Occupational Injuries, Illnesses, and Fatalities Among Workers in the Services Sector Industries

2003 to 2007

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Objective: Provide descriptive statistics and discuss priorities for injury and fatality risks among services sector workers. **Methods:** Bureau of Labor Statistics Survey of Occupational Injuries and Illnesses and Census of Fatal Occupational Injuries data for 2003 to 2007 were analyzed to identify occupational injury and fatality risks for services sector industry groups. **Results:** Many services sector industry groups experienced, on average, greater than one occupational fatality per week, and survey of occupational injuries and illnesses days-away-from-work rates in excess of those for all US workers. Overall, transportation incidents and homicides are leading factors contributing to fatalities. **Conclusions:** These results indicate the need for adoption of safety and health prevention practices in numerous industry groups. For groups that experience elevated injury and fatality rates, priorities for research and intervention can be identified through these data.

The National Occupational Research Agenda (NORA) services sector includes many industry groups with elevated numbers and rates of occupational injuries and traumatic injury fatalities. (NORA) uses a framework of industry sectors from the North American Industrial Classification System (NAICS), a system which categorizes U.S. industries based on the goods or services they provide.[1] A total of eight NORA sectors, most with a combination of multiple industry sectors, were designated and national research and intervention agendas have been posted on the National Institute for Occupational Safety and Health (NIOSH) internet site. The purpose of this study was to identify priorities for research and interventions across the NORA services sector through the tabulation and evaluation of occupational injury and fatality data between the years 2003 and 2007.

The NORA services sector was formed by the NIOSH as a combination of the following 11 North American Industry Classification System (NAICS) industrial sectors: information (NAICS 51); finance and insurance (52); real estate and rental (53); professional, scientific, and technical (54); management of enterprises (55); administrative support and waste services (56); education (61); arts, entertainment, and recreation (71); traveler accommodation and food services (72); other services except public administration (81); and public administration (92). The services sector is the largest of the eight NORA sectors employing more than 68 million workers,[2] which is more than 50% of the US workforce. Work environments and occupational hazards vary greatly within the services sector, ranging from many industry groups with relatively low annual injury and illness counts and rates to others with much higher injury and illness counts, rates of days-away-from-work (DAFW) injuries, and large fatality counts.

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METHODS

Data Sources

Data used for these analyses were collected and tabulated by the US Bureau of Labor Statistics (BLS),[1–3] which are available to the public through BLS Web sites.[4] They include establishment-based employment data collected by the occupational employment statistics (OES) program; occupational nonfatal injury and illness data from the annual Survey of Occupational Injuries and Illnesses (SOII), and fatal traumatic injury data from the Census of Fatal Occupational Injures (CFOI). The OES and SOII are population-based surveys and CFOI is a complete census of occupational fatalities.

Employment Data

The OES program is a Federal/State cooperative program that surveys approximately 200,000 establishments by mail every 6 months, taking 3 years to fully collect the sample of 1.2 million establishments.[5,6] The OES survey covers all full-time and part-time wage and salary workers in nonfarm industries, yet it excludes self-employed, owners, and partners in unincorporated firms, household workers, and unpaid family workers. Data on wage and salary workers are collected to produce national estimates of employment and wage for about 800 occupations and more than 450 industries. Workers are categorized into 22 major occupational groups and in one of 801 detailed occupations according to the 2000 version of the Standard Occupational Classification (SOC). The SOC major group excluded from the OES survey consists of military-specific occupations.[7] Industry classifications correspond to the two-, three-, four-, and five-digit NAICS industrial classes.[3] The NAICS levels are defined as sectors, subsectors, industry groups, and industries, respectively.

Nonfatal Occupational Injury and Illness Data

Between 2003 and 2007, the Federal/State SOII program statistics were collected annually from about 176,000 private industry establishments.[8] The program requires employers to report summary injury and illness information from their Occupational Safety and Health Administration record-keeping logs. These logs contain data for all disabling, serious, or significant injuries and illnesses, whether or not time-away-from-work was required. Nature, event, source, and part of body are also collected by SOII for cases resulting in at least 1 DAFW. These characteristics are coded according to the Occupational Injury and Illness Classification System.[3] The SOII also collects data for the number of employee hours worked and average employment to calculate prevalence rates and to classify establishment size. The survey began using version 2002 NAICS codes to classify industry in 2003. The SOII excludes all work-related fatalities as well as nonfatal work injuries and illnesses involving self-employed workers; workers on farms with 10 or fewer employees; private household workers; and Federal, State, and local government workers.[3] Days-away-from-work were used in this analysis because they represent more serious injuries and illnesses, are likely to be

reported more consistently, and have additional characteristic information that is useful for identifying intervention needs.

Occupational Fatality Data

The CFOI is a Federal/State cooperative program in all 50 states and the District of Columbia, Puerto Rico, and the Virgin Islands. Data for CFOI have been collected since 1992 for all occupational traumatic injury fatalities regardless of age, industry, or workers' compensation coverage. The BLS defines fatal work-related injury as those fatalities occurring to noninstitutionalized persons, who were working at the time of the incident, and on the premises of their employer or other places while on active duty. Multiple information sources are used by BLS to identify, verify, and profile fatal worker injuries. Information about each workplace fatality—occupation and other worker characteristics, source of injury, and circumstances of the event—is obtained by cross-referencing source records, such as death certificates, workers' compensation reports, and Federal and State agency administrative reports. To ensure that fatalities are work related, cases are substantiated with two or more independent source documents, or a source document and a follow-up questionnaire.[3]

Counts are available for private and public sector fatalities and can be reported separately or combined. In addition, wage and salary worker fatalities are available for industry groups. Fatality rates are published by BLS only for those occupations and industries that had at least 30 fatalities and 40,000 employed in 2003, the base year.[9] As a result, fatality rate estimates are published for only 14 of the three-, four-, and five-digit services sector NAICS codes.[10] Instead of these limited data, we calculated rates for industry groups with wage and salary worker fatality counts as numerators and OES population estimates as denominators.

