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Identifying High-Risk Small Business Industries for Occupational Safety and Health Interventions

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Background *Approximately one-third (32%) of U.S. workers are employed in small business industries (those with 80% of workers in establishments with fewer than 100 employees), and approximately 53 million persons in private industry work in small business establishments. This study was performed to identify small business industries at high risk for occupational injuries, illnesses, and fatalities.*
Methods *Small business industries were identified from among all three- and four-digit Standard Industrial Classification (SIC) codes and ranked using Bureau of Labor Statistics (BLS) data by rates and numbers of occupational injuries, illnesses, and fatalities. Both incidence rates and number of injury, illness, and fatality cases were evaluated.*
Results *The 253 small business industries identified accounted for 1,568 work-related fatalities (34% of all private industry). Transportation incidents and violent acts were the leading causes of these fatalities. Detailed injury and illness data were available for 105 small business industries, that accounted for 1,476,400 work-related injuries, and 55,850 occupational illnesses. Many of the small business industries had morbidity and mortality rates exceeding the average rates for all private industry. The highest risk small business industries, based on a combined morbidity and mortality index, included logging, cut stone and stone products, truck terminals, and roofing, siding, and sheet metal work.*
Conclusions *Identification of high-risk small business industries indicates priorities for those interested in developing targeted prevention programs.* Am. J. Ind. Med. 39:301–311, 2001. *Published 2001 Wiley-Liss, Inc.*†

KEY WORDS: small business; SIC codes; occupation; illnesses; injuries; fatalities

INTRODUCTION

Small business establishments (those employing fewer than 100 individuals) are found in all industrial segments. In fact, more than half (53 million) of the U.S. workforce in private industry is employed in small business establishments. Of these, 25 million (26%) are employed in businesses with fewer than 20 employees, and 14 million (15%) with fewer than 10 employees [Bureau of the Census, 1996] (Table I).

Costs associated with occupational morbidity and mortality in private industry are not trivial. The National Safety Council [NSC, 1997] estimates that occupational injuries and fatalities in the United States for all private industry in 1996 cost $121 billion, or $790,000 per death, and $26,000 per disabling injury. Another study places employers' costs of work-related injuries alone at $155 billion annually (based on 1990 dollars) [Miller, 1997]. Total annual costs of occupational injuries, illnesses, and fatalities in the U.S. in 1992 were estimated to exceed $170 billion [Leigh et al., 1997]. Yet occupational safety and health activities including research, regulation, enforce-

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TABLE I. Number and Percentage of Employees in Establishments with Fewer Than 100, 20, and 10 Employees, by Industry Division in 1994[a]

Industry Division	Total number of employees	<100 Employees		<20 Employees		<10 Employees	
		Number	%	Number	%	Number	%
Agriculture[b]	551,507	478,147	87	336,800	61	215,612	39
Mining	607,721	>272,655	>45[c]	>100,747	>17[c]	>47,306	>8[c]
Construction	4,709,379	3,716,851	79	2,150,840	46	1,336,954	28
Manufacturing	18,098,123	5,393,542	30	1,501,576	8	684,653	4
Transportation, communications, and public utilities	5,713,515	2,637,978	46	1,024,351	18	551,853	10
Wholesale trade	6,365,973	4,681,038	74	2,254,753	35	1,193,682	19
Retail trade	20,320,266	15,457,780	76	6,929,207	34	3,770,063	19
Finance, insurance, and real estate	7,002,431	4,149,983	59	2,262,835	32	1,388,866	20
Services	33,253,032	16,616,313	50	8,726,606	26	5,370,812	16
Total	96,733,300	>53,404,287	>55[c]	>25,287,715	>26[c]	>14,559,801	>15[c]

Source: Bureau of the Census *County Business Patterns (CBP) 1994.*

[a]Includes salary and wage-earning employees in all private industry.

[b]Agricultural services only (SIC 07).

[c]Indicates that it was not possible to determine the exact percentages in all size categories, as employment information is routinely withheld from CBP data by the Bureau of the Census to assure confidentiality of operations for some establishments. It was still possible to calculate at least the minimum percentages of workers in the desired categories for every industry.

ment, and intervention historically have not focused on small businesses despite their predominance and relatively large numbers of employees overall. Moreover, prevention of occupational injury and illness is often difficult in small business establishments because they generally have few safety and health resources, cannot hire staff devoted to safety and health activities, and often lack the ability to identify occupational hazards and conduct surveillance. The National Occupational Exposure Survey (NOES) found significant differences between small (8–99 employees) and large (500 or more employees) business establishments in the percentage with on-site occupational health units, providing medical screening tests, providing preplacement physicals, employing industrial hygiene (IH) or safety personnel, and using IH consultants [Pedersen and Sieber, 1988]. In a similar but broader survey of more than 7,000 establishments conducted by the Occupational Safety and Health Administration (OSHA) in 1990, it was determined that only 6.3% of all establishments had a medical surveillance program [ORA, 1993]. The category of smallest business establishments (1–19 employees) had the fewest with a medical surveillance program (3.8%), followed by those with 20–99 employees (14.4%), 100–249 employees (33.4%), and 250 or more employees (55.8%).

