

FATAL FALLS IN U.S. RESIDENTIAL CONSTRUCTION

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Falls from heights remain the most common cause of workplace fatalities among residential construction workers in the United States. This paper examines patterns and trends of fall fatalities in U.S. residential construction between 2003 and 2010 by analyzing two large national datasets. The results show that almost half of fatalities in residential construction were from falls during this study period. In the residential roofing industry, 80% of fatalities were from falls. In addition, about one-third of fatal falls in residential construction were among self-employed workers. Workers who were older than 55 years, were Hispanic foreign-born, or employed in small establishments (1-10 employees) also had higher proportions of fatal falls in residential construction compared to those in nonresidential construction. The findings suggest that fall safety of the residential construction industry lag behind commercial construction and industrial settings. Fall preventions in residential construction should be enhanced to better protect construction workers in this sector.

Introduction

Residential construction is one of the important subsectors in the U.S. construction industry, producing nearly half of the value of private construction in the country (U.S. Census Bureau, 2013). Falls from heights remain the leading cause of work-related injuries and fatalities among construction workers, particularly for those employed in residential construction, despite the overall declining trend in injury rates in the United States (CPWR, 2013; Dong *et al.*, 2013, 2012, 2009; Kaskutas *et al.*, 2009). Although there are some studies on safety in residential construction, few studies focus on fatal fall injuries among the U.S. residential construction workers at the national level. Due to the nature of construction work and significant variations between residential and commercial construction, studies covering fall hazards in commercial construction may not yield results with applicable strategies for reducing fatalities among residential workers. It is important to know the circumstances surrounding the residential construction fatal fall incidents to improve safety training and practices. As a result, this study examines the patterns and trends of fall fatalities in U.S. residential construction in order to provide insight for fall mitigation strategies among construction workers.

Method

Work-related death numbers were estimated from the 2003-2010 research files of the Census of Fatal Occupational Injuries (CFOI), a data collection by the U.S. Bureau of Labor Statistics (BLS).

Data on work-related fatalities are compiled from death certificates, workers' compensation reports, reports from the Occupational Safety and Health Administration (OSHA), medical examiner reports, newspaper articles, and other sources. Both the death and work-relatedness of the fatality must be corroborated by at least two data sources, or one data source and a follow-up questionnaire. The CFOI research files were obtained through a data use agreement with the BLS. Data covering employment in construction subsectors are from the Current Employment Statistics (CES), a large monthly establishment survey conducted by the BLS.

Fatalities in the construction industry were identified according to the North American Industry Classification System (NAICS). *Residential construction* includes both "residential building of construction" (NAICS 236xxx) and "residential specialty trade" (NAICS 238xx1; e.g., "residential building finishing contractors," NAICS 238301). *Nonresidential construction* is used as a comparison group, including both "nonresidential building of construction" (NAICS 2362xx) and "nonresidential specialty trade" (NAICS 238xx2; e.g., "nonresidential building finishing contractors," NAICS 238302). *Fatal falls* includes all types of falls (e.g., falls to a lower level, falls on the same level, and unspecified falls; BLS, 2007). *Establishment size* represents the number of wage-and-salary workers employed at the establishment of the decedent. *Fatality rate* is defined by deaths per 100,000 workers. Only fatalities among private wage-and-salary workers are included in the rate calculations to match the employment data in the CES.

Distributions of fatal falls in *residential construction* and *nonresidential construction* by major demographic and employment categories were tabulated and compared with overall fatalities in construction. Chi-square tests were used to measure whether characteristics of falls in residential construction differed significantly from nonresidential fall fatalities at the $\alpha = .05$ level; *t*-tests were applied to test whether the rate of fall fatalities in residential construction was significantly different from the rate in nonresidential construction. All statistical analyses were performed with SAS version 9.2 (SAS Institute, 2008).

Results

From 2003 to 2005, the number of residential fall fatalities increased by 31%, from 102 to 134, then dropped 40% by 2009 (Figure 1). There was a small increase in the number of fall fatalities from 2009 to 2010, from 81 to 87. Comparing residential building and residential specialty trade, the proportion of fatal falls occurring in the residential building subsector showed a slight increasing trend from 2003 to 2010.



Source: 2003-2010 Census of Fatal Occupational Injuries.

This research was conducted with restricted access to Bureau of Labor Statistics (BLS) data. The views expressed here do not necessarily reflect the views of the BLS.