Surveillance

Employment Data

May 2007 employment estimates by two-digit NAICS sectors and major occupational groups of SOC within each industry code were copied from public use data sets of OES.[2] In addition, the OES 2007 estimates for employment within four-digit NAICS industry groups were tabulated for those services sector industries with published annual SOII rates for at least 4 of 5 years, 2003 to 2007, or with noncensored wage and salary worker fatality values in each of the years.

Occupational Injury and Illness Data

The Prevention Index (PI), in which the count and rate rankings of injuries and illnesses within a data set are reduced to a combined score, can be used to guide priorities for occupational safety and health resources.[11] First developed in Washington State with workers' compensation data,[12] the method is duplicated here with industry-group-specific estimates from SOII. The data utilized in the analysis were the set of annual SOII DAFW counts and rates for NORA services sector industry groups that had estimates for at least 4 years between 2003 and 2007. Estimates for SOII were tabulated using BLS Profile Web site.[4] To determine the PI, industry group DAFW rates and counts for each year were separately ranked from highest to lowest. The average of the industry group annual ranks was determined for both rates and counts. For each industry group, the PI was calculated as the average of the rank orders of both rates and counts and then rank ordered from lowest to highest. In cases where one-yearly SOII rate estimate was missing, the average rank from the other 4 years was used. Missing counts were imputed as the average of the other four counts for that industry group.

Occupational Fatality Data

The BLS CFOI annual data were tabulated for the 92 unique four-digit NAICS industry groups in the NORA services sector for 2003 to 2007. In addition, Justice, Public Order, and Safety Activity (also known as "Public Safety, NAICS 9221") worker fatal injuries at Federal, State, and local levels were tabulated in each year. Fatal injuries in the remaining public administration groups at the three levels of government are the differences between their total fatalities and those experienced by the public safety workers. All together, fatality data for 98 industry classes were evaluated. Publicly available CFOI data from 2003 to 2007 were downloaded for each industry group using the BLS Profiles Web-based data system.[4] Because CFOI does not report cells with fewer than three deaths, only those services industry groups with uncensored counts in each of the 5 years were tabulated and listed in order of frequency. Fatalities due to transportation events and homicides are prevalent in services sector industry groups, so we tabulated fatalities for the industry groups with higher counts or proportions of deaths due to these events as a way to identify intervention needs.

The CFOI fatality rates are published for only a few of the services industries, so they are not presented here.[10] Instead, occupational fatality rates were calculated for industry groups as the average number of wage and salary worker fatalities for 2003 to 2007 divided by the estimated number of wage and salary workers from 2007 OES and expressed as the number of fatalities per 10,000 workers.

RESULTS

Employment Data

Table 1 displays 2007 OES estimates of employment by occupation class for the industries that make up the NORA services sector. Nearly 50% of the 68 million workers in the NORA services sector are employed in three industry sectors: education ($n = 12{,}455{,}550$, 18%) (NAICS 61), accommodations and food services ($n = 11{,}341{,}810$, 17%) (72), and public administration ($n = 9{,}533{,}390$, 14%) (92). All two-digit NAICS sectors include diverse populations across SOC classes with few null values in the cross tabulations. The largest SOC classes in the NORA services sector are administrative support (12.7 million, 19%), food (10.2 million, 15%), and education (7.8 million, 11%). Only education and food services sectors have greater than 50% of workers from a single major occupational class. Because OES counts the number of workers at establishments, multiple jobholders can be counted more than once.

Nonfatal Occupational Injury and Illness Data

Fifty of the 92 four-digit NAICS industry groups in the NORA services sector had SOII DAFW rate estimates tabulated for at least 4 of the 5 years between 2003 and 2007 (Table 2). Annual ranks for most industry groups were relatively stable from year to year; the average industry group range of ranks was less than 8. The greatest ranges of ranked annual values for industry groups were 25 for personal and household goods repair and maintenance (NAICS 8114) and 22 for commercial and industrial machinery and equipment rental (NAICS 5324).

The median DAFW for the highest-ranking NORA services sector industry groups (Table 2) ranged from 5 to 18 days in 2007. Over half of the ranked industry groups have median DAFW values of 7 or less. Those with median DAFW values greater than 11 are recreational vehicle parks and recreational camps (median = 18), dry cleaning and laundry services (15), death care services (15), waste treatment and disposal (12), and wired telecommunications carriers (12). The leading events or exposures listed by SOII for the injuries in these industry groups include contact with objects and equipment, falls on same level, and overexertion (data not shown).

