commonly thought. The largest index is for laborers, a group of workers generally at the lower end of the wage scale. These jobs usually involve much manual labor subjecting workers to hazards such as handling heavy objects for which there are no safety standards, and for which experience alone teaches injury avoidance. For example, strains and sprains account for 25 percent of injuries to all craftworkers, but for about 35 percent of the injuries to freight handlers and warehouse laborers. Furthermore, laborer occupations are generally entry jobs for inexperienced or untrained workers. Other studies have found short duration of employment to be strongly correlated with occupational injury. About 40 percent of all work-related injuries occur among workers in their first year on the job.

High risk jobs by industry division

Injury indexes by occupation were also developed for each of eight major industry divisions within the private nonfarm sector: mining; construction; manufacturing; transportation and public utilities; wholesale trade; retail trade; finance, insurance, and real estate; and services. (See table 2.) The following discussion presents the salient results of that analysis.

Some occupations had higher-than-average indexes across three or more of the industry divisions. Notable blue-collar occupations in this category included: carpenters, mechanics and repairers, plumbers and pipefitters, welders and flame cutters, delivery and route drivers, forklift operators, truckdrivers, material handlers, stock handlers, vehicle cleaners, and warehouse laborers. Among white-collar workers, stock clerks tended to have higher-than-average indexes, as did cleaning service and food service workers among the service employee group.

Within individual industry divisions, the high-risk occupations (that is, those with indexes of 1.2 or more, compared to the division base of 1) were:

Mining—mechanics and repairers; mine operatives; welders and flame cutters; and vehicle and equipment cleaners.

Construction—carpenters; glaziers; millwrights; sheetmetal workers; structural metal craftworkers; and construction laborers.

Manufacturing—metal molders; sheetmetal workers; assemblers; grinding machine operators; welders and flame cutters; delivery and route drivers; forklift and

Table 2. Selected occupational injury ratio indexes[1] by industry division, 1978

