

# Fatalities in the Landscape and Horticultural Services Industry, 1992–2001

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**Background** Although landscape and horticultural services workers have high injury and illness rates, little is known about fatalities in this industry.

**Methods** Census of Fatal Occupational Injuries and Current Population Survey data were analyzed to determine fatality rates and causes of landscaping deaths from 1992 to 2001.

**Results** There were 1,101 fatalities during the 10-year period and the average fatality rate was 13.50 deaths per 100,000 full-time employees. In 2001, the landscaping fatality rate was 3.33 (95% CI 2.84–3.91) times the all industry rate. The leading causes of death were transportation incidents (27%), contact with objects or equipment (27%), falls (24%), exposure to harmful substances and environments (18%), and assaults and violent acts (4%). The fatality rate for African American landscapers was 1.51 (95% CI 1.25–1.83) times the rate for white workers. Fatalities were also common among self-employed, small business, and young landscapers.

**Conclusions** Landscaping workers are at increased risk of fatal injury. Further research is needed to characterize industry hazards. *Am. J. Ind. Med.* 51:701–713, 2008.

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**KEY WORDS:** occupation; work; census of fatal occupational injuries; fatal injury

## INTRODUCTION

According to the Bureau of Labor Statistics (BLS), there were approximately 918,000 workers employed in the landscape and horticultural services (landscaping) industry in 2001 [BLS, 2006]. This industry, Standard Industrial Classification (SIC) 078, is part of the SIC major group agricultural services within the agriculture, forestry, and fishing division. It includes workers in three SIC subgroups:

landscape counseling and planning (SIC 0781), lawn and garden services (SIC 0782), and ornamental shrub and tree services (SIC 0783). These workers provide a wide variety of services and include groundskeepers, arborists, landscapers, tree trimmers, gardeners, and others.

An Occupational Health and Safety Administration (OSHA) analysis of injury and illness data from the BLS found that landscaping workers have high injury and illness rates. From 1993 to 2001, the rates for total cases and cases with lost workdays were higher for landscape and horticultural services than for private industry as a whole. In 2004, the total case rate was 7.0 cases per 100 full-time employees (FTE) in SIC 078 compared to 5.7 in all private industry. The rates for cases with lost workdays were 3.8 and 2.8 cases per 100 FTE in SIC 078 and all private industry, respectively. In addition, nearly half of the injuries involving days away from work caused injured workers to be off the job for more than 5 days [OSHA, 2006].

Some studies have investigated fatal injuries in industries or occupations related to landscape and horticultural services. The National Institute for Occupational Safety and Health (NIOSH) found that at least 207 persons

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occupationally engaged in tree trimming died from 1980 to 1989, most often due to electrocutions and falls [NIOSH, 1992]. The fatality rate for groundskeepers and gardeners more than doubled from 7.3 per 100,000 FTE in 1992 to 15.0 per 100,000 FTE in 2002, despite a declining fatality rate in all private industry and a decrease in groundskeeper injury and illness cases during this period [Pegula, 2005]. In a study of the ornamental shrub and tree services industry, Wiatrowski [2005] reported an average of 58 fatalities per year from 1992 to 2002.

Although high injury and illness rates have been observed in the landscape and horticultural services industry, there are surprisingly few data characterizing fatalities among these workers. Studies examining fatalities in various landscaping-related groups indicate that rates may be increasing. This study utilizes a national fatality surveillance database to assess rates and prevalent causes of fatal injuries in the landscaping industry.

## MATERIALS AND METHODS

### Data Sources

Data collected by the BLS' Census of Fatal Occupational Injuries (CFOI) were analyzed to describe fatalities in the landscaping industry from 1992 to 2001. The CFOI program began in 1992 and is a Federal/State cooperative program with participating agencies in all 50 States, the District of Columbia, and New York City. CFOI staff cross-reference a variety of sources to gather information on work-related fatal injuries, including OSHA reports, media accounts, death certificates, workers' compensation reports, police reports, and Federal and State agency administrative reports [BLS, 2007]. BLS requires two source documents or one source document and a follow-up questionnaire to validate the occupational nature of each fatal injury. States have up to 1 year to update their occupational fatality counts to ensure complete reporting.

The following CFOI variables were extracted from the microdata: reference year, month of injury, day of injury, time of incident, days survived after injury, nature of injury or illness, part of body injured, event, source, secondary source, worker activity, location, Census Bureau region, occupation, industry of employer, establishment size, employee status, length of service time with employer, gender, age group, race, Hispanic or Latino origin, foreign region of birth, and narratives describing how the injuries occurred. Each fatality record in the database includes data for these variables, which are classified using CFOI-defined category codes. If no category accurately describes the fatality circumstance, it is listed as not elsewhere classified (nec). Values are coded as not reported when data are insufficient to classify the fatality with respect to a variable.

For the period of 1992–2001, CFOI classified occupation using the 1990 version of the Census Occupation Classification System (COCS). The Occupational Injury and Illness Classification Structures (OIICS) classify the event, source, secondary source, nature of injury, and part of the body injured. The *event* describes the manner in which the injury was inflicted. The *source* is the object or substance that directly inflicted the injury and the *secondary source* identifies any other object or substance that contributed to the event. The OIICS codes for *nature of injury or illness*, which describe the physical cause of death, are not directly comparable to International Classification of Disease codes.

Data from the Current Population Survey (CPS) were used to estimate employment in SIC 078 for rate calculations. The CPS is a monthly household-based survey of employment and unemployment conducted for BLS by the U.S. Census Bureau. CPS obtains information on the U.S. non-institutional civilian population over 16 years of age by personal and telephone interviews. CPS sampled approximately 50,000 households per year from 1992 until July 2001, when the program was expanded to 60,000 households. An evaluation of the new sample revealed that national employment estimates were virtually unchanged. CPS also implemented a redesign of the questionnaire in 1994 to obtain more accurate information on informal or intermittent job activities [BLS, 2003a]. Data on the number of people employed in the landscaping industry are reported in the CPS database by sex, age group (1994 forward), race (white or African American), and Hispanic origin (yes or no) [BLS, 2006]. Information on fatality counts and rates for other industry sectors and all private industry was collected from the NIOSH Worker Health Chartbook [NIOSH, 2004].