TABLE 1. Cross Tabulation of Estimated Employment by Standardized Occupational Classifications Groups in the NORA Services Sector NAICS Sectors, 2007[2]

Occupation Code	Occupation Class	NAICS*											
		51	52	53	54	55	56	61	71	72	81	92	Total
11	Management	202,230	462,540	197,760	525,430	324,040	235,330	535,740	65,090	283,190	177,010	510,670	3,519,030
13	Finance/business	161,600	1,329,030	102,610	902,280	334,540	286,990	222,460	37,050	38,940	201,670	971,200	4,588,370
15	Computer/ mathematical	407,870	308,270	13,460	1,048,550	188,470	147,260	182,330	5,340	2,580	26,750	223,590	2,554,470
17	Engineering	65,210	3,060	4,920	915,720	49,550	80,540	21,340	1,650	380	6,870	283,850	1,433,090
19	Science/technology	29,480	29,210	5,240	354,440	33,690	29,220	168,330	4,410	1,090	12,500	280,360	947,970
21	Social	230	3,280	1,920	6,380	15,170	12,650	264,590	340	440	95,830	475,350	876,180
23	Legal	6,550	55,320	8,050	606,680	21,900	25,320	3,280	430	190	8,390	241,390	977,500
25	Education	15,510	1,600	440	19,550	5,730	34,640	7,391,910	30,300	550	75,670	217,610	7,793,510
27	Entertainment/ media/arts	466,610	19,750	11,820	324,100	31,880	53,050	204,950	186,740	16,520	81,550	58,520	1,455,490
29	Health care	1,380	31,750	7,880	147,010	24,920	201,040	241,960	6,690	4,570	9,660	413,300	1,090,160
31	HC support	0	2,270	4,380	70,920	7,830	103,190	34,050	5,530	7,540	29,840	141,650	407,200
33	Protection service	5,260	12,220	34,340	12,400	9,840	691,090	106,640	74,500	66,390	45,360	1,834,700	2,892,740
35	Food	45,380	1,560	22,730	4,740	16,090	111,440	457,160	315,630	9,026,350	104,040	106,020	10,211,140
37	Building maintenance	11,900	15,190	160,560	43,020	16,450	1,693,730	535,070	190,570	600,840	107,340	246,390	3,621,060
39	Personal care	57,120	1,040	23,230	30,770	9,980	69,610	215,310	533,140	140,880	704,360	274,290	2,059,730
41	Sales	402,510	753,130	535,700	344,900	107,600	520,780	36,770	154,010	336,650	235,640	65,970	3,493,660
43	Administrative support	693,680	2,940,480	497,010	1,849,400	560,880	1,886,690	1,336,150	184,490	419,280	603,620	1,737,470	12,709,150
45	Farm	0	170	1,050	5,570	1,300	18,150	2,980	4,330	530	1,080	27,520	62,680
47	Construction	4,830	1,730	27,380	62,030	11,180	313,600	41,270	9,600	4,220	14,420	461,190	951,450
49	Installation/ maintenance	296,730	13,130	324,960	76,830	44,320	204,400	147,260	68,560	97,680	664,180	381,500	2,319,550
51	Production	77,250	3,020	12,180	112,780	33,560	792,370	21,610	7,150	78,060	324,970	165,380	1,628,330
53	Transport/material handling	67,470	3,180	145,470	55,560	66,330	995,600	284,400	37,850	214,930	350,670	415,460	2,636,920
	Total	3,018,800	5,990,930	2,143,090	7,519,060	1,915,250	8,506,690	12,455,560	1,923,400	11,341,800	3,881,420	9,533,380	68,229,380

NAICS, North American Industry Classification System; NORA, National Occupational Research Agenda.

*NAICS industrial sectors: information (NAICS 51); finance and insurance (52); real estate and rental (53); professional, scientific, and technical (54); management of enterprises (55); administrative support and waste services (56); education (61); arts, entertainment, and recreation (71); traveler accommodation and food services (72); other services except public administration (81); and public administration (92).

TABLE 2. Four-Digit NAICS Services Sector Industry Groups Ranked by the Average Annual Rank of Survey of Occupational Injuries and Illness (SOII) Days-Away-From-Work (DAFW) Rates

NAICS	Industry Group	Year					Average of Sum*	Rank of Average of Sum	2007 Median DAFW
		2003	2004	2005	2006	2007			
5621	Waste collection	1	1	1	1	1	1	1	9
5622	Waste treatment and disposal	3	3	2	3	2	2.6	2	12
5323	General rental centers	6	4	7	NA	6	5.75	3	7
5617	Services to buildings and dwellings	7	6	9	5	3	6	4	6
5629	Remediation and other waste management	4	NA	13	2	5	6	4	9
7131	Amusement parks and arcades	5	2	5	6	18	7.2	6	7
7212	RV parks and recreational camps	2	9	6	7	12	7.2	6	18
8113	Commercial and industrial machineries equipment repair and maintenance	12	5	10	4	NA	7.75	8	NA
7223	Special food services	NA	10	4	13	7	8.5	9	7
5321	Automotive equipment rental and leasing	9	7	3	14	13	9.2	10	6
7211	Traveler accommodation	10	12	11	10	8	10.2	11	7
5311	Lessors of real estate	11	16	12	9	17	13	12	11
7111	Performing arts companies	17	11	20	19	4	14.2	13	11
7132	Gambling industries	14	13	18	15	11	14.2	13	8
8123	Dry cleaning and laundry services	15	14	17	12	16	14.8	15	15
7113	Promoters performing arts, sports, and similar events	16	8	21	24	10	15.8	16	4
8114	Personal and household goods repair and maintenance	8	33	8	21	9	15.8	16	6
7139	Other amusement and recreations services	19	20	14	18	15	17.2	18	5
8111	Automotive repair and maintenance	18	19	19	20	14	18	19	9
5313	Activities related to real estate	13	15	15	29	19	18.2	20	5
5171	Wired telecommunications carriers	NA	22	23	17	20	20.5	21	12
5324	Commercial and industrial machineries and equipment rental	25	24	22	8	30	21.8	22	10
5152	Cable and other subscription programming	24	17	26	22	21	22	23	11
7222	Limited-service eating places	20	29	24	16	23	22.4	24	5
8122	Death care services	23	23	29	11	26	22.4	24	15
8129	Other personal services	21	18	27	23	25	22.8	26	3
5322	Consumer goods rental	22	21	28	NA	22	23.25	27	10
5616	Investigation and security services	28	25	16	25	24	23.6	28	7
5111	Newspaper, periodical, book, and directory publishers	30	27	25	28	28	27.6	29	8
7221	Full-service restaurants	27	26	33	26	31	28.6	30	5
6111	Elementary and secondary schools	26	34	30	30	27	29.4	31	6
8112	Electronic and precision equipment repair and maintenance	29	31	32	27	29	29.6	32	2
6113	Colleges, universities, and professional schools	31	30	31	32	32	31.2	33	7
5121	Motion picture and video industries	35	32	NA	35	33	33.75	34	8
5413	Architectural, engineering, and related services	34	38	34	34	37	35.4	35	5
5151	Radio and television broadcasting	37	37	36	36	34	36	36	5
5312	Offices of real estate agents and brokers	33	35	NA	40	36	36	36	7
6112	Junior colleges	39	39	38	31	35	36.4	38	4
6116	Other schools and instruction	NA	28	39	37	43	36.75	39	6
6115	Technical and trade schools	32	45	35	33	39	36.8	40	9
8121	Personal care services	40	36	37	41	42	39.2	41	4