Given that more than 6.3 million (98%) of the approximately 6.5 million private industry business establishments operating in the United States are classified as small business establishments, it is difficult to know where best to utilize the limited Federal, State, and local resources available for occupational safety and health. There are, however, some industries comprised predominantly of small business establishments. These industries, referred to as ''small business industries,'' have at least 80% of their employees working in business establishments with fewer than 100 employees. Approximately one-third (32%) of the U.S. private industry workforce is employed in small business industries. Small business industries may have limited access to occupational safety and health innovations driven by large businesses and may benefit from public health assistance and intervention.

This study was undertaken to identify high-risk small business industries in order to alert the occupational safety and health community, employers, workers, insurance companies, trade associations, and others to focus prevention activities on industries that have the greatest need. Determining which small business industries have the highest risk of occupational morbidity and mortality is an important first step for developing strategies for preventing work-related injury, disease, and death among these industries. This goal is consistent with *Healthy People 2000: National Health Promotion and Disease Prevention Objectives* to ''establish in 50 states either public health or labor department programs that provide consultation and assistance to small businesses to implement safety and health programs for their employees'' [DHHS, 1990].

METHODS

Bureau of Labor Statistics (BLS) and Bureau of the Census data were used to identify and rank the highest risk

small business industries for injuries, illnesses, and fatalities in the United States. Small business industries were defined as those Standard Industrial Classification (SIC) codes [OMB, 1987] for which at least 80% of the employees in an industry were employed in business establishments with fewer than 100 employees. To remain consistent with a previously recognized NIOSH classification, a small business establishment is considered a regional or branch office, storage facility, family-operated store, or any other business with fewer than 100 employees at a single site. Although definitions for small business establishments vary, this definition is comparable to that used by other agencies and small business interest groups [NIOSH, 1999]. The numbers of workers employed and, therefore, at risk in these SIC codes were obtained from the Bureau of the Census *County Business Patterns (CBP), 1994* [Bureau of the Census, 1996]. The top 25% high-risk small business industries were ranked based on both total cases and incidence rates of occupational nonfatal injuries, illnesses, and fatalities separately. Small business industries were also ranked based on a combined risk index achieved by combining information on nonfatal injuries, illnesses, and fatalities into a single index. The following formula was used to calculate the combined risk index score: Combined risk index score = [(injury ranking score)+(illness ranking score)+(fatality ranking score)], where for each small business industry, a score was assigned from zero to five based on the individual ranking of the industry for injury, illness and fatality incidence rates. Rankings of 1–5 for injury, illness, or fatality rates were assigned a score of five; 6–10, a score of four; 11–15, a score of three; 16–20, a score of two; and 21–26, a score of one. All small business industries not ranked in the top 25% for injuries, illnesses, or fatalities were assigned scores of 0. A second combined risk index score was calculated according to the above formula, except that the ranking score for fatalities was assigned a weighting factor of two. This weighting factor was used to emphasize the severity of fatalities in the combined index. Due to space limitations, only information on the top 10 high-risk small business industries, derived based on the two combined risk indices scores, is reported in this paper. A more detailed discussion of the rankings is presented in a NIOSH publication [NIOSH, 1999].

Occupational injury and illness data by SIC codes were obtained from the BLS annual *Survey of Occupational Injuries and Illnesses (SOII), 1995* [BLS, 1997]. The *SOII* is a scientifically selected probability sample of 250,000 establishments, and is designed to provide detailed industry information on nonfatal occupational injuries and illnesses. The establishments included in the survey were selected as representative of their industrial classification and workforce size. Data for coal, metal and nonmetal mining, and railroad transportation are provided by the Mine Safety and Health Administration (MSHA) and the Federal Railroad Administration. Excluded from the survey are self-employed individuals and workers on farms with fewer than 11 employees. Estimates of the number and rates of nonfatal occupational injuries and illnesses are based on logs kept by private industry employers in accordance with record-keeping guidelines of the U.S. Department of Labor. The BLS survey data on nonfatal occupational morbidity are reported by industry as the total number of cases and the incidence rates per 100 full-time workers for injuries, illnesses, and injuries and illnesses combined.

In the *CBP* as well as in the occupational injury and illness data prepared by the BLS, data are not consistently available for each of the more than 900 four-digit SIC codes. The BLS annual *SOII* is designed to provide information at the four-digit SIC level for manufacturing industries only and at the three-digit level for all other industries. In several cases, data are available only at the two-digit level. Despite the decreasing specificity of activities and hazards at the two- and three-digit SIC code level, occupational morbidity and mortality data presented for small business industries at these levels were considered important and included for this study when information at the four-digit level was not available.