Occupations[2]	Mining	Construction	Manufacturing	Transportation and public utilities	Wholesale trade	Retail trade	Finance, insurance, and real estate	Services
All occupations	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Professional, technical and kindred workers	[3].10	[3].20	.11	[4].24	[4].20	[3].24	[4].40	.43
Managers and administrators, except farm	[3].14	[4].18	.16	.15	.20	.58	.62	.43
Salesworkers	[3].13	[3].35	[3].17	[4].26	.26	.47	[4].35	.55
Clerical and kindred workers	.09	.09	[4].22	[3].28	.24	.48	.62	.24
Shipping, receiving clerks	-	-	[4].99	-	.91	1.69	-	-
Stock clerks, storekeepers	-	-	[4].58	[4]1.10	[4].86	[4]2.17	-	1.77
Craft and kindred workers	.92	1.03	.87	.83	1.48	1.65	8.78	2.16
Carpenters and apprentices	-	1.20	-	-	[4]1.87	[4]2.61	[4]9.80	[4]1.94
Electricians and apprentices	[4].65	.84	.74	[4].51	-	-	-	[4]2.19
Blue-collar supervisors, n.e.c.	[4].54	.97	.45	.49	.67	[4].94	[4]4.96	[4]2.35
Glaziers	-	[4]2.00	-	-	-	-	-	-
Machinists and apprentices	-	-	.96	-	[4]1.80	-	-	-
Mechanics and repairers	[4]1.47	1.03	1.18	1.51	1.92	1.97	-	2.30
Auto body repairers	-	-	-	-	-	1.98	-	[4]1.88
Household appliance and accessory installers	-	-	-	-	-	[4]2.16	-	[4]2.33
Millwrights	-	[4]2.79	-	-	-	-	-	-
Molders, metal and apprentices	-	-	[4]2.23	-	-	-	-	-
Painters, construction, maintenance and apprentices	-	.57	-	-	-	-	[4]5.73	[4]2.04
Plumbers, pipefitters and apprentices	-	1.14	[4].94	-	[4]1.57	-	-	[4]2.56
Sheetmetal workers and apprentices	-	1.84	[4]1.62	-	-	-	-	-
Structural metal craftworkers	-	[4]1.83	-	-	-	-	-	-
Operatives, except transport	1.49	1.11	1.31	[4]1.83	1.87	1.74	-	2.21
Asbestos and insulation workers	-	[4]1.16	-	-	-	-	-	-
Assemblers	-	-	[4]1.40	-	-	-	-	-
Cutting operatives, n.e.c.	-	-	[4]1.18	-	-	-	-	-
Garage workers, gas station attendants	-	-	-	-	-	[4]1.45	-	-
Laundry, dry cleaning operatives, n.e.c.	-	-	-	-	-	-	-	1.79
Meat cutters, butchers, except manufacturing	-	-	-	-	-	2.81	-	-
Mine operatives, n.e.c.	[4]1.42	-	-	-	-	-	-	-
Packers, wrappers, except retail	-	-	[4].90	[4]1.89	-	-	-	-
Grinding machine operatives	-	-	[4]1.88	-	-	-	-	-
Welders and flame cutters	[4]1.46	[4].73	1.74	[4]1.49	-	-	-	-
Transport equipment operatives	[4]1.45	.97	1.49	1.74	2.28	2.29	[4]7.41	3.70
Delivery and route drivers	-	-	[4]1.34	[4]4.76	[4]1.72	[4]1.37	-	4.03
Forklift, tow motor operatives	-	-	1.21	-	1.71	[4]3.77	-	-
Truckdrivers	[4]1.18	1.01	1.87	2.10	2.86	3.45	-	[4]7.68
Laborers, except farm	[4]3.12	1.78	4.11	3.09	4.41	2.87	14.20	3.58
Construction laborers, except carpenters' helpers	-	1.43	-	-	[4]9.50	-	-	-
Freight, material handlers	-	[4]1.00	[4]1.81	3.58	[4]1.67	[4]3.08	-	6.90
Garbage collectors	-	-	-	[4]8.16	-	-	-	-
Gardeners, groundskeepers, except farm	-	-	-	-	-	-	[4]10.38	[4].82
Stock handlers	-	-	-	-	[4]1.47	[4]1.80	-	[4]1.65
Vehicle and equipment cleaners	[4]2.00	-	-	-	[4]1.21	[4]1.33	-	[4]1.18
Warehouse laborers, n.e.c.	-	-	5.38	[4]10.35	9.29	[4]15.59	-	-
Service workers, except private household	[4].38	[4].57	.98	[3]1.62	[4]1.12	1.11	3.92	1.65
Cleaning service workers	-	-	1.17	.70	-	1.16	[4]3.69	1.31
Food service workers	-	-	-	-	-	1.11	-	2.32
Nursing aides, orderlies, attendants	-	-	-	-	-	-	-	3.18

[1] The indexes are derived from the following formula: percent injuries divided by percent employment. Injury and illness data are the mean percents from 25 States weighted for their respective employments. Employment data are percents of private wage-and-salary workers from the Bureau of Labor Statistics 1978 National Industry Occupational-Employment Matrix.

An index was considered publishable only if data for the occupation met the following criteria:

- Injury data were available from five or more States.
- The unweighted mean percentage of injuries was 0.25 or greater. (Except for major occupational groups.)
- The weighted mean percentage of injuries was 0.1 or greater. (Except for major occupational groups.)
- Occupational employment was 0.1 or more of the total.
- The standard deviation of the injury means was 0.5 or less, except as specified in footnote 4.

[2] Excludes data for agriculture, forestry, and fisheries; private households; and the public sector.

[3] Indicates a standard deviation of mean percent injuries greater than 1.75. (Only shown for major occupational groups.)

[4] Indicates a standard deviation of mean of percent injuries between 0.25 and 1.75.

NOTE: Dashes indicate data not available, or data which did not meet publication criteria.

n.e.c. = not elsewhere classified.

tow motor operators; truckdrivers; freight and material handlers; and warehouse laborers.

Transportation and public utilities—mechanics and repairers; packers and wrappers; welders and flame cutters; delivery and route drivers; freight and material handlers; garbage collectors; and warehouse laborers.