(*Continued*)

TABLE 2. (*Continued*)

NAICS	Industry Group	Year					Average of Sum*	Rank of Average of Sum	2007 Median DAFW
		2003	2004	2005	2006	2007			
5241	Insurance carriers	36	41	41	39	41	39.6	42	4
5417	Scientific research and development	38	40	NA	38	44	40	43	6
5182	Data processing, hosting, and related services	42	42	40	42	40	41.2	44	11
5221	Depository credit intermediation	41	43	42	43	38	41.4	45	7
5242	Agencies, brokerages, and insurance related	44	47	43	45	NA	44.75	46	NA
5222	Nondepository credit intermediation	45	44	44	47	45	45	47	2
5412	Accounting, tax preparation, bookkeeping, and payroll	46	46	45	44	NA	45.25	48	NA
5411	Legal services	43	48	46	46	NA	45.75	49	NA
5231	Securities and commodity contracts intermediation and brokerage	47	49	47	48	46	47.4	50	9

NA, not available; NAICS, North American Industry Classification System; RV, recreational vehicle.
*Average of annual rank of SOII rates within the 50 services sector industry groups with estimates in 4 or 5 of the years, 2003 to 2007.

The highest 25 PI ranks for the NORA services sector industry groups are listed in Table 3. The list includes seven large industry groups, each with greater than 1 million workers, and three relatively small industry groups with fewer than 100,000 workers each. The average population of the ranked industry group size is 1.26 million workers. The NAICS sectors with the largest number of ranked industry groups in Table 3 are as follows: 53—real estate and rental ($N = 5$); 56—administrative support and waste services ($N = 5$); 72—traveler accommodation and food services ($N = 4$); 71—arts, entertainment, and recreation ($N = 3$); and 81—other services except public administration ($N = 3$). The two industry groups with the highest PI rankings are NAICS 5617—services to building and dwellings and NAICS 7211—traveler accommodations.

Occupational Traumatic Injury Fatality Data

The total 2003 to 2007 fatality count for the NORA services sector at the two-digit NAICS level is 7740, which is more than 27% of all US occupational fatalities for those years (data not shown). The sum of all reported services sector fatalities at the industry group or four-digit level is 7614. The difference, 126 fatalities, is dispersed among the censored values in the more detailed industry group data sets. It is noteworthy that fatality counts for some industry groups include private and public sector employees, for example, Waste Collection and Elementary and Secondary Education.

Overall, 33 of the NORA services sector industry groups recorded 50 or more total fatalities for the 5-year period (Table 4). Twenty-two of these groups (67%) reported greater than 100 fatalities for the 5-year period. The greatest number of fatalities ($n =$ 1047, 14%) occurred in the services to buildings and dwellings industry group (NAICS 5617). The majority of these fatalities ($n =$ 847, 81%) were recorded in landscaping services (NAICS 56173) industry. Most of the fatalities that occurred in services to buildings and dwellings were due to transportation incidents ($n = 297$, 28%), falls from elevation ($n = 268$, 26%), contact with objects and equipment ($n = 233$, 22%), especially struck by falling objects ($n = 147$, 14%), and contact with electric current ($n = 98$, 9%).

Fatalities for public safety, which includes law enforcement, firefighting (may also operate emergency medical services), and corrections, had the second highest total with 839 deaths for 2003 to 2007 (Table 4). Approximately 70% of these fatalities ($N = 585$) were among local police protection (NAICS 92212) and 26% for fire protection ($N = 215$) (NAICS 92216). For both police protection and fire protection personnel, nearly one half of their fatalities were due to transportation events. About 40% of local law enforcement fatalities were attributed to homicides.

Automotive repair, solid waste collection, and limited-service eating establishments industry groups each experienced more than 260 fatalities, or an average of one death per week. Fatalities in automotive repair were primarily due to assaults and violent acts, contact with objects and equipment, and transportation. Solid waste collection fatalities mostly resulted from transportation incidents and contact with objects and equipment. Limited-service eating establishment fatalities were mostly homicides.