The CFOI and CPS databases do not include individually identifiable information and the project did not involve intervention or interaction with living individuals. Therefore, this study is not classified as human subjects research and was exempt from Institutional Review Board consideration.

### Data Analysis

CFOI fatality records for the landscaping industry were analyzed using SAS<sup>®</sup> statistical software (Version 8, Cary, NC). The dataset was limited to fatalities among workers aged 16 years or older that occurred in SIC 078 during the period of 1992 through 2001. This 10-year time frame was selected due to the implementation of new record keeping procedures in 2002 and a change in industry classification systems in 2003, both of which preclude comparisons of data after 2002 with data from prior years [BLS, 2003b].

Descriptive statistics were generated for all variables in the database to obtain information on demographics, occupational characteristics, and fatality circumstances. The variable for event was examined in depth to determine the primary causes of worker fatalities. Significance testing

for differences between proportions was conducted using Chi-square tests. Proportional distributions were also used to compare fatality characteristics of non-Hispanic white, non-Hispanic African American, and Hispanic workers, which excluded workers for whom both Hispanic origin and race was not reported ( $n = 89$ ) and non-Hispanic workers of other or not reported race ( $n = 22$ ).

The trend in fatality rates over time was plotted using the linear regression trendline function in Microsoft Excel. Crude fatality rates were calculated using fatality counts from CFOI in the numerator and CPS employment data in the denominator. In addition to the overall fatality rate for the landscaping industry, overall and/or event-specific rates by sex, age, race, and Hispanic origin were computed. Because CPS data were not disaggregated by age until 1994, rates by age are calculated for the years 1994–2001 [BLS, 2006].

Rate ratios were calculated to compare rates by industry, sex, age, race, and Hispanic origin. Because employment data do not provide sufficient detail to group workers by both race and Hispanic origin, rate ratios for landscaping workers compare Hispanic to non-Hispanic workers and African American to white workers. Rate ratios compare mutually exclusive groups except in the case of industry and age; the SIC 078 fatality rates by event are compared to all private industry event rates and age group rates are compared to the rate for all ages combined. Ninety-five percent confidence intervals (95% CIs) on the rate ratio were computed using Miettinen’s Test-Based Limits and significance was tested using the Chi-square statistic with one degree of freedom [as described in Kahn and Sempos, 1989].

## RESULTS

Employment in the landscaping industry increased from 703,000 workers in 1992 to 918,000 in 2001. A total of 1,101 fatal injuries occurred during this period. In contrast to decreasing trends in all private industry, the SIC 078 fatality rate increased slightly over time (Fig. 1). In 2001, the fatality rate was 3.33 (95% CI 2.84–3.91) times higher for landscaping workers than all private industry. Fatality rates by sex, age group, race, and Hispanic origin are presented in Table I. The male landscaper fatality rate was 7.15 (95% CI 4.80–10.64) times the rate for female workers; women comprised 10.6% of the workforce during the study period but only 1.6% of the fatalities. Fatality rates increased markedly with age.

Time and location of fatal events are described in Table II. Landscaping fatalities were evenly spread throughout the workweek and deaths peaked during the summer months. Deaths were most frequent in the South. The most common worker location at time of death was at a home or on a street or highway; 44.8% of the deaths in the latter category occurred on a local road.

Nearly all of the fatalities were traumatic in nature, primarily resulting from intracranial injury (24.7%), multiple traumatic injuries or disorders (24.9%), or other injuries (38.9%). The part of the body most often injured was the head (26.3%), nearly all of which were brain injuries. Injuries to multiple body parts (27.1%), body systems (24.4%), and the trunk (18.0%) were also common. Eighty-five percent of the fatally injured workers survived less than a day and 97.0% died within a month of being injured.

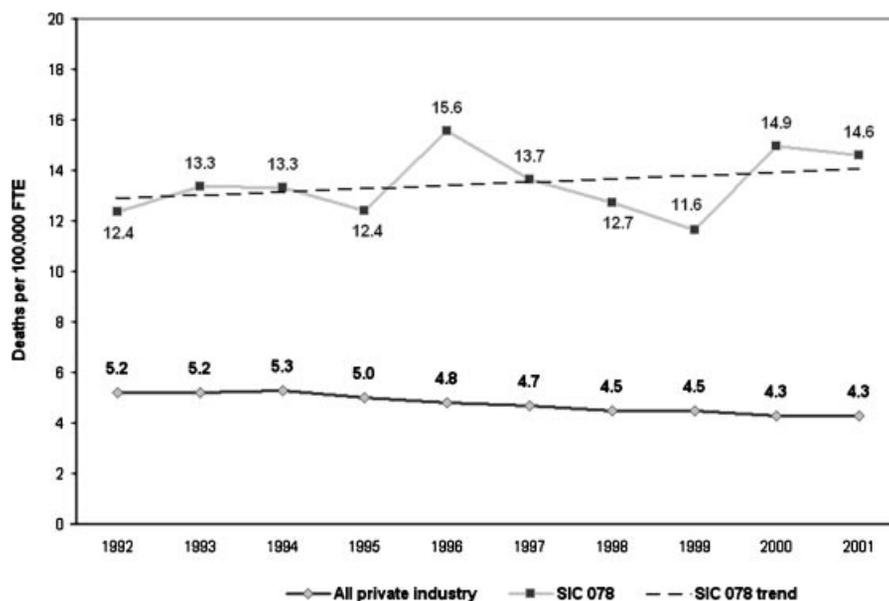


FIGURE 1. Fatality rates for all private industry and SIC 078, 1992–2001.

