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NONFATAL OCCUPATIONAL FALL INJURIES IN THE WEST VIRGINIA CONSTRUCTION INDUSTRY

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Abstract—Descriptive analyses were conducted using the West Virginia workers' compensation and supplemental injury records to assess nonfatal occupational falls from elevated work surfaces in the construction industry. These analyses are based on the 182 fall injuries reported to the State workers' compensation during fiscal year 1991 for which there were complete supplemental injury data. County-specific injury rates were calculated for counties with six or more fall injuries. Most of these incidents occurred among young white males who were employed as either craftsmen and kindred workers (48%) or laborers (33%) on non-union jobs in the general construction category (SIC-15). The counties with the highest injury rates that exceed the State rate of 5.9 per 1000 construction workers were located around or near the major industrial areas of Kanawha and Monongalia counties. Of the 182 claimants in the study population, one-third had been employed in their occupation for 2 years or less. For 60% of the claimants, the length of employment with the company for which they were employed at the time of the fall injury was two years or less; 26% had been employed for six months or less. Approximately, 63% of the 182 claimants had received some type of fall protection training. Ladders and scaffolds were involved in 50% of all falls. Fall protection devices were not commonly used by the 182 construction workers who worked from elevated surfaces. Fifty percent of the claimants were using tools or handling materials when the fall occurred. Fifty-nine percent of the falls occurred from elevated work surfaces which were relatively low heights ($\leqslant$10 feet) where few safety regulations apply even though the potential for a serious injury still exists. Copyright © 1996 Elsevier Science Ltd

INTRODUCTION

Occupational falls account for over 40% of all injuries (combining both fatal and nonfatal injuries) in the construction industry (Keyserling 1988; National Institute for Occupational Safety and Health 1993). Approximately 50% of all occupationally-related fatal falls occur in the construction industry and these falls represent 23% of all fatal injuries (United States Department of Labor 1991; Cattledge et al. 1993; Kisner and Fosbroke 1994). The National Traumatic Occupational Fatality (NTOF) surveillance system maintained by the National Institute for Occupational Safety and Health (NIOSH) at the Division of Safety Research (DSR) indicates that during the 1980s, construction had the second highest fatality rate (25.6/100,000 workers) among all major industrial divisions, preceded only by the mining industry (31.9/100,000 workers) (National Institute for Occupational Safety and Health 1980; Kisner and Fosbroke 1994).

A 1981 Bureau of Labor Statistics (BLS) survey of falls from elevations revealed that over one-third of the occupational falls reported in all industries occurred in the construction industry and mainly among the following Standard Industrial Classification (SIC) categories: the general building contractor (SIC-15) and special trades contractor (SIC-17) groups, representing 12 and 25% of falls across all industries, respectively (United States Department of Labor 1984). Cohen and Compton (1982) reviewed workers' compensation data from New York State and found that the special trades (SIC-17) had a higher percentage of injuries as a result of falls from one level to another than any other industrial classification.

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The purpose of this paper is to report the descriptive analyses of construction workers who sustained a nonfatal fall injury from an elevated work surface in West Virginia during fiscal year 1991 (1 July 1990–30 June 1991).

METHOD

Study population

The data on occupational falls in the construction industry was obtained from the West Virginia Workers' Compensation Fund (WVWC). Cases were defined as construction workers who experienced a nonfatal occupational fall from an elevated work surface between 1 July 1990, and 30 June 1991 (fiscal year 1991), in West Virginia, and had filed a claim with the WVWC. To determine the representativeness of fiscal year 1991 (FY 1991) construction-related nonfatal occupational fall claims, comparisons of demographic and injury information were made with the same type of claims filed during fiscal years 1985–1989. Similar distributions were observed for all variables.

Data sources

The database used in this study was acquired from the WVWC and included all claims submitted for falls from one level to another which occurred during FY 1991 (West Virginia Workers' Compensation Fund 1991). To develop a more detailed picture of the circumstances surrounding the fall incident, supplemental information was obtained for FY 1991 fall claimants via a follow-back telephone interview conducted within a few weeks to 17 months after the fall injury. The data included detailed information on the demographic and incident information, including length of employment with the company, construction activity of the employer at the time of the fall incident, circumstances of the fall injury, height worked, distance the employee fell, and the frequency of work performed from an elevated work surface.

Fall injury rates for individual counties of West Virginia were derived using the United States Census of Population 1990: Equal Employment Opportunity Special File as the source for denominator data (United States Department of the Interior 1992). Construction industry employees were extracted from the occupational groupings enumerated for the civilian labor force. Rates were computed per 1000 construction workers.