Estimated fatality rates for salary and wage workers by industry group also are presented in Table 4. This table includes only those industry groups with greater than 50 total fatalities and with fatalities tabulated in each year, 2003 to 2007. Rates were calculated while using the 2007 OES estimates of the salary and wage worker populations within industry groups as denominators. When using the OES denominators, our method produced an overall 2007 fatality rate of 0.33 per 10,000 salary and wage workers. The occupational fatality rate for all US wage and salary workers published by CFOI for 2007 was 0.34 per 10,000 workers[10] (The published CFOI rates are calculated using Current Population Survey [CPS] denominator data).

Twelve services sector industry groups experienced more than 50 total fatalities and fatality rates greater than the 2007 US average rate for wage and salary workers of 0.34 per 10,000 workers, according to our calculations. The three highest fatality rates for wage and salary services sector workers were in the private sector waste management and remediation industry (NAICS 562). The majority of these fatalities occurred in transportation incidents. Religious organizations also experienced an elevated fatality rate. Most of these fatalities were due to highway incidents and falls to lower levels. Services to buildings and dwellings led all industry groups with 1047 fatalities and their fatality rate for wage and salary workers was about 2 times the US average.

Among most services sector industry groups that averaged more than 20 total fatalities per year, transportation events were the leading cause of fatalities (Table 5). The largest number of transportation-related fatalities occurred in services to buildings and dwellings ($n = 297$) and local police protection industries ($n = 287$).

TABLE 3. Prevention Index (PI) for NORA Services Sector Industry Groups ($N = 25$) With the Highest Combined Rankings of Days-Away-From-Work (DAFW) Injury and Illness Counts and Rates

SOII PI Rank	NAICS	Industry Group	Count Rank	Rate Rank	Average Count*	2005 Rate
1	5617	Services to buildings and dwellings	1	4	26,752	174.7
2	7211	Traveler accommodation	4	11	21,634	166.0
3	5621	Waste collection	16	1	4,562	353.5
4	5311	Lessors of real estate	7	12	7,300	160.5
4	7223	Special food services	9	10	5,853	204.8
6	5622	Waste treatment and disposal	22	2	2,842	281.7
6	7139	Other amusement and recreations services	6	18	8,028	150.1
6	8111	Automotive repair and maintenance	5	19	10,082	122.5
9	7222	Limited-service eating places	2	23	25,940	95.0
10	8113	Commercial and industrial machine and equipment repair and maintenance	21	6	2,970	169.9
11	5321	Automotive equipment rental and leasing	20	9	3,056	220.6
12	5629	Remediation and other waste management services	26	5	2,108	156.9
12	7131	Amusement parks and arcades	24	7	2,122	202.9
14	5171	Wired telecommunications carriers	11	21	5,468	111.4
14	5313	Activities related to real estate	12	20	5,336	134.9
16	7221	Full-service restaurants	3	30	24,588	73.1
16	8123	Dry cleaning and laundry services	18	15	4,034	126.5
18	5616	Investigation and security services	8	28	6,606	131.2
19	5323	General rental centers	37	3	1,198	181.6
20	7132	Gambling industries	27	14	1,902	124.2
21	5111	Newspaper, periodicals, book, and directory publishers	14	29	5,194	94.7
22	5413	Architectural, engineering, and related services	10	35	5,724	52.2
23	6113	Colleges, universities, and professional schools	13	33	5,300	77.5
24	5322	Consumer goods rental	23	26	2,260	91.4
25	6111	Elementary and secondary schools	19	31	3,736	83.8

NAICS, North American Industry Classification System; NORA, National Occupational Research Agenda; SOII, Survey of occupational injuries and illnesses.
*Average of the SOII number of DAFW injuries for either 4 or 5 years of 2003 to 2007.

The proportion of transportation fatalities was particularly high in technical and trade schools (97%), newspaper, periodicals, book and directory publishers (81%), waste collection (71%), architectural, engineering and related services (67%), waste treatment and disposal (57%), and spectator sports (53%). Remarkably, 106 of 109 transportation fatalities in technical and trade schools were associated with aircraft crashes during flight training.[13]

Homicides were also a leading cause of occupational fatalities in a number of services sector industry groups during 2003 to 2007 (Table 6). Local law enforcement experienced the largest number of homicides (232), which accounted for approximately 40% of their fatalities. The industry group with the second largest number of homicides (172) was limited-services eating establishments. Three food and beverage industry groups combined account for a total of 399 homicides between 2003 and 2007. The largest proportion of all fatalities due to homicides (83%) was observed in the personal care services industry group. The proportion of homicides attributed to robbery was the highest in these industry groups: Nondepository credit intermediation (69%), limited-service eating places (56%), traveler accommodation (40%), and investigation and security services (40%).

DISCUSSION

This review, which relied on BLS data systems between 2003 and 2007, reveals elevated occupational injury and fatality risks for many US services sector workers, although data are limited for many of the industry groups. Fatality counts are quite high for landscape services workers and local government public safety workers. Automotive repair, solid waste collection, and limited-service eating establishments industry groups also totaled greater than 260 fatalities, or an average of one or more deaths per week. The PI method, as applied with BLS SOII DAFW data, identified elevated risks for nonfatal injuries and illnesses in many of the 92 industry groups in the services sector. The largest numbers of ranked industry groups were in real estate and rental (NAICS 53), administrative support and waste services (NAICS 56), and traveler accommodation and food services (NAICS 72). Many of the ranked industry groups from the PI analysis also experienced more frequent fatalities.