**TABLE I.** Fatality Rates in SIC 078 by Selected Demographic Characteristics, 1992–2001

Characteristic	N	%	Rate per 100,000 FTE	Rate ratio (95% confidence interval)	P-value
Sex					
Male	1083	98.4	14.85	7.15 (4.80–10.64)	<0.001
Female	18	1.6	2.08		
Age <sup>a</sup>					
16–24	144	15.7	9.20	0.68 (0.58–0.80)	<0.001
25–44	457	49.9	12.26	0.90 (0.83–0.99)	0.031
≥44	315	34.4	21.55	1.59 (1.42–1.77)	<0.001
Race					
African American	116	10.5	19.11	1.51 (1.25–1.83)	<0.001
White	918	83.4	12.62		
Race not elsewhere classified	20	1.8			
Asian, Native Hawaiian, or Pacific Islander	13	1.2			
American Indian or Alaskan Native	5	0.5			
Not reported	27	2.5			
Hispanic or Latino Origin					
Hispanic	243	22.1	11.12	0.86 (0.75–1.00)	0.049
Not Hispanic	768	69.8	12.86		
Not reported	90	8.2			

Includes groups with five or more fatalities; columns may not add to 100%.

<sup>a</sup>Does not include 1992 and 1993 fatalities due to lack of CPS data. Age group rates are compared to overall rate for landscaping industry.

Table III describes the industry, occupation, establishment size, and employment type of fatally injured landscapers. The industry with the most fatal injuries was ornamental shrub and tree services (SIC 0783) and the most common occupation was groundskeepers and gardeners, except farm (COCS 486). A third of the workers were self-employed and three-quarters of the landscapers with a reported establishment size worked at companies with 10 or fewer employees. Fatally injured workers who were self-employed were significantly older than those that were not self-employed ( $P < 0.001$ ). Length of service with employer was reported for only 20.0% of the deaths; nearly half of these workers had been employed by the company for a year or less.

Foreign-born workers comprised 14.5% of the fatally injured landscapers and included workers born in North America (8.0%), Central America and Mexico (4.8%), Europe (0.6%), and Asia (0.5%).

African Americans comprised 7.4% of the landscaping workforce from 1992 to 2001. The overall fatality rate for African American landscapers was 1.51 (95% CI 1.25–1.83) times the rate for whites and African Americans had a higher fatality rate than whites during 7 of the 10 study years (Fig. 2). Compared to white or Hispanic landscapers, African American workers were older and more commonly worked in the South. They were also more likely to be self-employed or work at a small establishment (Table IV).

Approximately 27.8% of landscaping workers employed during the study period were Hispanic and

Hispanic employment increased by 120,000 FTE from 1992 to 2001. More than half ( $n = 137$ ) of the Hispanic workers were foreign-born. Fatality rates for Hispanic workers tended to be lower than for non-Hispanics (Fig. 3) and the rate ratio for Hispanics compared to non-Hispanics was 0.86 (95% CI 0.75–1.00). Compared to white and African American landscapers, Hispanic landscapers were younger and more worked in the West. Hispanic workers were also less likely to be self-employed, work in small establishments, or be employed as groundskeepers or gardeners (Table IV).

There was a statistically significant difference between whites, Hispanics, and African Americans in the proportion of fatalities caused by each event type (Table IV). Exposure to harmful substances and environments, the leading cause of death among African American landscapers, was the fourth most common event among whites. Transportation incidents caused nearly 40% of Hispanic deaths but less than a quarter of those among whites and African Americans. Contact with objects or equipment and falls were the leading cause among white landscapers.

### Transportation Incidents (299 Fatalities)

Transportation incidents were the leading cause of death in SIC 078. The transportation fatality rate increased from 3.13 deaths per 100,000 FTE in 1992 to 5.01 in 2001. The rate of transportation deaths in 2001 was 2.68 (95% CI

**TABLE II.** Time and Location of Fatalities in SIC 078, 1992–2001

Characteristic	N	%
<b>Day</b>		
Sunday	57	5.2
Monday	193	17.5
Tuesday	186	16.9
Wednesday	193	17.5
Thursday	191	17.4
Friday	177	16.1
Saturday	104	9.5
<b>Month</b>		
January	49	4.5
February	68	6.2
March	62	5.6
April	88	8.0
May	104	9.5
June	100	9.1
July	137	12.4
August	132	12.0
September	109	9.9
October	112	10.2
November	75	6.8
December	65	5.9
<b>Region</b>		
South	527	47.9
West	238	21.6
Midwest	169	15.4
Northeast	167	15.2
<b>Location</b>		
Home	394	35.8
Street or highway	270	24.5
Industrial place and premises	94	8.5
Farm	38	3.5
Public building	25	2.3
Place for recreation and sport	17	1.5
Other places	263	23.9

2.03–3.54) times the rate for all private industry that year. Transportation incidents caused half of the fatalities among women. The proportion of deaths that occurred among workers aged 24 or younger was higher for transportation incidents than for other causes (Table V). Nearly 80% of transportation-related deaths occurred among workers who were not self-employed (Table V). With respect to occupation, 168 were groundskeepers and gardeners and 33 were classified as supervisors or related agricultural occupations. Only 17 of the workers who died in transportation incidents were motor vehicle operators, all of which were truck drivers. Most transportation deaths were due to highway incidents, all of which were caused by collisions between vehicles and/or

**TABLE III.** Industry, Occupation, Establishment Size, and Employment Type of Fatally Injured Workers in SIC 078, 1992–2001