The number of occupational fatal injuries occurring within specific SIC codes were obtained from the BLS annual *Census of Fatal Occupational Injuries (CFOI), 1994* [BLS, 1995]. For each SIC code, a fatality rate was calculated according to the following equation: Fatality rate = [(number of fatal work injuries/number employed) (100,000 workers)]. *CFOI* includes information on fatalities among self-employed, agricultural, and other workers not included in the *CBP*. Therefore, to calculate the fatality incidence rate, these fatality cases were subtracted from the total number of fatality cases for each SIC to be consistent with the *CBP* (which was used to determine the number of persons employed by SIC).

RESULTS

In total, 253 SIC codes were identified as meeting the definition of a small business industry. This group covers approximately 4 million establishments and 30 million workers, roughly one-third of all employees in U.S. private industry. The 253 small business industries identified by SIC codes include the following: one industry at the two-digit SIC level, 102 industries at the three-digit SIC level, and 150 at the four-digit SIC level. Of those at the four-digit SIC level, 96 were contained within a broader (three-digit) small business industry.

Occupational injury, illness, and fatality data were available for only 105 of the small business industries. This included one industry at the two-digit level, 88 industries at the three-digit level, and 16 industries at the four-digit level. Given that the *SOII* is designed to provide information at the

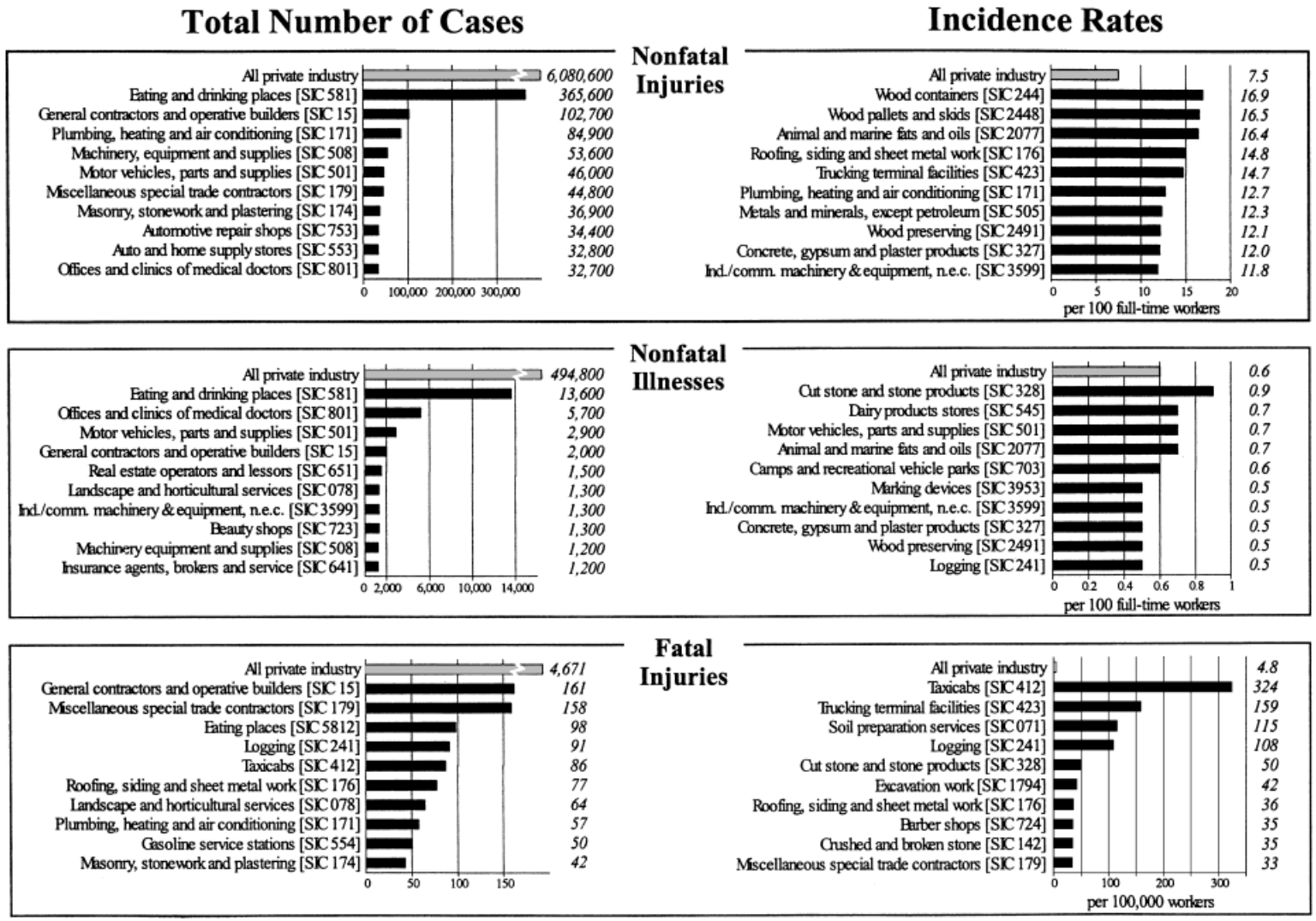

FIGURE 1. Total cases and incidence rates for the top ten small business industries by occupational injuries, illnesses, and fatalities.