Combinations of rates and counts for occupational injuries and illnesses help to direct priorities in health and safety prevention programs.[11,14,15] The PI-ranked industries are based on injury and illness rates and counts from Washington State workers' compensation data.[12] A similar method is applied here with the SOII counts and rates for services sector industry groups but is limited to those that had published data for at least 4 years between 2003 and 2007. The PI gives equal weight to count and rate ranks and frequently these ranks differ. The different patterns of count and rate ranks have been suggested as guides for public health prevention strategies.[16]

Using the PI, the services sector industry groups with greater DAFW injury and illness risks are more prevalent in real estate and rental (NAICS 53); administrative support and waste services (56); traveler accommodation and food services (72); arts, entertainment, and recreation (71); and other services (81). Hazards across these industry sectors are highly diverse, yet the surveillance data for injuries are generally consistent with US industry as a whole.

TABLE 4. NORA Services Sector Four-Digit NAICS Industry Groups With 50 or More Total Occupational Injury Fatalities Between 2003 and 2007; Number of Traumatic Injury Fatalities Per Year, Total Traumatic Injury Fatalities, Total Traumatic Injury Fatalities Among Wage and Salary Workers, and Average Annual Traumatic Injury Fatality Rates for Wage and Salary Workers

NAICS	Industry	Year					Total Fatalities (% of Total)	Total Wage and Salary Fatalities	Fatality Rate,* Per 10,000 Workers Per Year†
		2003	2004	2005	2006	2007			
5617	Services to buildings and dwellings	193	208	221	222	203	1047 (14)	703	0.76
—	Local government public safety	175	164	148	147	205	839 (11)	839	‡
8111	Automotive repair and maintenance	87	86	79	79	61	392 (5)	233	0.53
—	Local government except public safety	96	80	75	69	52	372 (5)	372	‡
5621	Waste collection	73	48	52	54	39	266 (3)	205	2.99
7222	Limited-service eating places	61	48	46	52	59	266 (3)	222	0.11
5616	Investigation and security services	36	50	34	40	49	209 (3)	200	0.51
—	State government except public safety	35	46	43	36	40	200 (3)	200	‡
6111	Elementary and secondary schools	44	37	33	43	32	189 (2)	24	0.01
5613	Employment services	19	27	46	32	58	182 (2)	180	0.10
5413	Architectural, engineering, and related services	27	42	41	32	38	180 (2)	155	0.22
7221	Full-service restaurants	39	29	27	47	36	178 (2)	128	0.06
—	State government public safety	40	21	39	37	40	177 (2)	177	‡
5111	Newspaper, periodicals, book, and directory publishers	30	34	37	25	43	169 (2)	150	0.46
7139	Other amusement and recreation services	33	38	31	28	32	162 (2)	132	0.24
7224	Drinking places (alcoholic beverages)	33	34	26	31	27	151 (2)	109	0.62
7211	Traveler accommodation	28	22	24	36	29	139 (2)	121	0.14
5311	Lessors of real estate	21	24	19	39	28	131 (2)	89	0.30
7112	Spectator sports	26	31	23	20	25	125 (2)	75	1.11
8131	Religious organizations	18	31	21	25	28	123 (2)	117	‡
6113	Colleges, universities, and professional schools	14	33	26	18	23	114 (1)	36	0.03
6115	Technical and trade schools	27	24	23	18	17	109 (1)	74	1.09
5629	Remediation and other waste management services	17	18	28	13	17	93 (1)	81	1.41
5622	Waste treatment and disposal	18	22	12	18	21	91 (1)	75	1.52
8113	Commercial and industrial machineries and equipment repair and maintenance	19	13	21	21	16	90 (1)	63	0.69
—	Federal government except public safety	16	12	17	19	10	74 (1)	74	‡
8121	Personal care services	10	13	20	9	19	71 (1)	28	0.09
8123	Dry cleaning and laundry services	16	14	10	5	16	61 (1)	42	0.25
5313	Activities related to real estate	17	11	8	8	15	59 (1)	47	0.18
5312	Offices of real estate agents and brokers	13	12	11	9	7	52 (1)	36	0.24
5221	Depository credit intermediation	11	12	10	10	9	52 (1)	51	0.06
5411	Legal services	14	3	12	12	11	52 (1)	§	§
7121	Museums, historical sites, and similar institutions	7	8	15	8	12	50 (1)	§	§

NAICS, North American Industry Classification System; NORA, National Occupational Research Agenda.
*Fatality rate for salary and wageworkers in private sector with OES population estimate as denominator.
†Fatality rate for all US wage and salary workers using this method is 0.33 per 10,000 full-time equivalent worker.
‡Reliable denominator not available.
§Number of fatalities among wage and salary workers is not reported in one of the years.

TABLE 5. Services Sector Industries With Greatest Number of Transportation Fatalities, CFOI 2003 to 2007

NAICS	Industry	Transportation Fatalities (*n*)	Total Fatalities	Proportion, %
6115	Technical and trade schools	106	109	97.2
5111	Newspaper, periodicals, book, and directory publishers	137	169	81.1
5416	Management, scientific, and technical consulting	33	44	75.0
5621	Waste collection	189	266	71.1
5413	Architectural, engineering, and related services	120	180	66.7
—	Police protection—state	64	109	58.7
5622	Waste treatment and disposal	52	91	57.1
7112	Spectator sports	66	125	52.8
—	Police protection—local	287	585	49.1
—	Fire protection—local	101	215	47.0
7223	Special food services	22	47	46.8
6111	Elementary and secondary schools	86	189	45.5
6113	Colleges, universities, and professional schools	51	114	44.7
7139	Other amusement and recreations services	66	162	40.7
8131	Religious organizations	47	123	38.2
5613	Employment services	67	182	36.8
5616	Investigation and security services	76	209	36.4
5629	Remediation and other waste management services	28	93	30.1
5617	Services to buildings and dwellings	297	1047	28.4
7222	Limited-service eating places	55	266	20.7
8111	Automotive repair and maintenance	73	392	18.6

CFOI, Census of Fatal Occupational Injuries; NAICS, North American Industry Classification System.