RESULTS

From 1 July 1990 to 30 June 1991, a total of 321 claimants met the criteria of the case definition. The state- and county-specific fall injury rates presented are based on all fall claimants for which the state and county of injury information was provided. The remainder of the analyses are based on the 182 claimants for which the supplemental information concerning the circumstances of the fall was available.

Demographic information

At the time of the fall injury, claimants ranged from 18 to 70 years of age, with a median age of 35 years and a mean of 36.8 years. The greatest concentration of fall injuries occurred among persons aged 20–39 years (117 persons, 64.3%) (Table 1). Most of the study population were predominantly male (181 persons, 99.5%), white (180 persons, 99%) and married (137 persons, 75.3%) at the time of injury. Sixty-six percent of the claimants were high school graduates (120 persons), and an additional 12% had graduated from either a vocational/technical school, college, or graduate school (Table 1).

Injury information

Time of injury. By season, autumn and summer had the highest incidence of fall injury (57 persons,

Table 1. Demographic information of nonfatal occupational fall injuries, construction industry, West Virginia, FY 1991

Variable	*N*	(%)
Number of cases	182	100.0
*Age (years)**:		
16–19	4	2.2
20–24	20	11.0
25–29	21	11.5
30–34	41	22.5
35–39	35	19.2
40–44	22	12.0
45–49	10	5.5
50–54	14	7.7
55–59	11	6.0
60–64	3	1.9
65+	1	0.5
Race:		
White	180	99.0
Black	1	0.5
Refused	1	0.5
Sex:		
Male	181	99.5
Female	1	0.5
*Marital status**:		
Married	137	75.3
Divorced	17	9.3
Never married	28	15.4
Education:		
Eighth grade or less	11	6.0
Some high school	29	15.9
High school or GED	120	65.9
Some technical college	3	1.6
College graduate	11	6.0
Postgraduate/professional degree	8	4.4

*The status of these variables is at the time of injury.

31.3% and 51 persons, 28%, respectively). The range of injury incidents experienced throughout the year was from nine claims each in February, March, and June to 23 each in September and October (Fig. 1). The mean number of injuries per month was 15.2. Most of the fall injuries occurred on Monday (38 claims, 23.3%), while Friday, Saturday, and Sunday had the fewest fall injuries, 15.3, 3.1 and 1.2%, respectively. While 85% of all fall injuries occurred between 8:00 a.m. and 4:00 p.m., fall injuries were most likely to occur in the morning between the hours of 6:00 a.m. and noon (97 claimants, 55.1%).

Place of injury. Most fall injuries occurred in the same county as the contractor's establishment. When the county of injury and county of residence were compared, 87 construction workers (47.8%) commuted from their county of residence to another county to work. Thirty-eight percent of all claimants reported traveling 40 miles or greater to and from work (round-trip) each day.

Kanawha County, which houses the State Capitol of Charleston, had the greatest concentration of fall injury claims (22 claims, 12.3%), followed by Monongalia County with 7.3%. Due to variability, county-specific fall injury rates were calculated only for counties where there were six or more injuries. When the fall injury rates were reviewed, 14 counties had fall injury rates higher than the state-specific rate of 5.9 per 1000 construction workers. County rates higher than the state-specific rate ranged from 6.5 in Greenbrier to 24.9 in Grant. Most of the 14 counties with high rates were clustered near two major industrial centers of the state, namely, Kanawha and Monongalia Counties (Appendix, and collectively these 14 counties represent 41.2% (United States Department of Commerce 1992) of the construction workforce in the State.

The three most common job sites where fall injuries occurred were commercial or industrial buildings (43.4%), privately owned homes (23.6%), and apartment buildings (19.8%). Most of the construction projects where the construction worker was injured were non-union jobs (59.3%).

Injury occurrence

Work surface. The three leading categories for the type of work surface from which a fall occurred were ladders (61 cases, 33.5%), followed by scaffolds (39 cases, 21.4%), and a roof truss, wall, beam or other building structure (25 cases, 13.7%) (Fig. 2).