four-digit SIC level for manufacturing industries and at the three-digit SIC level for all other industries, data were not available for many small business industries at the four-digit SIC code level. The lack of data for some SIC codes may also be due to the small numbers of events (injuries, illness, or fatalities) reported for these industries. Figure 1 shows the top 10 high-risk small business industries ranked according to each of the following measures: total cases and incidence rates for nonfatal injuries; total cases and incidence rates for nonfatal illnesses; and total cases and incidence rates for fatalities. For each measure, a value for all private industry is shown for comparative purposes.

The top 10 (and even the top quartile) of small business industries had incidence rates for nonfatal injuries above the private industry average rate of 7.5 per 100 full-time workers (Fig. 1). Manufacturing of wood containers [SIC 244], and its subcategory, wood pallets and skids [SIC 2448], followed by the manufacture of animal and marine fats [SIC 2077] had the highest rates of nonfatal injuries at 16.9, 16.5, and 16.4, respectively. When considering the actual number of workers affected by nonfatal injuries, the largest numbers occurred among eating and drinking establishments [SIC 581] with 365,000 cases; general contractors and operative builders [SIC 15] with 102,000 cases; and plumbing, heating, and air conditioning [SIC 171] with 84,900 cases of nonfatal injuries.

Only four of the 105 small business industries had incidence rates for occupationally related illnesses above the average rate for all private industry (0.6 per 100 full-time workers) (Fig. 1). These included cut stone and stone products [SIC 328; Incidence Rate (IR) = 0.9]; dairy products stores [SIC 545; IR = 0.7]; motor vehicles, parts, and supplies [SIC 2077; IR = 0.7]; and manufacture of animal and marine fats and oils [SIC 2077; IR = 0.7]. The largest numbers of occupational illnesses occurred among employees at eating and drinking establishments [SIC 581] with 13,600 cases, offices and clinics of medical doctors [SIC 801] with 5,200 cases, and motor vehicles, parts, and supplies [SIC 501] with 2,900 cases reported.

To further investigate the possible causes of morbidity among the highest risk small business industries, the authors also reviewed data for the 10 small business industries with the highest incidence rates for lost worktime due to occupational injuries and illnesses (Table II). The leading causes of lost worktime injuries and illnesses were examined according to nine categories: contact with objects (including struck by, struck against, and caught in machinery or equipment); slips and falls; overexertion (including lifting); repetitive motion; exposure to harmful substances or environments; transportation accidents; fires and explosions; assaults and violent acts; and all other events. Contact with objects was the leading cause of lost worktime injury in 9 of the 10 small business industries, accounting for an average of 36.4% (range 21.2–61.2%) of lost worktime morbidity. Contact with objects was also the leading cause of lost worktime morbidity for all private industry, accounting for 27.5% of these injuries and illnesses. Overexertion was the second leading cause, accounting for an average of 21.2% (range 5.3–34%) of lost worktime morbidity in the top 10 small business industries, and 27.4% of those injuries and illnesses in all private industry. Overexertion was the leading cause of lost worktime morbidity in trucking terminal facilities [SIC 423]. The third leading cause of lost worktime morbidity was slips and falls, accounting for 19.9% (range 3.4–24%) in the top 10 small business industries and a similar amount (19%) in all private industry. Based on these patterns, the causes of lost worktime morbidity in small business industries seem to reflect those of all private industry. Interestingly, only small percentages of lost worktime morbidity were attributed to transportation accidents (~3–4%, range 0–8.9%) and assaults and violent acts (~0–1%, range 0–1.4%) in both small business industries and all private industry, while these events were the leading causes for occupational fatalities.

The top 10 (and the top quartile) of small business industries all had fatality rates above the average rate for all private industry (4.8 per 100,000 workers) (Fig. 1). The highest rates were found among taxicabs [SIC 412; IR = 324], trucking terminal facilities [SIC 423; IR = 159], soil preparation services [SIC 071; IR = 115], and logging [SIC 021; IR = 108]. The largest numbers of occupational fatalities, however, occurred among general contractors and operative builders [SIC 15] with 161 fatalities; miscellaneous special trade contractors [SIC 179] with 158 fatalities; and eating establishments [SIC 5812] with 98 work-related fatalities.