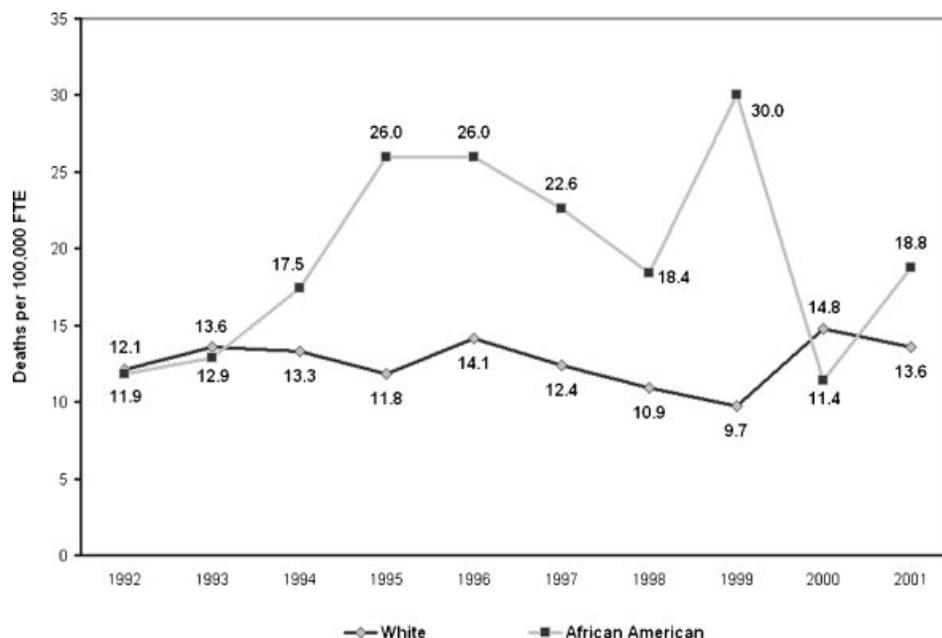
Characteristic	N	%
<b>Industry</b>		
Ornamental shrub and tree services	567	51.5
Lawn and garden services	346	31.4
Landscape counseling and planning	85	7.7
Not elsewhere classified	103	9.4
<b>Occupation</b>		
Groundskeepers and gardeners, except farm	692	62.9
Supervisors, related agricultural occupations	76	6.9
Timber cutting and logging occupations	59	5.4
Horticultural specialty farmers	46	4.2
Laborers, except construction	38	3.5
Managers and administrators, not elsewhere classified	29	2.6
Farmers, except horticulture	28	2.5
Forestry workers, except logging	22	2.0
Truck drivers	18	1.6
Farm workers	13	1.2
Managers, horticultural specialty farms	12	1.1
Other	68	6.1
<b>Establishment size</b>		
1–10 employees	572	52.0
11–19 employees	59	5.4
20–49 employees	66	6.0
50–99 employees	21	1.9
100+ employees	60	5.5
Not reported	323	29.3
<b>Employment type</b>		
Self-employed	366	33.2
Work in family business	11	1.0
Work for pay or compensation, or other	716	65.0
Other or not reported	8	0.7

Includes groups with five or more fatalities; columns may not add to 100%.

mobile equipment (Table VI). Overturned vehicles caused 43 of the 77 non-highway deaths. The pedestrian highway deaths were most often caused by workers being struck by vehicles or mobile equipment while they were in the roadway (n = 25), in a parking lot or non-roadway area (n = 21), or on the side of the road (n = 16).

**Contact With Objects and Equipment (294 Fatalities)**

The fatality rate for contact with objects and equipment injuries was 3.60 deaths per 100,000 FTE. In 2001, the fatality rate from contact with objects and equipment was 4.59 (95% CI 3.31–6.35) times higher in SIC 078 than in all private industry. Contact with objects and equipment deaths



**FIGURE 2.** Fatality rates for white and African American workers in SIC 078, 1992–2001.

were most frequent in the ornamental shrub and tree services subgroup (Table V). A higher proportion of workers who died from contact injuries worked at establishments with 10 or fewer employees than those who died of other causes (Table V). Workers who died of contact-related injuries were most frequently in the COCS classifications for groundskeepers and gardeners (59.2%), timber cutting and logging occupations (10.5%), supervisors and related agricultural occupations (5.1%), and horticultural specialty farmers (5.1%). As shown in Table VII, most of these fatalities were due to struck by object injuries, many of which involved trees or logs. The most common type of struck by object injuries were struck by a falling object ( $n = 184$ ). Twenty-six of the caught in or crushed by equipment or objects deaths were due to the worker being caught in running equipment or machinery.

### Falls (265 Fatalities)

There were 3.25 fatal falls per 100,000 FTE during the study period and the rate of fatal falls was 5.81 (95% CI 4.28–7.89) times higher in SIC 078 than in all private industry in 2001. The proportion of deaths caused by falls increased substantially with each age group ( $P < 0.001$ ); the fatality rate increased from 0.34 deaths per 100,000 FTE among 16–19 years old to 8.97 deaths per 100,000 FTE among workers over 65. Over 70% of the workers who died from falls worked in ornamental shrub and tree services (Table V). Self-employed landscapers comprised nearly half of the fall deaths, compared to less than 36% for each of the other four

events types. The secondary sources of injury indicate that workers most often fell from trees or logs, truck mounted bucket or basket hoists, and ladders (Table VIII).

### Exposure to Harmful Substances and Environments (200 Fatalities)

The average fatality rate for exposure to harmful substances and environments during the study period was 2.45 deaths per 100,000 FTE and the fatality rate was 6.78 (95% CI 4.77–9.65) times higher in SIC 078 than in all private industry in 2001. The leading cause of death in this category was contact with electric current, most commonly due to contact with overhead power lines ( $n = 117$ ) (Table IX). Exposure-related deaths caused 23.4% of the fatalities among 16- to 19-year-old landscapers.