Claimants could have landed on more than one surface due to the diversity of surfaces found at construction worksites, and there is also the possibility of a fall trajectory involving collision(s) along the route to a final landing place. Multiple responses were encouraged from claimants. The most common surfaces were concrete, rock, or asphalt (93 responses) while earth, dirt, or grass surfaces were the second

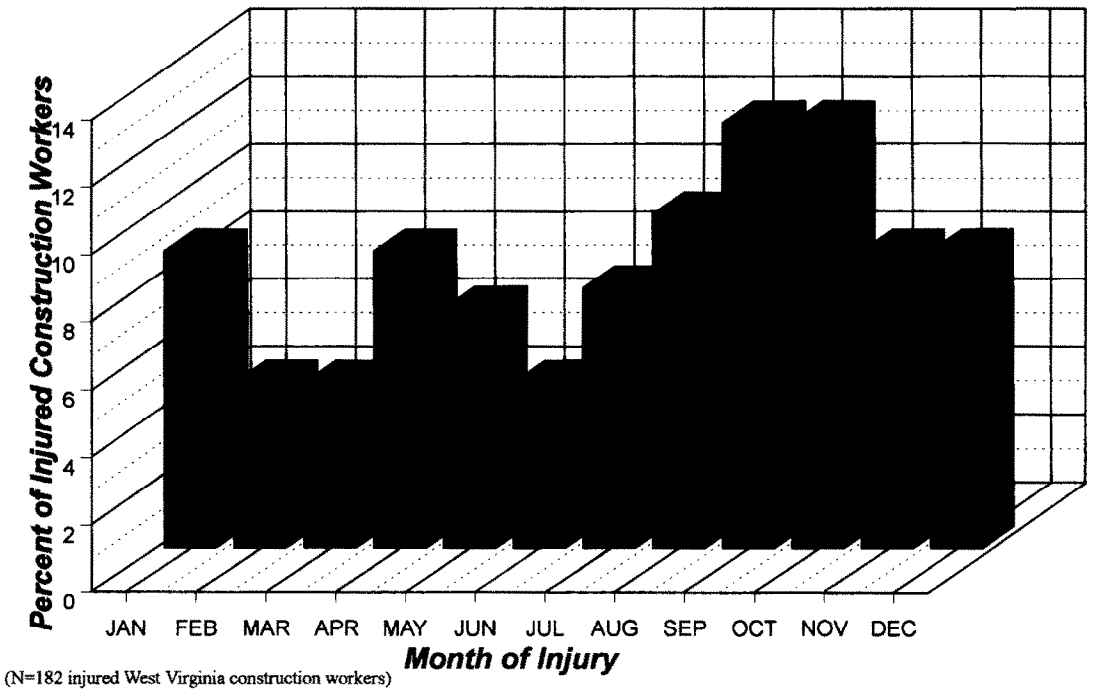


Fig. 1. Construction-related fall injuries by month.