There were 62 small business industries for which the data indicated that at least one occupational fatality had occurred. Transportation incidents were the leading cause of deaths in 26 of the 62 small business industries. This pattern persists for all private industry where transportation incidents accounted for 41% of all work-related fatalities. Transportation incidents include events involving vehicles, powered industrial vehicles or powered mobile industrial equipment in which at least one vehicle (or mobile equipment) is in normal operation in the course of work. Assaults and violent acts were the leading cause of deaths in 17 small business industries, predominantly in the retail and service sector. Homicides by shooting accounted for approximately 80% of all fatalities due to assaults and violent acts. Contact with objects and equipment was the leading cause of fatalities in six small business industries predominantly in the construction and logging industries. Construction was also the predominant industry for fatalities from falls, being the leading cause of fatalities in six additional small business industries. Table III shows the breakdown of the leading causes of fatalities occurring

TABLE II. Small Business Industries Ranked by Lost Worktime Injury and Illness Incidence Rate, with Percentages by Major Events/Exposures Contributing to Work-Related Injuries and Illnesses for 1995

					Percent								
Rank	SIC	Industry name	Incidence rate (per 100 full-time workers)	Total lost worktime injuries and illnesses	Transportation incidents	Assaults and violent acts	Contact with objects	Slips and falls	Exposure to harmful substances	Fires and explosions	Overexertion	Repetitive motion	All other events
—	—	Private industry	3.6	2,040,929	4	1	28	19	5	< 1	27	4	12
1	2077	Animal/marine fats and oils	9.3	455	—	—	25	10	25	—	19	—	—
2	423	Trucking terminal facilities	8.8	293	9	—	21	22	7	—	30	3	7
3	244	Wood containers	8.4	3,113	< 1	—	61	3	—	—	22	2	8
4	176	Roofing, siding and sheet metal work	7.8	11,702	2	—	29	25	9	—	22	1	11
5	241	Logging	6.7	4,533	4	—	54	16	—	—	5	—	20
6	327	Concrete, gypsum, and plaster products	6.0	10,125	6	< 1	34	19	5	< 1	21	2	12
7	505	Metals and minerals, except petroleum	5.8	5,604	4	—	42	13	3	—	22	3	14
8	2491	Wood preserving	5.6	506	16	—	32	8	—	—	19	7	17
9	141	Dimension stone	5.6	190	—	—	50	13	—	—	34	—	—
10	174	Masonry, stonework and plastering	5.5	17,522	1.0	—	33	24	3	—	25	2	13

Source: Bureau of Labor Statistics *Survey of Occupational Injuries and Illnesses, 1995.*

Note: Numbers within the event/exposure columns represent percentage of fatalities within the SIC associated with that event or exposure. Dashes (—) indicate no data reported or data that do not meet publication criteria. Percentages may not add to 100 where data are missing.

TABLE III. Small Business Industries Ranked by Work-Related Fatality Incidence Rate, with Percentages by Major Event/Exposure Contributing to Work-Related Fatalities for 1994

					Percent					
Rank	SIC	Industry name	Incidence rate (per 100,000 workers)	Fatal injuries [SEP][a]	Transportation incidents	Assaults/ violent acts	Contact with objects and equipment	Falls	Exposure to harmful substances/ environments	Fires and explosions
—	—	Private industry	4.8	4671 [1252]	41	20	16	10	10	3
1	412	Taxicabs	324	86 [17]	12	86	—	—	—	—
2	423	Trucking terminal facilities	159	7 [—]	43	—	—	—	—	—
3	071	Soil preparation services	115	5 [—]	100	—	—	—	—	—
4	241	Logging	108	91 [39]	19	—	79	—	—	—
5	328	Cut stone and stone products	50	6 [—]	—	—	—	—	—	—
6	1794	Excavation work	42	39 [8]	36	—	53	—	—	—
7	176	Roofing, siding and sheet metal work	36	77 [12]	9	—	6	67	15	—
8	724	Barber shops	35	5 [—]	–	100	—	—	—	—
9	142	Crushed and broken stone	35	13 [—]	39	—	39	—	—	—
10	179	Miscellaneous special trade contractors	33	158 [24]	20	—	31	32	9	6

Source: Bureau of Labor Statistics *Census of Fatal Occupational Injuries, 1994*.

[a] The number in the brackets [SEP] refers to the number of additional fatalities associated with self-employed persons for each SIC.

Note: Numbers within the event/exposure columns represent percentage of fatalities within the SIC associated with that event or exposure. Dashes (—) indicate no data reported or data that do not meet publication criteria. Percentages may not add to 100 where data are missing.

within the top 10 high-risk small business industries based on the incidence rates for work-related fatalities.

Morbidity and mortality measures combined into a single index, first without the weighting factor and then with a weighting factor (2) for fatalities, are presented in Figure 2. The highest risk small business industries identified in both indices include: logging [SIC 241]; cut stone and stone products [SIC 328]; trucking terminal facilities [SIC 423]; camps and recreational vehicle parks [SIC 703]; animal and marine fats and oils [SIC 2077]; roofing, siding, and sheet metal work [SIC 176]; landscape and horticultural services [SIC 078]; and concrete, gypsum, and plaster products [SIC 327]. Using the unweighted formula, industrial and commercial machinery and equipment, NEC [SIC 3599] and wood preserving [SIC 2491] also rank in the top 10. In the weighted calculations, taxicabs [SIC 412], miscellaneous special trade contractors [SIC 179], and wood containers [SIC 244] rank in the top 10. Based on the 1994/1995 BLS data, the 13 small business industries indicated in Figure 2 accounted for 182,000 occupational injuries (3% of all private industry injuries), 45,400 occupationally related illnesses (9% of all private industry illnesses), and 667 occupational fatalities (11% of all private industry fatalities).