TABLE 6. Services Sector Industries With Greatest Number of Homicides for 2003 to 2007

NAICS	Industry	Total Fatalities	Homicides, *N* (% of Total)	Homicides Due to Robbery*, *N* (% of Total)
—	Police protection—local	585	232 (40)	NA
7222	Limited-service eating places	266	172 (65)	97 (36)
7224	Drinking places (alcoholic beverages)	186	122 (66)	<22 (<12)
7221	Full-service restaurants	178	105 (59)	39 (22)
8111	Automotive repair and maintenance	392	78 (<20)	<19 (<5)
5616	Investigation and security services	209	60 (29)	24 (11)
8121	Personal care services	71	59 (83)	<23 (<32)
7211	Traveler accommodation	139	52 (<37)	<15 (<11)
5311	Lessors of real estate	131	45 (<34)	<15 (<11)
5617	Services to buildings and dwellings	1,047	30 (<3)	<15 (<2)
—	Police protection—state	109	27 (25)	NA
5222	Nondepository credit intermediation	42	26 (<62)	<19 (<45)

NAICS, North American Industry Classification System.
*Number of homicides attributed to robber as secondary source. Usual primary source is bullet. Less-than sign (<) indicates that data were missing from the tabulations for one or more of the years for this group.

Contact with equipment and objects, falls on same level and from heights, transportation incidents, and assaults and violent acts are the most frequent events and exposures associated with the injuries, although the order of prevalence and severity differs among the groups. Functional limitations from the injuries can be severe with values for the median DAFW as high as 18.

The SOII data collection included a nationally representative sample of establishments of all sizes and industries in the private sector (before 2008) but excluded self-employed, farms with fewer than 11 employees, private households, US postal service, and public sector establishments.[3] The SOII publishes estimates for total cases and cases that result in reassignment or transfer, plus DAFW cases with additional detailed nature, event, part of body, and source and demographic variables. We chose to use DAFW data in this analysis because they represent more serious injuries and illnesses and the additional information that is available helps identify research and intervention needs. The SOII also collects data on employment levels that are used for rate calculations and classifying establishment size.[3]

Cases reported to SOII are those that should appear on establishment Occupational Safety and Health Administration injury and

illness record-keeping logs, that is, those injuries and illnesses that require medical treatment beyond first aid, result in job restrictions or the employee being reassigned or transferred to a different position, or cause the employee to miss work for at least 1 day after the date of injury or illness.[3] Recent reports have expressed concerns about underreporting of occupational injuries and illnesses in the SOII data.[8,17–21]

Only 50 of the 92 NAICS industry groups in the services sector met the "4 of 5-year criterion" for inclusion in the PI-ranked data set. A few industry groups, which were excluded because of limited SOII data, namely cable and other program distribution (NAICS 5175) and spectator sports (NAICS 7112), also experienced rates and counts that were elevated in at least 2 of the 5 years, but the data were deemed insufficient for generalizability. Appropriate research and intervention needs may, nonetheless, be high priorities for those industry groups and additional surveillance with BLS SOII data for many higher-risk groups is warranted.

The BLS published NORA services sector CFOI rates for 2003 to 2007 for only seven subsectors (three-digit NAICS codes), five industry groups (four-digit), and two industries (five-digit). These groupings are consistent with Census Codes.[10] Because of the small number of available rates, they are not presented here. Instead, we calculated fatality rates for industry groups as the ratio of the average annual number of CFOI wage and salary worker fatality counts to the 2007 OES population estimates of wage and salary workers in the industry groups. Nevertheless, OES excludes workers who may constitute significant portions in some services sector industry groups such as self-employed, unincorporated partnerships, household workers, and unpaid family members. To make the comparisons as accurate as possible, we used wage and salary worker fatality counts as numerators. The OES can differ substantially from CPS industry group estimates.[3] The magnitude of differences in the population estimates can approach a factor of 2, with either system at times having a larger estimate. Because OES counts the number of workers at establishments, multiple jobholders can be counted more than once within an industry. For example, the CPS household survey estimate of employment for landscaping industry (NAICS 56173) is 1.276 million employees in 2007 whereas OES establishment-based survey estimates 681,010 employees. In contrast, CPS estimates 8.3 million employees in food services whereas OES estimates 9.5 million employees. Where OES might underestimate populations within groups, our rates would be higher than actual. Where OES overestimated populations, our estimates would be lower than actual. (CFOI has begun publishing rates on the basis of estimated hours worked for better comparisons among groups.[3])