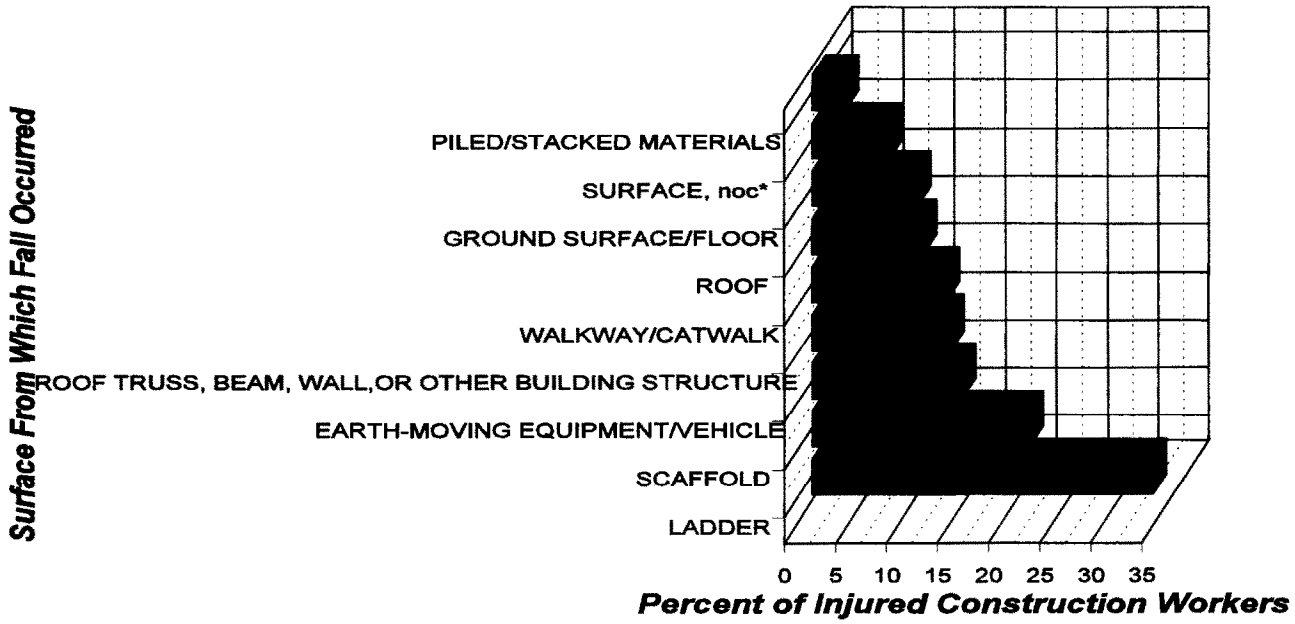


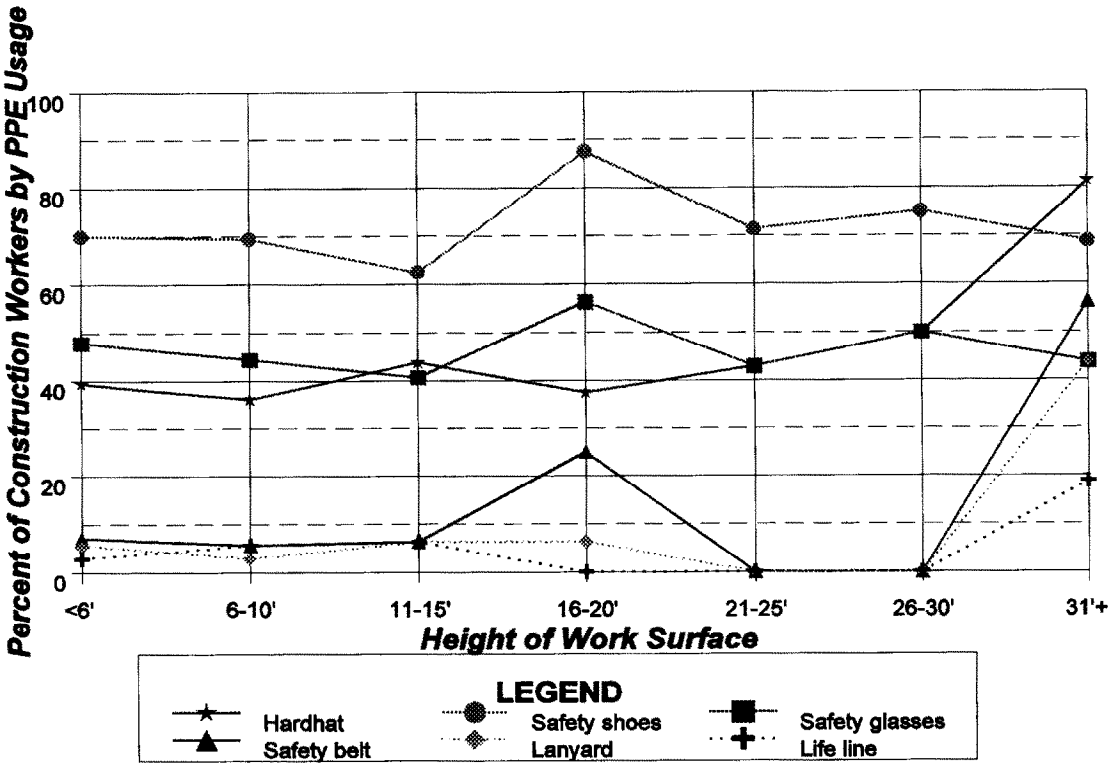
Fig. 2. Surface from which fall occurred.

highest (57 responses). Seventy-three percent of the claimants (132) reported landing on a single surface, 21% listed two surfaces, 4% listed 3 surfaces, and 1% listed 4 surfaces. Sixty-eight percent (124) reported the fall occurred outdoors.

Activities. The three most common activities claimants were engaged in prior to the fall were using tools (44 cases, 24%), handling materials (41 cases, 22.5%), and climbing or descending a ladder (19 cases, 10.4%). The two major surfaces claimants reported falling from were scaffolds and ladders. Of those persons who fell from a scaffold, the three most common activities engaged in at the time of the fall were tearing down something, painting, or nailing something. Of ladder falls, the most common activity was climbing or descending a ladder. The majority of these activities were identified as usual job duties (125 cases, 68%).