DISCUSSION

By drawing from the available data on the injury, illness, and fatality experience for various industries, it was possible to determine which small business industries involve the highest risks to the health and safety of workers. This study serves as a starting point for identifying the small business industries that are most likely to require additional attention and intervention to improve health and safety conditions. It also points out the lack of information for many small business industries, indicating a need for better surveillance of these industries.

The morbidity and mortality indices are presented both as the total number of cases and the incidence rates. The total counts of injury, illness, and fatality cases by industry indicate the numbers of employees affected by hazards within given SIC codes. These counts also focus attention on industries in which interventions and hazard controls could affect the greatest number of employees. For example,

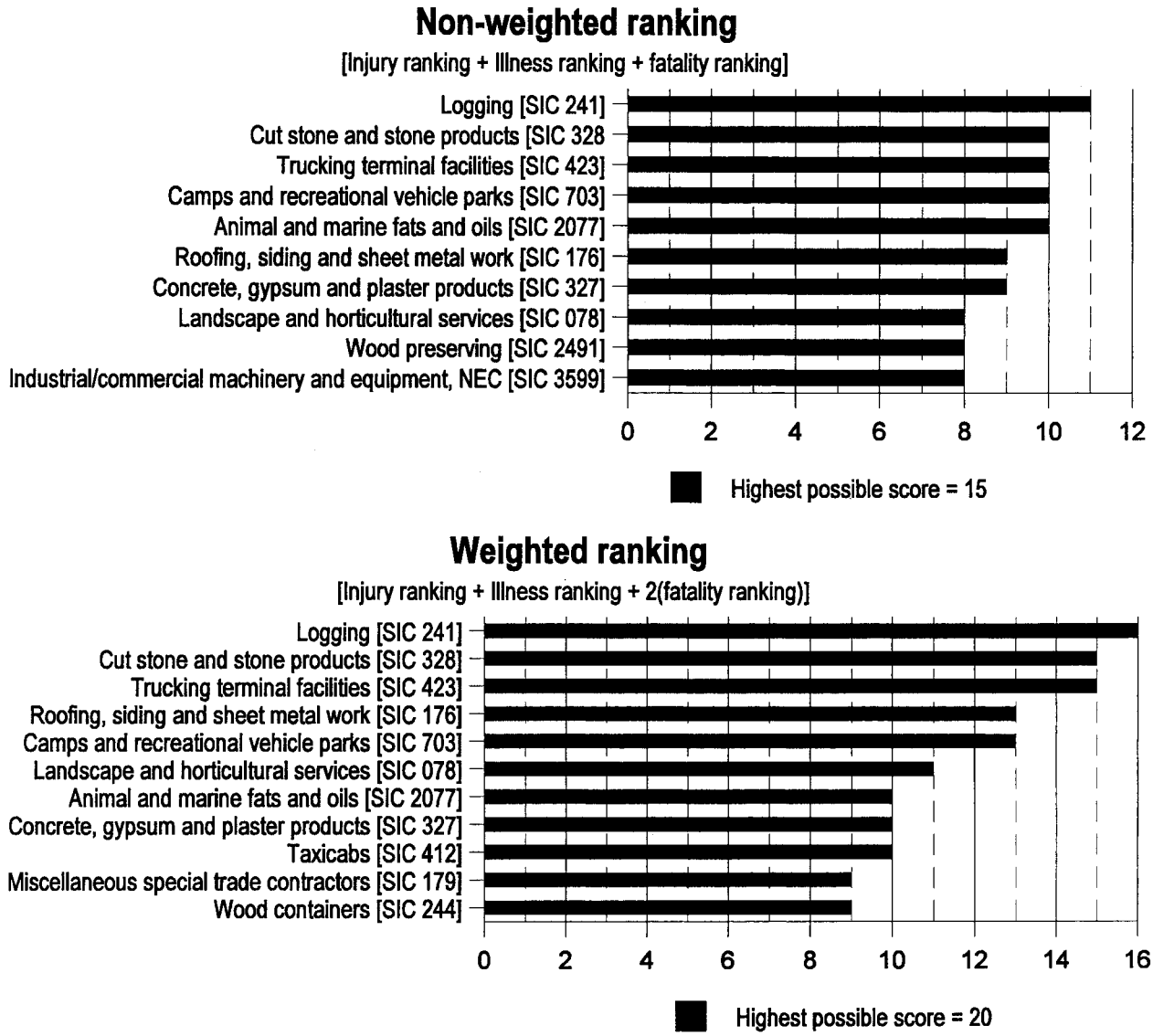

FIGURE 2. High-risk small business industries ranked by combined hazard risk indices scores.