### Assaults and Violent Acts (39 Fatalities)

The fatality rate for assaults and violent acts was 0.48 deaths per 100,000 FTE. The most common causes of assaults by persons were work-related shootings (Table X). The fatality rate for workers aged 65 and older was 2.56 deaths per 100,000 FTE, over 5 times the rate for all ages. Twenty-seven of the workers who died from fatal assaults and violent acts were employed as groundskeepers and gardeners. Over half of the workers were employed in lawn and garden services (Table V).

**TABLE IV.** Selected Characteristics of SIC 078 Fatalities by Race and Hispanic Origin<sup>a</sup>, 1992–2001

Characteristic	White (n = 647) %	African American (n = 100) %	Hispanic (n = 243) %
Age*			
<25	15.0	6.0	21.8
25–44	50.9	36.0	56.0
≥45	34.0	58.0	22.2
Region*			
Northeast	21.3	6.0	7.0
Midwest	21.2	8.0	6.2
South	43.3	80.0	40.7
West	14.2	6.0	46.1
Employment type*			
Self-employed	37.1	49.0	21.0
Not self-employed	62.9	51.0	79.0
Establishment size*			
1–10 employees	58.3	62.0	36.6
>10 employees	16.5	7.0	25.5
Not reported	25.2	31.0	37.9
Industry*			
Landscape counseling and planning	7.4	6.0	10.7
Lawn and garden services	23.2	45.0	49.0
Ornamental shrub and tree services	62.1	38.0	27.2
Not elsewhere classified	7.3	11.0	13.2
Occupation*			
Groundskeepers and gardeners, except farm	58.7	60.0	77.8
Event*			
Transportation incidents	23.3	21.0	38.3
Contact with objects and equipment	30.6	24.0	17.3
Falls	28.0	22.0	17.3
Exposure to harmful substances and environments	15.8	27.0	21.0
Assaults and violent acts	2.2	6.0	5.8

<sup>a</sup>In this table, white, African American, and Hispanic are mutually exclusive categories.

\* $P < 0.0001$ .

## DISCUSSION

The landscape and horticultural services fatality rate increased from 12.38 per 100,000 FTE in 1992 to 14.60 per 100,000 FTE in 2001. This trend is in contrast to decreasing fatality rates in the agriculture, forestry, and fishing industry as well as in all private industry during this period [NIOSH, 2004].

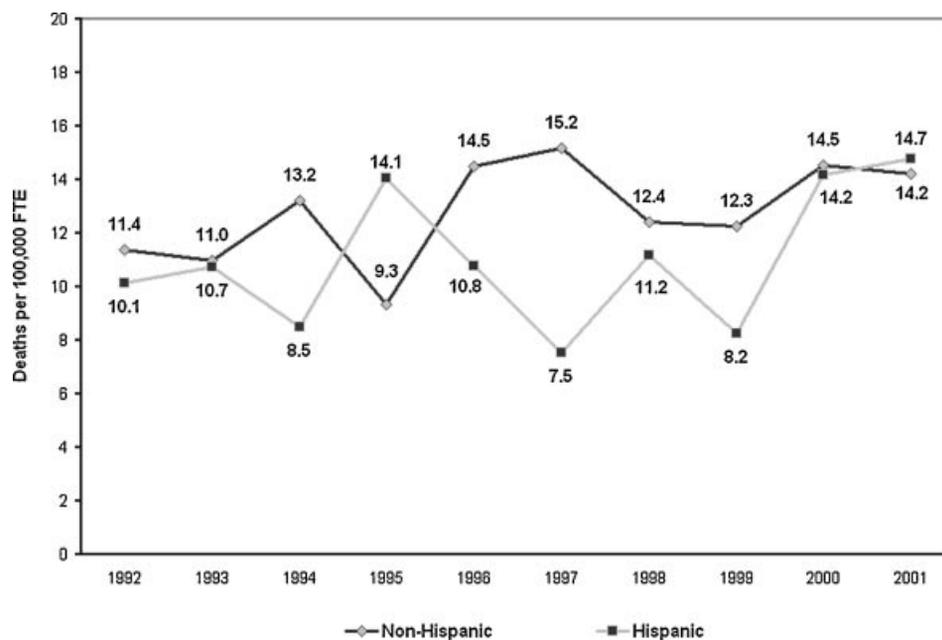
### Industry Subgroup

There were substantial differences in the causes of fatal injuries among subgroups of the landscaping industry. Over half of the deaths occurred among ornamental shrub and tree services workers. Contact with objects and equipment and falls were the leading causes of death in this subgroup,

causing significantly higher proportions of fatalities in ornamental shrub and tree services than in other subgroups. Transportation incidents and assaults and violent acts caused a greater proportion of fatalities among the landscape counseling and planning and lawn and garden services subgroups. The lack of subgroup employment data prevents comparisons of fatality rates. However, ornamental shrub and tree services deaths were more likely to occur during job activities at the worksite (i.e., falls, contact with objects and equipment), which suggests that primary tasks in ornamental shrub and tree services work may be more hazardous.

### Employment Type

A third of the landscaping workers who died from 1992 to 2001 were self-employed. Self-employed workers are not



**FIGURE 3.** Fatality rates for non-Hispanic and Hispanic workers in SIC 078, 1992–2001.

subject to OSHA regulation and are less likely to have formal safety procedures; several studies have reported elevated fatality rates among the self-employed [Mirabelli et al., 2003; Muntaner et al., 2004; Bunn et al., 2006]. Pegula [2004] reported that in all private industry from 1995 to 2001, the average fatality rate among self-employed workers was 2.7 times higher than non-self-employed workers. The study also found these self-employed workers to be commonly

engaged in logging, trimming, and pruning activities at the time of death. In the current analysis, self-employed landscapers were older than non-self-employed workers, which may partially account for the increased fatality rate. However, other studies that reported an older age distribution among self-employed workers found that fatality rates remained elevated with adjustment for age [Mirabelli et al., 2003; Pegula, 2004].