Cause of fall. The five leading causes reported for the fall incident were a slippery substance on the surface (31 cases, 17%), a slip or trip (26 cases, 13.9%), a loss of balance (14 cases, 7.7%), unsafe equipment (12 cases, 6.6%), and a ladder slipping/skidding (14 cases, 7.7%). However, when claimants were asked how the fall actually occurred, nearly one-third of the claimants (60 cases, 32.9%) indicated either they or the equipment slipped or they tripped. The next most frequent response was that the equipment broke or fell (21 cases, 11.5%). When the causes of the scaffold falls were examined, the three most common reasons the falls occurred were because either there was a slippery substance on the surface, the equipment was unsafe, or the equipment slipped. For ladder falls, the four most common reasons reported were either there was a slippery substance on the surface, the ladder was improperly set up on a steep surface which caused the ladder to slip, the claimant slipped, or there was a loss of balance.

Height of work surface. The majority of claimants reported working between one and 15 feet above the ground before the fall (128 cases, 70.3%). The range of height of the elevated work surfaces was one to 70 feet. Of the 178 cases with adequate height information, 39% of the claimants (70 persons) reported working from a height of less than six feet, but altogether 58.9% (105 persons) of all fall incidents occurred from 10 feet or less. Seventy percent of the fall victims reported usually working daily or almost daily from the height they fell (128 persons). Figure 3 shows the usage of personal protective equipment among these workers by height of work surface. Of the personal protective equipment (PPE) used by injured workers, hardly any used fall protection devices. When they were asked why PPE was not used, responses included it was not needed while performing their job duty, did not have one, equipment was too difficult to use while performing job duty, did not know what the PPE was for the job, or the work environment was not adequate to accommodate the safety devices (e.g. there was no place to tie off or hook the equipment).



Information based on responses to the separate personal protective equipment/device.
(N=182 injured West Virginia construction workers)

Fig. 3. Personal protective equipment usage by height.

Claimants were asked the distance they fell as well as the height of the work surface from which the fall occurred. When the distance fell was examined among the injured workers, 50.0% (89 persons) fell less than six feet. Of all fall injuries, 70.2% (125 persons) were reported to have fallen from 10 feet or less.

Lost workdays. The number of workdays missed as a result of a fall injury claim ranged from zero (0) to 391 days (median = 6 days, mean = 59.8 days). The frequency of lost workdays varied, from no lost workdays reported by 42 persons, 1–4 lost workdays reported by 34 persons, to greater than 91 lost workdays by 37 persons (Table 2). Lost workdays due to the fall injury and the employment status at the time of the follow-back telephone interview were used as indicators of severity. More than a year after the fall incident, 13.7% of the claimants reported being temporarily disabled and another 2.2% reported being permanently disabled. Table 2 shows lost workdays by height from which the fall occurred.

Type of injuries

In many cases multiple injuries were recorded, but the primary injury was abstracted from the first injury description listed. Strain or sprain was the most frequently cited nature of injury (77 cases, 43.5%). Bruises and contusions (52 cases, 29.3%) and fractures (33 cases, 18.6%) were the next most common injuries.

The part of body code on the injury report provides information on what body part had sustained injury. The greatest number of injuries among these construction workers involved the lower extremities (55 cases, 30.6%), followed by the back, which was the second most frequently injured body area (41 cases, 23%).

Occupational information

Occupational titles. WVWC provides three-digit occupation codes for claimants. The allocation codes for occupation are unique to the State of West Virginia Workers' Compensation occupational coding system. These allocation codes have 14 major categories. The two most frequently represented allocation categories in the fall from elevation category were craftsmen and kindred workers (82 persons, 45.1%) and laborers, excluding farm (59 persons, 32.4%) (Table 3).

The occupation codes offer further specificity

Table 2. Distribution of occupational titles of injured construction workers, West Virginia, FY 1991