eating and drinking places [SIC 581] lead all other small business industries in number of nonfatal injuries (365,600) and illnesses (13,600), and are third for occupational fatalities (125); this SIC is also the largest small business industry, with over 449,000 establishments and more than 6.9 million employees. Because the total number of cases does not account for differences in the number of employees in various SIC codes, it does not allow risk comparisons across SIC codes. However, the incidence rates represent the number of employees affected divided by the number of employees in a given SIC per 100 full-time employees for nonfatal injuries and illnesses and per 100,000 employees for fatal injuries. Therefore, manufacturing of wood containers [SIC 244], which experienced 8,100 nonfatal injuries in 1995—16.9 cases per 100 full-time employees, ranks first among all small business industries in comparison with eating and drinking places [SIC 581] which experienced an injury IR of 7.4 cases per 100 full-time employees and does not rank in the top 25% of the highest risk small business industries for nonfatal injuries. Although incidence rates allow for comparisons across small business industries, they may be highly influenced by small numbers. Therefore, for the most complete representation of the risks associated with each small business SIC code, both total number of cases and incidence rates should be considered.

As a means of considering the three measures of occupational risk together, two combined risk indices scores were calculated by adding the scores assigned to the rankings of small business industries by incidence rates for nonfatal injuries, illnesses, and fatal occupational injuries.

The first risk index score was based on the combined total of the ranking for an industry based on three morbidity/mortality measures. The second risk index score was calculated the same way, except with a weighting factor of two for fatalities to emphasize the severity of this outcome. Although the weighting factor of two for fatalities is subjective, it appears reasonable based on the recognition that injuries are the most common measure reported, illnesses are grossly under-reported, and fatalities are the least common and most severe consequence of exposure to occupational hazards. The combined risk indices scores (with or without a weighting factor) are not intended as the paramount measures for ranking and comparing small business industries. However, the scores reflect SIC codes that appear more frequently in the top 25% of the highest risk small business industries based on reported injury, illness, and fatality experience. The rankings by these indices may be useful in prioritizing which industries and specific SIC codes deserve further investigation to identify and characterize hazards and to develop strategies for their prevention and control. In the rankings by the two combined risk indices scores, many of the small business industries had tied rankings. Possible suggestions for breaking the ties would be to consider the number of workers in the competing small business industries and to give higher priority to the industry with the greatest number of employees; to consider the total cases of occupational injury, illness, and fatal occupational injury and give priority to the industries in which more cases of occupational morbidity and mortality are reported; or to investigate further the nature of occupational morbidity to determine the severity using lost worktime, total compensation costs by industry, average cost per injury or illness, the degree of disability associated with the injuries, and other information.

Costs of job-related injuries and illnesses have also been used previously as an index for ranking industries. Total cost by industry and average cost per employee have been calculated from BLS data for 1985–1986 for eight broad industry divisions and up to as many as 395 specific industries at the three-digit SIC level [Leigh and Miller, 1999]. Of the top 20 most costly three-digit codes based on the total costs by industry annual average (1986 dollars), seven were small business industries identified among the top 10 highest risk small business industries for either nonfatal injury, illness, or fatal occupational injury in this report: Trucking and Truck Terminals [SIC 423], rank = 1 ($241.1 million); Eating and Drinking Places [SIC 581], rank = 2 ($205.8 million); Miscellaneous Special Trade Contractors [SIC 179], rank = 7 ($84.8 million); Plumbing, Heating and Air Conditioning [SIC 171], rank = 8 ($80.2 million); Logging Camps and Contractors [SIC 241], rank = 10 ($76.7 million); Machinery, Equipment, and Supplies [SIC 508], rank = 19 ($61.1 million); and Masonry, Stonework, and Plastering [SIC 174], rank = 20 ($59.5 million). The comparability of the rankings with those of this study is noteworthy, as nearly 10 years separate the comparison periods for which the data were collected (1985–1986 vs. 1994–1995).

An assessment of fatal causes of death in the workplace using BLS data from 11 states between 1979 and 1986 [Leigh, 1995] also was consistent with this report. Of the 10 industries identified with the highest fatality rates, six were among the top 10 small business industries for occupational fatalities in this report: logging [SIC 241] with 186 deaths; cut stone and stone products [SIC 328] with 103 deaths; taxicabs [SIC 412] with 102 deaths; crushed and broken stone [SIC 142] with 37 deaths; trucking and truck terminals [SIC 421] with 32 deaths; and miscellaneous special trade contractors [SIC 179] with 32 deaths per 100,000 full-time employees. The similarities between these reports indicate that many small business industries continue to experience high numbers and rates of occupational fatalities.