**TABLE V.** Selected Characteristics of SIC 078 Fatalities by Event, 1992–2001

Characteristic	Transportation (n = 299) %	Contact (n = 294) %	Falls (n = 265) %	Exposure (n = 200) %	Assaults (n = 39) %
Age*					
<25	20.7	16.7	8.7	15.5	18.0
25–44	44.8	54.1	46.8	61.0	43.6
≥45	34.5	28.2	44.2	23.5	38.5
Industry*					
Landscape counseling and planning	16.1	4.8	3.0	3.0	20.5
Lawn and garden services	51.5	19.4	17.7	33.5	53.9
Ornamental shrub and tree services	21.1	69.1	70.6	53.0	12.8
Not elsewhere classified	11.4	6.8	8.7	20.4	12.8
Employment type*					
Self-employed	21.1	31.6	48.3	35.5	28.2
Not self-employed	78.9	68.4	51.7	64.5	71.8
Establishment size*					
1–10 employees	43.5	61.6	56.2	49.5	33.3
>10 employees	31.1	16.0	8.7	32.5	15.4
Not reported	25.4	22.5	35.1	18.0	51.3

\* $P < 0.0001$ .

**TABLE VI.** Selected Characteristics of Transportation Fatalities (n = 299) in SIC 078, 1992–2001

	N	%
<b>Event</b>		
Highway incident	137	45.8
Non-highway incident, except rail, air, water	77	25.8
Pedestrian, non-passenger struck by vehicle, mobile equipment	67	22.4
Railway incident	8	2.7
Aircraft incident	6	2.0
<b>Source</b>		
Pickup truck	66	22.1
Truck	35	11.7
Automobile	33	11.0
Tractor	28	9.4
Tractor mowers	17	5.7
Truck, nec	14	4.7
Riding lawn mowers	13	4.3
Dump truck	13	4.3
Semi-trailer, tractor trailer, trailer truck	12	4.0
Passenger or light delivery van	10	3.3
Front end loaders	9	3.0
Highway vehicle, motorized	8	2.7
Forwarder/yarder, skidder	5	1.7
<b>Secondary source</b>		
Semi-trailer, tractor trailer, trailer truck	24	8.0
Automobile	17	5.7
Trees, logs	15	5.0
Pickup	12	4.0
Water	12	4.0
Highway vehicle, motorized	10	3.3
Train	8	2.7
Ground	7	2.3
Towers, poles	6	2.0
Dump truck	6	2.0
Not reported	148	49.5
<b>Activity</b>		
Driving, operating truck	67	22.4
Riding in, on truck	53	17.7
Driving, operating farm vehicle	26	8.7
Riding in, on other vehicle	21	7.0
Walking in or near a roadway	18	6.0
Constructing, repairing, cleaning	15	5.0
Driving, operating industrial/construction vehicle	13	4.3
Operating farm machinery	9	3.0
Operating earth moving machinery	7	2.3
Logging, trimming, pruning	6	2.0
Driving, operating automobile	5	1.7

Includes groups with five or more fatalities; columns may not add to 100%.  
nec = not elsewhere classified.

**TABLE VII.** Selected Characteristics of Contact With Objects and Equipment Fatalities (n = 294) in SIC 078, 1992–2001

	N	%
<b>Event</b>		
Struck by object	233	79.3
Caught in or compressed by equipment or objects	52	17.7
Caught in or crushed in collapsing materials	5	1.7
<b>Source</b>		
Trees, logs	185	62.9
Dump truck	17	5.8
Chippers	14	4.8
Powered chainsaws	12	4.1
Mowing machinery	7	2.4
Bucket loaders	6	2.0
Machine and appliance parts, nec	6	2.0
Truck	6	2.0
<b>Secondary source</b>		
Trees, logs	18	6.1
Construction, logging, and mining machinery	9	3.1
Powered cutting hand tools	9	3.1
Fasteners, connectors, ropes, ties	6	2.0
Not reported	230	78.2
<b>Activity</b>		
Trimming, pruning, nec	90	30.6
Clearing brush, trees	22	7.5
Using power saw (band saw, chain saw)	18	6.1
Logging, trimming, pruning	18	6.1
Repairing	18	6.1
Logging	17	5.8
Operating wood chipper	16	5.4
Operating heavy equipment	14	4.8
Walking	11	3.7
Vehicular and transportation operations	9	3.1
Logging, trimming, pruning, nec	9	3.1
Loading, unloading (packing, unpacking) materials	6	2.0

Includes groups with five or more fatalities; columns may not add to 100%.  
nec = not elsewhere classified.

## Establishment Size

Almost three-quarters of the deaths with a reported establishment size occurred at companies with 10 or fewer employees. Small businesses are exempt from many federal occupational safety and health regulations and may lack safety training for workers, occupational health personnel, and mechanisms for hazard recognition and prevention [Lentz and Wenzl, 2006]. NIOSH analyzed BLS data from 1994 and 1995 to rank small business industries using a weighted risk index based on occupational injury, illness, and fatality rates [NIOSH, 1999; Okun et al., 2001]. Of the 253 small business industries ranked, landscape and horticultural

**TABLE VIII.** Selected Characteristics of Fall Fatalities (n = 265) in SIC 078, 1992–2001

	N	%
<b>Event</b>		
Fall to lower level	258	97.4
Fall on same level	5	1.9
<b>Source</b>		
Ground	208	78.5
Street, road	10	3.8
Floors, walkways, ground surfaces	9	3.4
Trees, logs	8	3.0
Sidewalks, paths, outdoor walkways	8	3.0
<b>Secondary source</b>		
Trees, logs	162	61.1
Truck mounted bucket or basket hoist	22	8.3
Ladders	22	8.3
Roof	6	2.3
Powered chainsaws	6	2.3
Trucks	6	2.3
Not reported	14	5.3
<b>Activity</b>		
Trimming, pruning, nec	163	61.5
Logging, trimming, pruning	19	7.2
Climbing, descending trees	14	5.3
Using power tools	11	4.2
Clearing brush, trees	10	3.8
Climbing, descending ladder	9	3.4
Using non-powered hand tools	5	1.9

Includes groups with five or more fatalities; columns may not add to 100%.  
nec = not elsewhere classified.

services was the sixth most risky. This composite score reflects the SIC 078 rankings as eleventh in number of non-fatal occupational injuries, sixth in number of non-fatal occupational illnesses, tenth in number of lost workday cases, and seventh in number of fatal occupational injuries.