Occupation allocation categories (codes)	Occupational title category at time of injury (codes)	*N*	(%)	Total (%)
Professional, technical, and kindred workers (001–096)	(006) Engineers	2	1.1	4 (2.2)
	(087) Technician, NOC	1	0.6	
	(092) Designer	1	0.6	
Managers and administrators, except farm (101–146)	(136) Sales managers and department heads, retail trade	1	0.6	5 (2.7)
	(145) Managers and administrators, NOC	4	2.2	
Clerical and kindred workers (201–296)	(249) Receptionists, secretaries	1	0.6	1 (0.6)
Craftsmen and kindred workers (301–446)	(304) Boilermakers	1	0.68	82 (45.1)
	(310) Brickmasons and stonemasons	3	1.6	
	(311) Brickmasons and stonemasons, apprentice	1	0.6	
	(312) Bulldozer operators	1	0.6	
	(316) Carpenters	27	14.8	
	(317) Carpenter apprentices	1	0.6	
	(330) Electricians	13	7.1	
	(334) Excavating, grading, and road machine operators; except bulldozer	4	2.2	
	(341) Foremen, NOC	6	3.3	
	(374) Mechanics and repairmen, NOC	3	1.6	
	(381) Millwrights	2	1.1	
	(390) Painters, construction and maintenance	7	3.9	
	(403) Plumbers and pipe fitters	6	3.3	
	(414) Sheet metal workers and tinsmiths	7	3.9	
Mine operatives (451–496)	(465) Surface coal miner, NOC	1	0.6	2 (1.1)
	(483) Roofer bolter	1	0.6	
Operatives, except mine and transport (501–596)	(501) Asbestos and insulation workers	1	0.6	8 (4.4)
	(514) Driller, earth	1	0.6	
	(580) Welders and flame-cutters	4	2.2	
	(592) Machine operatives	1	0.6	
	(594) Miscellaneous operatives	1	0.6	
Transport equipment operatives (601–626)	(614) Truck drivers	7	3.9	7 (3.9)
Laborers, except farm (640–696)	(646) Construction worker/laborer	6	3.3	59 (32.4)
	(680) Laborers, NOC	53	29.1	
Service workers, except private household (801–876)	(803) Janitors and sextons	1	0.6	2 (1.1)
	(875) Service workers, except private household, NOC	1	0.6	
Missing Information		12	6.0	12 (6.6)
Total			100.0	182

Source: West Virginia Workers' Compensation Fund, construction industry, occupational fall injuries from an elevated work surface, fiscal year 1991 (July 1, 1990–June 30, 1991) data.

Table 3. Lost workdays by height of work surface from which the fall occurred, West Virginia, FY 1991

Height of work surface (feet)	*N*	Lost workdays (%)														
		0	1–4	5–7	8–14	15–21	29–35	36–42	43–49	50–56	57–63	64–70	78–84	85–91	92+	Total
<6	70	35.7	24.3	7.1	8.6	2.9	2.9	2.9	1.4	0.0	2.9	1.4	0.0	1.4	8.6	39.3
6–10	35	25.7	22.9	8.6	11.4	2.9	5.7	0.0	0.0	0.0	0.0	2.9	2.8	0.0	20.0	19.7
11–15	31	6.4	12.9	9.7	6.4	9.7	9.7	3.2	0.0	3.2	0.0	3.2	3.2	0.0	32.3	17.4
16–20	15	6.7	13.3	13.3	0.0	6.7	0.0	13.3	0.0	6.7	6.7	0.0	0.0	0.0	33.3	8.4
21–25	7	28.6	14.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.3	0.0	0.0	0.0	42.9	3.9
26–30	4	0.0	25.0	25.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3
31+	16	18.6	6.3	0.0	6.2	0.0	0.0	12.5	0.0	0.0	6.2	6.2	0.0	6.2	37.5	9.0
Total	178	23.1	18.7	7.7	7.1	4.9	3.9	3.9	0.6	1.1	2.8	1.7	1.1	1.1	22.5	100.0
*N**		42	34	14	13	9	7	7	1	2	5	3	2	2	37	178

Source: West Virginia Workers' Compensation database, FY91, falls from elevation claims, construction industry.
*Lost workday information was missing for four claimants.

regarding claimant occupation (Table 3). The most frequently cited occupational title was for all laborers (59 persons, 32.4%), and carpenters (28 persons, 15.6%). Although mine operatives were represented in this database, these cases were individuals employed by construction companies who were also involved in construction activities in the mining industry.

Job experience. The amount of time respondents were employed in the occupation in which they were injured ranged from two weeks to 42 years (median = 11 years, mean = 11.3 years). Approximately one-third of the respondents had been employed in their occupation for two years or less at the time of injury. Of these respondents with two years or less experience,

39.4% percent were employed for six months or less, 32.7% for six months to one year and the remaining 27.6% for one to two years. Twenty-one percent of the respondents had a tenure that ranged from 16 to 42 years in their identified occupation.