This investigation of high-risk small business industries does not evaluate the variations in injury, illness, and fatality counts and rates by establishment size within industries. According to the *SOII, 1995*, the nonfatal occupational injury IR for all private industry was 7.5 cases per 100 full-time employees, with the following incidence rates by establishment size groups: one to ten employees averaged 3.0 injury cases per 100 full-time workers; 11 to 49 employees averaged 6.5 cases; 50 to 249 employees averaged 9.6 cases; 250 to 999 employees averaged 8.5 cases; and 1,000 or more employees averaged 7.8 cases per 100 full-time workers. Generally, this pattern holds true in each of the major industry divisions, with the smallest establishments (1–10 employees) recording the lowest injury and illness rates, the medium size establishments (50–249 employees) recording the highest rates, and rates for the largest establishments falling somewhere between. This pattern contradicts that seen with fatal occupational injuries, where small business establishments experience the highest rates [Mendeloff and Kagey, 1990]. Drawing from the *CFOI* data for all industries in 1994, the BLS noted that at least one-third of all work-related fatalities occurred in establishments with fewer than 20 employees, at least half occurred in establishments with fewer than 100 employees, and for 38% of occupational fatalities the establishment size was not known [BLS, 1995]. Differences between incidence patterns for nonfatal and fatal occupational injury events have been attributed to under-reporting of occupational injuries by small business establishments [Oleinick et al., 1995]. Further investigation and better surveillance may be required to obtain more accurate measures of injury and illness for industries within the various established size categories. This type of inquiry is a logical next step and could provide useful insight about work processes, equipment, controls, level of training, and other factors that

influence worker safety and health and that may differ by establishment size.

While the goals of this analysis (first, to identify small business industries, and second, to determine those with the highest risk of occupational injury, illness, and fatality) were straightforward, the means for accomplishing these goals have limitations. *CBP, 1994* was chosen as the most comprehensive recent survey of U.S. businesses for providing employment information by SIC codes at the four-digit level. Even so, this survey does not include information about self-employed workers, domestic service employees, agricultural production workers, and several other work groups. Employees in the public sector not covered in the survey may include many workers in small business settings and operations. Newer industries, such as many of those associated with communication and information technology, are not specifically recognized under the present SIC system and therefore cannot be characterized using the existing national databases. In addition, non-traditional employees, such as mobile or multi-location employees, temporary employees, contractual workers, family members, or volunteers, are not likely to be included in conventional surveys of the workforce. Addressing these information gaps would more accurately characterize all small business industries, some of which may have been excluded from this investigation as a result of these deficiencies.

Similar limitations were associated with the *1995 SOII* which also excludes self-employed workers and farms with fewer than 11 employees. Again, this survey was chosen because it provides the most recent data characterizing the occupational injury and illness experience of industries identified from the *CBP, 1994*. The annual BLS survey is one of the best instruments for characterizing occupational morbidity; yet under-reporting of work-related injuries and illnesses is likely due to economic incentives, lack of familiarity with reporting requirements, or other factors [Ruser and Smith, 1991; Nelson et al., 1992; Leigh, 1995].

Characterizing hazards associated with small business industries is further complicated by the lack of data on occupational injuries, illness, and fatalities for many of the small business industries at the three- and four-digit SIC level. However, the data are sufficient to characterize the risk within small business industries experiencing the greatest number of occupational injuries, illnesses, and fatalities. The difficulties expressed here emphasize the challenge of accurately characterizing small business industries and identifying associated occupational hazards. In spite of these limitations, this research contributes important information for targeting those industries with the greatest need for occupational safety and health services and interventions.

The difficulties in preventing occupational injuries and illnesses in small businesses should not be underestimated. There are formidable obstacles such as the lack of resources and trained occupational safety and health personnel within these facilities. In addition, occupational regulations may be confusing for some small businesses. Prior to developing and implementing occupational interventions within high-risk small business industries, there is need to assess the specific hazards within each industry. Data collected by the BLS and other government agencies (e.g., the NIOSH National Traumatic Occupational Fatality surveillance system) provide a good starting point, especially as surveillance methods evolve to include new and under-represented industry segments and seek to address limitations of data collection. These data may be supplemented with the use of non-conventional surveillance tools such as workers' compensation insurance records, hospital registries, searches of media and Internet-based news sources. The communication of safety and health information based on hazard recognition can be accomplished through outreach and partnership programs with trade groups, labor unions, industry representatives, State and local government agencies and health departments. As a direct result of this study, NIOSH developed a resource guide for small businesses [NIOSH, 2000] with references and contacts (phone numbers, addresses, Web Sites) providing relevant safety and health information for small business owners and managers. Successful interventions must be developed and implemented in partnership with the affected businesses. In these partnerships, hazard control, prevention, and training can be addressed. The OSHA Construction Accident Reduction Emphasis (CARE) program is an example of an intervention program involving laborers groups, churches, regional colleges, and construction contractors in developing and communicating safety messages at construction sites in Florida to curb a rash of fatalities in construction, a predominantly small business industry. Effective interventions will require creative approaches such as the utilization of product stewardship programs, OSHA consultation programs, and partnerships with trade associations, suppliers, and other associations representing small business industries.

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