Wholesale trade—carpenters; machinists; mechanics and repairers; plumbers and pipefitters; delivery and route drivers; forklift operators; and several nonfarm laborer jobs.

Retail trade—shipping and receiving clerks; stock clerks; carpenters; automobile and household appliance mechanics and repairers; gas station attendants; meat cutters and butchers; delivery and route drivers; forklift operators; truckdrivers; freight and material handlers; vehicle cleaners; and warehouse laborers.

Finance, insurance, and real estate—carpenters; blue-collar supervisors; mechanics and repairers; painters; gardeners and groundskeepers; and cleaning service and food service workers.

Services—stock clerks; carpenters; electricians; blue-collar supervisors; mechanics and repairers; painters; plumbers and pipefitters; laundry and dry-cleaning operatives; delivery and route drivers; truckdrivers; freight and material handlers; stock handlers; cleaning service and food service workers; and nursing aides and orderlies.

A few of these occupations show markedly high indexes—10 to 14 times the averages for the industry divisions in which they are found. In addition to the inherent danger associated with some jobs, two other factors can account for these very high indexes. First, if the injury incidence rate for the industry division is low, a hazardous occupation will have a much higher index relative to the industry division base of 1 than it would when located in a division with a high injury rate. This would explain why painters appear on the list of high-risk jobs for finance, insurance, and real estate, but not for construction.

The second factor is associated with the nature of the data used to derive the rates, and high turnover in some jobs. A single job characterized by high turnover may have several workers employed in it throughout the year. More than one of these employees could experience work-related injuries, but the average annual employment for that job would be one worker. Thus, while the job is counted only once, each injury to any of its incumbents would be reported separately.[9] □

——— *FOOTNOTES* ———

[1] Hereafter, the term injury will also encompass illnesses. The single term is used for brevity.

[2] For a discussion of differences in State coverage and reporting requirements, see Norman Root and David McCaffrey, "Providing more information on work injuries and illnesses," *Monthly Labor Review*, April 1978, pp. 16–21.

[3] A summary of the incidence rate calculation for the Annual Survey of Occupational Injuries and Illnesses is provided in *Occupational Safety and Health Statistics: Concepts and Methods*, Report 518 (Bureau of Labor Statistics, 1978).

[4] The data are from the following States: Alaska, California, Colorado, Hawaii, Idaho, Indiana, Iowa, Kentucky, Maine, Maryland, Michigan, Minnesota, Missouri, Montana, Nebraska, New Jersey, New Mexico, Oregon, South Dakota, Tennessee, Utah, Vermont, Washington, Wisconsin, and Wyoming.

[5] The Cramer's V measure of association of .076 indicates that the frequencies of injuries are similar in the 25 States for the nine occupational groups. Thus, the work injury and illness data of the 25 States were combined for use in the computation of the indexes. For a description of this test of statistical significance see *Statistical Package for the Social Sciences (SPSS) Manual* (New York, McGraw-Hill, Inc., 1975), pp. 224–25.

[6] A description of this data source is available in *National Industry Occupational-Employment Matrix, 1970, 1978, and Projected 1990*, Bulletin 2086 (Bureau of Labor Statistics, 1981). Occupations in the matrix and in the Supplementary Data System (SDS) are coded according to the 1970 Bureau of Census Alphabetical Index of Industries and Occupations. Publishable occupational employment data by State are not available from the matrix.

[7] Standard deviations were computed on the percent distributions of each occupation in each State to measure their dispersion from the mean. Occupations with standard deviations either greater than 1.75 or less than 0.25 times the mean value of the occupation were excluded from this analysis, except as noted.

[8] The reader is reminded that the occupations appearing in tables 1 and 2 are not the only ones with high indexes. Excluded from this analysis are occupations which did not meet size and dispersion criteria for publication.

[9] High turnover in specific jobs, of course, means short duration of employment, which is strongly correlated with occupational injuries. For a more complete discussion of this relationship, see Norman Root and Michael Hoefer, "The first work-injury data available from new BLS study," *Monthly Labor Review*, January 1979, pp. 76–80.