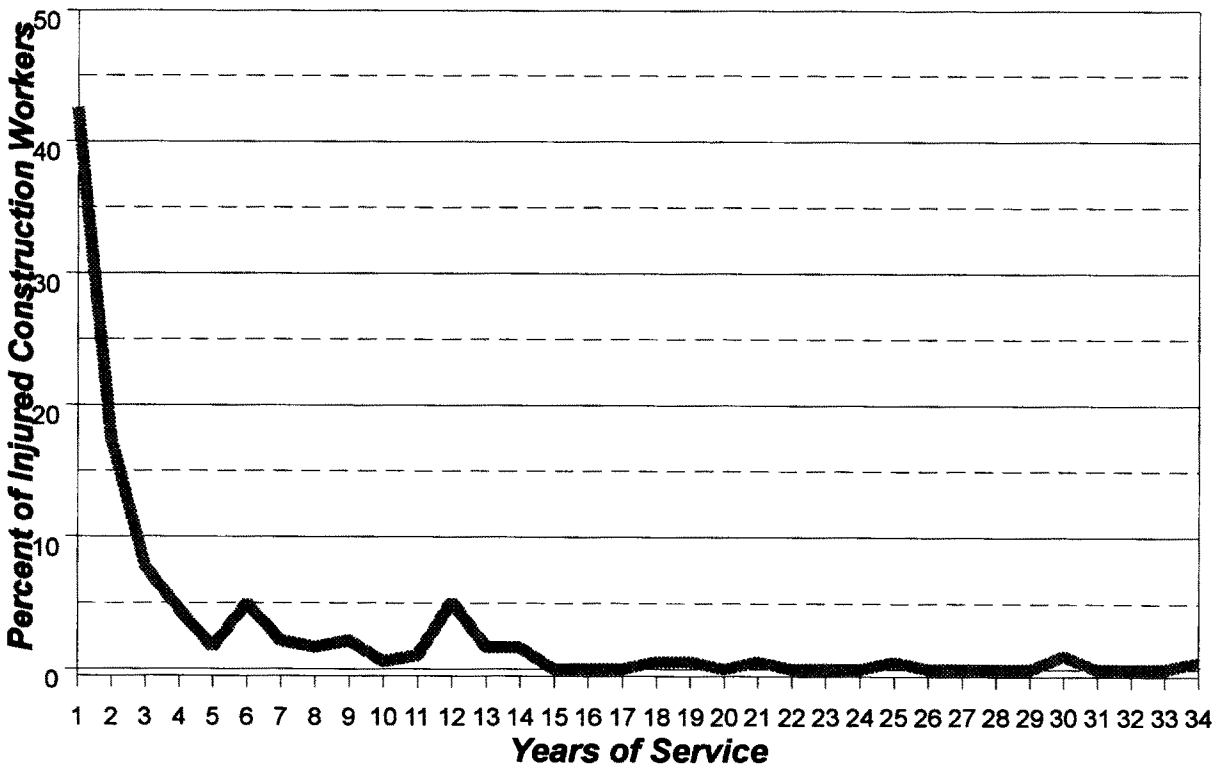
Length of employment with the company at the time of injury ranged from one week to 34 years. However, 60% of all claimants were employed for two years or less, of which 26% were employed for six months or less (Fig. 4).

Fall protection training. According to the claimants, 63% of the 182 claimants had received some type of safety training and/or education about fall protection. Claimants were asked a series of questions assessing the methods that were used to train them on fall protection such as on-the-job instructions; company-issued pamphlets, posters or written rules; training courses from trade associations; training courses from a union; training seminars from an outside agency; schools, colleges, or apprentice program; training presented by a safety consultant, or some other form of training not previously listed. The two most common methods used by employers to disseminate safety and/or health training or education were: on-the-job instructions (54%) or company pamphlets, posters, or written rules (47%). When the frequency of the fall protection training was reviewed, 28% reported receiving training at least twice a year from the employer at the time of the fall injury, while another 12% received training once a year.

Company of employment at time of injury

Since the employer's SIC codes could not be directly derived from the claimant injury information, claimants were asked to describe their employer. Ninety-one percent of the claimants were able to categorize the SIC category of their employer at the time of the fall. Fifty-one percent of the employers were classified as either a general construction contractor (SIC-15), 17.6% as a heavy construction contractor (SIC-16), and 22.5% as a special trades contractor (SIC-17).

The employer class and activity codes were reviewed from the WVWC database, because SIC codes are not used. Most workers' compensation agencies assign an employer class to classify the industry grouping and an activity code to depict the major activity of the company. The WVWC uses a two-level coding system of employer class and activity code. The employer class codes are a letter-number combination, 25 of which are for construction (L01-L54, non-consecutive). The largest concentration of



(N=182 injured West Virginia construction workers)

Fig. 4. Occupational fall by length of service.

claims were filed by employees of the L20 category, general construction, not otherwise classified (noc) for buildings less than three stories (60 cases, 36.4%), followed by employees of the L18 category, electrical wiring, millwright (19 cases, 10.4%).