Primary causes of occupational traumatic injury fatalities among services sector employees are transportation incidents, assaults, and violent acts, contact with objects and equipment, and falls—similar to what is seen with DAFW injuries and illnesses. The numbers and rates of fatalities among many services sector industry groups were elevated over the 5-year period, especially for landscape services, public safety, automotive repair, and the solid waste management industry as a whole. Previous researchers, using data from the Fatality Analysis Reporting System between 1992 and 2001, reported that the services industry accounted for the second highest number of motor vehicle–related deaths in the United States ($n = 1884$).[22] Transportation occupational fatalities and traumatic injuries can be prevented through effective comprehensive safety and health programs and interventions such as mandatory seat belt use policies, fatigue management, adequate allowance for transit times, and training for operation of specialized vehicles.[23] Recent studies have identified best practice approaches with respect to vehicle selection, integrated training and education, and incentives for crash-free driving.[24] We found that the highest number of transportation fatalities came from the services to buildings and dwellings industry group ($n = 297$), specifically, landscaping services. Transportation safety may be overlooked in the landscaping industry because many of these companies are family-owned and operate in a small business setting.[25]

The second highest number of transportation fatalities came from the local police protection industry group ($n = 287$). Traffic-related incidents have been the leading cause of occupational death among our nation's law enforcement officers for the last 13 years and the number of traffic-related deaths significantly increased between 2009 and 2010.[26] The exact reasons for these findings are unknown, but several factors could play a role. First, training in high-speed and other risky driving situations is inconsistent for law enforcement nationwide.[27] Second, research has demonstrated that there are situations where the wearing of a seat belt may interfere with the job responsibilities of a police officer, such as exiting a patrol car quickly or having the belt interfere with firearm access.[28] These point to areas of future intervention research into effective seat belt redesign or various continuing education training programs.[27]

Fatality risks from assaults and violent acts are evident in the homicide data reported by CFOI. Homicides averaged more than 20 per year in local police protection ($n = 232$), limited-services eating places (172), drinking places (122), and full-service restaurants (105). Workplace violence is a pervasive problem—approximately 50% of all workplace homicides nationwide occurring within the services sector population. Robbery is frequently associated with homicides in limited-services eating establishments. Yet, some services industry group proportions of homicides associated with robbery are relatively low such as drinking places (<18%), full-service restaurants (37%), and automotive repair and maintenance (<24%). Reductions in fatalities in these industry groups will require effective interventions, which are dependent on the types of violence that are present.

The elevated incidence of homicide among services sector workers has been reported in other studies. Tiesman et al[27] reported that 1072 law enforcement officers died as a result of homicide between 1992 and 2002, 5.6 officers per 100,000 workers. A significantly higher proportion of these deaths were among male officers. Women in the accommodation and food services industry have significantly higher workplace homicide rates than women in other industries.[29] Between 1980 and 1992, the locations with the highest risk of homicide were grocery stores, eating and drinking establishments, hotels and motels, and justice and public order.[30] The latter three of these groupings are in the services sector and homicide rates continue to be elevated in each. Factors such as working alone, working at night, and assisting customers have been shown to increase the risk for workplace homicide and these conditions are common in many services sector industry groups.[31] Workplace violence is also common among young workers, minority workers, and immigrants.[32–34]

The full spectrum of occupational risks among services sector workers cannot be characterized with available BLS injury, illness, and fatality data. In the BLS data, acute disorders, such as skin diseases, respiratory conditions, and poisoning, are more likely reported than chronic illnesses such as cancers, which have long latencies between occupational exposure and clinical diagnosis.[3] Nationally representative surveillance systems do not exist for most chronic outcomes.[35–37]

Several factors apart from occupational risks may contribute to some of our findings. For example, health disparities exist among workers in many services sector industries and numerous factors contribute to these disparities. Lack of health insurance may be the largest and the most important contributor.[38] Even workers' compensation insurance is not universally available or utilized for occupational injuries and illnesses.[21] Other studies show that blue-collar workers, older workers, and Hispanic workers, many of whom are employed in the services sector, have some of the lowest rates of

preventive screenings for chronic diseases and highest rates of uncorrected visual and/or hearing impairment.[39,40]

The methods used in this analysis have at least four notable limitations. First, neither industry groups nor major occupation classes can be used as sensitive or specific indicators of exposure to occupational hazards. More detailed information is needed to match jobs with tasks that are associated with recognized hazards or to identify emerging hazards. Second, OES estimates of all full- and part-time employees used as fatality rate denominators exclude self-employed individuals, owners, and partners in unincorporated firms, household workers, or unpaid family workers.[5] These exclusions may be significant because many small, unincorporated businesses exist in the services sector. Actual fatality rates may be lower than reported here for industry groups that employ a substantial number of workers through small, unincorporated entities. Third, SOII counts and rates are not available for public administration before data collection for calendar year 2008, so they are omitted from this analysis. An additional 48 four-digit industry groups in the services sector were omitted because of missing SOII estimates for more than 1 year. Additional SOII data on rates and counts for total occupational injuries and illnesses that result in reassignment or job transfer are available but are not reported here. Fourth, sufficient surveillance information does not exist for chronic occupational disease and illness.

CONCLUSIONS

The risks for occupational injuries, illnesses, and fatalities are elevated for many industry groups in the services sector and intervention strategies developed for these and other industries should be more widely utilized. Publically available data from BLS can be used to evaluate many risks even though the injury and illness data have been reported to undercount actual events [8,17–21] and, on the whole, the illness data are less useful than fatality and injury data. It is necessary to "drill down" in the data to best evaluate risks for specific industries and occupations and to identify the attendant intervention needs. Although aware of the many caveats, the NORA services sector used these data in conjunction with stakeholder input and expert knowledge to establish a set of priority occupational safety and health research and intervention goals. The sector will continue to monitor these data sources and others that are available to evaluate the appropriateness of the strategic and intermediate goals in the National Services Agenda.[41]

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