## Age

Landscaping fatality rates increased with age, which is consistent with the agriculture, forestry, and fishing industry and all private industry [NIOSH, 2004]. However, the average fatality rate for landscaping workers aged 16–24 was 9.20 deaths per 100,000 FTE, nearly three times the rate for this age group in all private industry [NIOSH, 2004]. These results indicate that young landscapers are at increased risk compared to young workers in other industries. Teen worker fatalities have been investigated in potentially dangerous industries such as construction, home building, farming, and agriculture [Schulman et al., 1997; Lipscomb and Li, 2001; Bonauto et al., 2003; Suruda et al., 2003;

**TABLE IX.** Selected Characteristics of Exposure to Harmful Substances and Environments Fatalities (n = 200) in SIC 078, 1992–2001

	N	%
<b>Event</b>		
Contact with electric current	140	70.0
Drowning or submersion	31	15.5
Environmental heat	14	7.0
Struck by lightning	7	3.5
Injections, stings, and venomous bites	7	3.5
<b>Source</b>		
Power lines, transformers, convertors	68	34.0
Water	31	15.5
Environmental heat	14	7.0
Trees, logs	11	5.5
Non-powered cutting hand tools, nec	7	3.5
Powered chainsaws	7	3.5
Lightning	7	3.5
Insects, arachnids (spiders, ticks, scorpions, etc.)	5	2.5
<b>Secondary source</b>		
Power lines, transformers, convertors	56	28.0
Trees, logs	17	8.5
Pools	8	4.0
Truck mounted bucket or basket hoist	6	3.0
Not reported	92	46.0
<b>Activity</b>		
Trimming, pruning, nec	101	50.5
Using lawnmower	9	4.5
Clearing brush, trees	9	4.5
Vehicular and transportation operations	7	3.5
Planting (landscape work)	6	3.0
Materials handling operations	6	3.0
Using power saw (band saw, chain saw)	5	2.5
Cleaning, washing	5	2.5
Climbing, descending	5	2.5

Includes groups with five or more fatalities; columns may not add to 100%.  
nec = not elsewhere classified.

Runyan et al., 2006]. Although no prior studies have focused on fatalities among young landscapers, research has been conducted on non-fatal injuries. A study of high school students in Wisconsin found that only 55% of teenagers in tree trimming and cutting had work permits, compared to 70% among all employed teens [Zierold and Anderson, 2006]. The study did not find a difference in injury risk between teenagers with and without work permits, but workers without permits were less likely to report having received safety training. In the current study, fatalities from exposure to harmful substances and environments, mostly electrocutions, caused nearly a quarter of the deaths among landscapers aged 16–19 years. A study of CFOI data on electrocutions in all industries from 1992 to 1999 reported that young workers are at higher risk of electrocution than

**TABLE X.** Selected Characteristics of Assault and Violent Act Fatalities (n = 39) in SIC 078, 1992–2001

	N	%
<b>Event</b>		
Assaults and violent acts by person(s)	22	56.4
Self-inflicted injury	16	41.0
<b>Source</b>		
Bullets	20	55.6
Machine and appliance parts	5	13.9
<b>Secondary source</b>		
Co-worker or former co-worker	7	18.0
Person other than injured worker, nec	7	18.0
Person other than injured worker, unspecified	6	15.4
Injured worker (self)	6	15.4
Not reported	7	18.0
<b>Activity</b>		
Activity, nec	8	20.5
Using power tools	5	12.8
Not reported	12	30.8

Includes groups with five or more fatalities; columns may not add to 100%.  
nec = not elsewhere classified.

older workers, despite the opposite being generally true for fatal work-related deaths [Taylor et al., 2002]. A NIOSH alert concluded that young workers lack safety training, perform tasks for which they are not trained or have no experience, are inadequately supervised, have underdeveloped understanding of work hazards, and are unaware of child labor laws [NIOSH, 2003]. These factors contribute to injuries and fatalities among young workers and may be especially relevant in dangerous industries such as landscaping.

## Event

The leading cause of fatalities in the landscaping industry, transportation incidents, was also the leading cause of all occupational fatalities during the study period [CDC, 2004]. Roadway crashes caused 22% of all work-related deaths and rates remained stable from 1992 to 2001, despite a decrease in the all industry fatality rate [CDC, 2004]. OSHA does not investigate fatalities that occur on public roads or highways, which are under the jurisdiction of the Department of Transportation [OSHA, 2007]. It is notable that most transportation deaths occurred among groundskeepers and gardeners or supervisors; less than 10% of the transportation fatalities were among motor vehicle or equipment operators. While there are federal regulations for vehicles used in interstate commerce, “no equivalent body of regulations is applicable to workers who drive other types of company-owned or personal vehicles for work purposes. For those drivers, the content, implementation, and enforcement of workplace driver-safety policies is left primarily to the

employer” [CDC, 2004] Transportation safety may be particularly overlooked in the landscaping industry where many of the fatalities occur in small business settings and where other, more obvious work-related hazards are evident.