DISCUSSION AND CONCLUSION

This study examined workers' compensation claims of construction workers who experienced a nonfatal fall from an elevated work surface to another level while at work. The demographic figures are comparable with other studies which identify persons in the 40 and younger age group as heavily represented among those occupationally injured in a fall (United States Department of Labor 1990). The fall claimants described here are predominantly male (99.4%) and white (99%). Nearly 78% of the study population had the equivalent of a high school degree or better.

Fall injury experience in West Virginia during the fiscal year of 1991 showed a pattern unlike the usual pattern in the construction industry which shows consistently high figures for injuries during the summer months. The peak period for injuries in West Virginia was autumn, with the months of September and October each having an equivalent incidence of 12.6%. Injuries slowly escalated during the summer months, with injuries in June at an unusually low level, comparable to the winter months. No explanation for this aberration from the expected trend is readily available, but could be related to weather or economic conditions. By day of week of occurrence, Monday had the highest percentage of fall injuries (23.3%), with another peak on Thursday (21.5%). Only the peak on Monday is similar to other workers' compensation data regarding fall injuries among construction workers (United States Department of Labor 1990). The percentage of injuries on the weekend was low due to the reduced workload on those days.

Ladders or scaffolds were involved in over 50% of the falls. Almost half of the nonfatal fall claimants were using tools or handling materials at the time of injury. Most of these injuries occurred on non-union jobs and at job sites where work was being performed on commercial or industrial buildings, apartment buildings, or privately owned homes which are all included in SIC-15. This particularly high incidence of fall injuries points to the importance of targeting prevention activities to reduce falls injuries on construction sites. Because some construction activities generally take place above ground level, extra precautions are required during routine tasks and could be encouraged through standardized safety and health training that specifically targets fall hazards. An evaluation of the implementation of safe work practices after training would also need to be considered to assess its effectiveness. The non-use of fall protection devices among these workers is surprising, especially at the higher heights, where they would be useful. The lack of fall protection devices usage suggests the following:

(1) Employers need to include a fall protection component in their company's safety and health program.
(2) The quality of fall protection training needs to be improved and employees need to be trained in what PPE to use, as well as how and when to use it.
(3) Employers should provide and enforce the use of fall protection PPE to prevent fall injuries.
(4) Research and development of fall protection PPE is needed for environments where existing PPE are difficult to adapt.

The findings of this paper indicate that nonfatal falls from elevation present a significant problem for individuals employed in the construction industry who work from elevated work surfaces. The profile of a workforce which is regularly exposed to elevations while performing their usual duties indicates the need for appropriate precautions to guard against fall injuries while on the job. Although the claimants reported receiving fall protection training, the quality of the training is not known. Most regulations, such as '29 CFR Part 1926 Subpart M 1926.500 d', stipulate fall protection at various heights dependent on the job activities. The lowest height usually mentioned in the regulations is around six feet. Fifty-nine percent of these injuries occurred from a height of 10 feet or less and resulted in serious injuries requiring lost workdays over one month. Although most current regulations regarding the use of fall protection methods do not cover the relatively lower heights (<6 feet) worked by 39% of the injured fall victims, workers must be trained to perform their jobs in a safe manner. This cannot be achieved without a properly structured safety and health training program on fall hazards for both managers and hourly employees and the implementation of these safe practices on the job sites. The injured workers who fell $\leqslant 6$ feet were mainly construction laborers, electricians, truck drivers, and ironworkers.

Based on the educational attainment level of this study population, structured safety and health education and training programs which focus on fall protection and prevention may be an effective prevention strategy. This type of strategy promoting fall prevention and protection programs may be helpful in reducing fall injuries among employees most at risk in the construction industry.

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APPENDIX

Counties with the Highest Rates of Occupational Fall Injuries in the West Virginia Construction Industry, FY 1991

Location	Total construction workers	Injury rate*
West Virginia	50330	5.9
14-County study area:	20773	
Grant	442	24.9
Boone	748	17.4
Hancock	676	14.8
Mingo	539	13.0
Lewis	604	11.6
Monongalia	1811	9.9
Harrison	1683	9.5
Ohio	1119	8.9
Putnam	1475	8.8
Marion	1482	8.1
Kanawha	5138	7.6
Raleigh	1892	7.4
Cabell	2084	6.7
Greenbrier	1080	6.5

Source: United States Department of Commerce, Bureau of the Census. Census of Population, 1990: Equal Employment Opportunity Special File. Washington, D.C.: Bureau of the Census, 1992.

*Rate per 1000 construction workers.