## Race and Hispanic Origin

The fatality rate among African American landscaping workers was 1.51 (95% CI 1.25–1.83) times the rate among white workers. African American workers in the general industry category of agriculture, forestry, and fishing also have higher fatality rates than white workers [NIOSH, 2004]. Loomis and Richardson [1998] analyzed work-related deaths in North Carolina from 1977 to 1991 and reported that the age- and sex-adjusted injury rate ratio for African American workers was 1.36 (95% CI 1.22–1.51). The authors concluded that this difference was largely due to African American employment in more dangerous occupations. Since fatally injured African American landscapers in this study were significantly older than white workers, these rates may be influenced by the age distribution of the African American landscaper population. In addition, a large proportion of fatally injured African Americans worked at small establishments. Due to the lack of precise employment data by industry subgroup, it is unknown whether race, age, employment type, or some combination accounts for the elevated fatality rate observed among African American landscaping workers in this study.

Workers of Hispanic origin had a slightly lower fatality rate than non-Hispanic landscapers (RR 0.86, 95% CI 0.75–1.00). This finding is consistent with fatality rates for the agriculture, forestry, and fishing industry as a whole, where the fatality rate for Hispanic workers was 15.8 deaths per 100,000 FTE compared to 20.2 among non-Hispanic workers [NIOSH, 2004]. In all private industry, however, the fatality rate among Hispanic workers is higher than non-Hispanic workers [NIOSH, 2004] and research has shown that Hispanic workers tend to be more heavily represented in industries with elevated injury, illness, and fatality rates [Anderson et al., 2000; Richardson et al., 2003]. In the construction industry for example, Dong and Platner [2004] reported that Hispanic workers were at greater risk of fatal injury than non-Hispanics (RR 1.84, 95% CI 1.60–2.10).

Fatally injured Hispanic landscapers were younger than non-Hispanic landscaping workers. If the Hispanic landscaping workforce as a whole is also younger, then confounding by age may account for the low fatality rate. There were 89 fatalities for which Hispanic origin was not reported, which may have biased the results if the distribution of Hispanic origin differed between workers with and without available data on this characteristic. It is also possible that Hispanic origin was underreported in the sources of fatality information used by CFOI. A primary CFOI data source is death certificates, which may underreport Hispanic ethnicity.

Caveney et al. [2006] found that 5% of self-identified Mexican American participants in the Brain Attack Surveillance in Corpus Christi project were misreported as non-Hispanic white on their death certificates. Eschbach et al. [2006] reported that California death certificates misclassified 7% of U.S.-born Hispanics deaths and under-ascertainment was especially prevalent among older U.S.-born Hispanics. Although the CFOI program attempts to verify ethnicity of fatally injured workers using several sources, the use of death certificate information may contribute to the lower fatality rate among Hispanics. It may also be a factor in the younger age distribution of fatally injured Hispanic workers in this study. Alternatively, it is possible that the lower Hispanic fatality rate is due to employment in safer working conditions. The proportion of Hispanic workers in the ornamental shrub and tree services subsector was lower than the proportion of whites and African Americans. If job tasks in this SIC subgroup are more dangerous than in other subgroups, the Hispanic fatality rate would be lower. In addition, significantly fewer fatally injured Hispanics were self-employed or worked at small businesses, both of which are known to be associated with higher fatality risk.

### Strengths and Limitations

Because no one source captures all work-related fatalities, the CFOI program uses a diverse network of sources to obtain as complete a count of occupational fatalities as possible [BLS, 2007]. In contrast to the OSHA Integrated Risk Management System database, CFOI includes fatalities that are not under OSHA jurisdiction or are not usually investigated by OSHA (e.g., self-employed workers, transportation-related deaths). Studies have also shown that CFOI captures more work-related fatalities than NIOSH's National Traumatic Occupational Fatality surveillance system or the Centers for Disease Control and Prevention's mortality statistics for work-related deaths [Biddle and Marsh, 2002; Layne, 2004; CDC, 2007]. CPS employment estimates are based on survey data and rates calculated using CPS denominator data are subject to sampling and non-sampling error. However, a study comparing fatal injury rates calculated using data from CPS and the U.S. Census reported minimal differences between the two denominator data sources [Richardson et al., 2004].

As discussed previously, a principal limitation of the CPS data is that employment information for SIC 078 was available grouped by sex, age, race, and Hispanic origin only. The lack of data disaggregated by other variables in the CFOI database made it impossible to compare rates for many groups (e.g., self-employed workers, industry subgroups). In addition, the lack of age-specific employment data for African American and Hispanic landscapers was a major limitation since age-adjusted fatality rates could not be calculated. Proportional distribution analyses were used to

determine significant differences between groups when employment data were not available. This method is limited by the lack of an external comparison group. However, in the absence of rate data, proportional distributions can provide valuable information on differences in fatality characteristics and highlight factors commonly associated with work-related deaths.

This study focused on fatalities that occurred in SIC 078 from 1992 to 2001. Due to the BLS implementation of new recordkeeping procedures in 2002, CFOI data after that year are not comparable to data from prior years. BLS also implemented a new industry classification system in 2003, the North American Industry Classification System (NAICS). The NAICS system classifies most landscape and horticultural services workers as "landscaping services" (NAICS code 561730), but not all SIC 078 workers are classified in this grouping [U.S. Census Bureau, 2003]. Therefore, future investigations of landscaping fatalities using CFOI will not be directly comparable to this study.

### CONCLUSIONS

Most work-place deaths are preventable. Yet in 2001, the fatality rate for landscape and horticultural services workers was over three times the rate for all private industry. This investigation demonstrates the need for additional research to characterize risk factors and suggest strategies to minimize both fatal and non-fatal landscaping injuries. Research should target high-risk groups such as self-employed, small business, young, and African American workers.

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