Figure 1. Number of fatal fall injuries in residential construction, 2003-2010

Table 1 compares characteristics of fall fatalities in residential to those in nonresidential construction. More than one quarter (26.5%) of residential fatalities occurred among workers age 55 years and older, compared to just 18.7% of nonresidential fatalities. A larger proportion of Hispanic residential fall decedents were foreign-born when compared to their nonresidential counterparts (27.2% vs. 23.0%, $p < .001$). In addition, nearly one in three residential fatalities occurred among the self-employed, compared to just one in ten nonresidential fatalities. Moreover, decedents in residential construction were more likely to work in small establishments than those in nonresidential construction ($p < .001$). More than 61% of residential fall fatalities occurred among establishments with 10 or fewer employees, compared to 43% of nonresidential fatalities. Region also varied by type of construction ($p < .001$). The South accounted for 46.3% of residential and 54.8% of nonresidential fall fatalities. While the West had similar percentages of fall fatalities, residential construction experienced a higher proportion of fatalities in the Northeast and Midwest.

Table 1. Characteristics of fall fatalities, residential vs. nonresidential construction, 2003-2010

	Residential (<i>n</i> = 869)	Nonresidential (<i>n</i> = 806)	All fatalities (<i>n</i> = 2,986)	<i>p</i> -value ^a
Age (in years)				< .001
16-19	1.6%	2.6%	2.3%	
20-24	8.1%	7.4%	7.1%	
25-34	16.1%	22.5%	18.3%	
35-44	21.9%	23.7%	22.7%	
45-54	25.9%	25.1%	26.5%	
55-64	17.7%	13.7%	16.2%	
65 and over	8.8%	5.0%	6.7%	
Gender				.165
Male	99.7%	99.1%	99.5%	
Race				.446
White	84.7%	84.4%	84.1%	
Black	4.5%	5.6%	5.5%	
Other	10.4%	9.9%	9.8%	
Hispanic origin				.868
Hispanic	32.6%	32.5%	30.1%	
Foreign-born	27.2%	23.0%	23.6%	.001
Self-employed	30.8%	10.9%	19.8%	.001
Establishment size				.001
1-10 employees	61.6%	42.9%	47.4%	
11-19 employees	5.3%	7.4%	6.3%	
20-49 employees	5.3%	13.9%	8.8%	
50-99 employees	2.7%	8.1%	4.7%	
100+ employees	1.6%	12.3%	6.9%	
Not reported	23.6%	15.4%	26.0%	
Region				.001
South	46.3%	54.8%	45.7%	
West	18.3%	18.7%	18.0%	
Northeast	19.8%	12.8%	18.1%	
Midwest	15.7%	13.7%	18.1%	

Source: 2003-2010 Census of Fatal Occupational Injuries

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^a. *p*-values reflect chi-square tests for the association between sector (residential and nonresidential) and other characteristic variables.

When self-employed workers were excluded, average fall fatality rates for 2003-2010 were slightly higher for residential than for nonresidential building construction (4.7 vs. 4.2 fatalities per

100,000 workers); however, the death rate for residential building construction was higher than the average of 4.2 for all construction (Table 2). Over the time period, there was a greater yearly variation among residential building (3.0 to 6.7) compared to nonresidential building (3.3 to 5.3).

Table 2. Number and rate of fatal fall injuries in construction, residential vs. nonresidential building construction, 2003-2010 (Private wage-and-salary workers)

Year	Residential Building NAICS 2361xx		Nonresidential Building NAICS 2632xx		All construction		<i>p</i> -value ^c
	Number	Rate ^{a, b}	Number	Rate ^{a, b}	Number	Rate ^b	
2003	29	3.6	37	5.3	292	4.3	.195
2004	42	5.1	26	3.9	346	5.0	
2005	59	6.7	37	5.3	323	4.4	
2006	52	5.4	25	3.3	345	4.5	
2007	34	3.7	39	4.9	351	4.6	
2008	24	3.0	35	4.3	269	3.8	
2009	27	4.4	23	3.3	205	3.4	
2010	30	5.5	21	3.3	195	3.5	
Average	37	4.7	30	4.2	291	4.2	

Source: 2003-2010 Census of Fatal Occupational Injuries and Current Employment Statistics

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^a Cases without detailed industrial classification information were excluded from calculations.

^b Rate = Number of deaths per 100,000 workers.

^c *p*-value reflects a *t*-test for the rates between residential and nonresidential building construction.

Conclusions and Discussion

This paper examined the patterns and trends of fatal falls in the U.S. residential construction from 2003 to 2010. The results show that almost half of fatalities in residential construction were from falls during the study period. In the residential roofing industry, 80% of fatalities were from falls. Among those fall decedents in residential construction, one in three was self-employed. In addition, workers who were older than 55 years, were Hispanic foreign-born, or worked for small establishments (1-10 employees) had higher proportions of fatal falls in residential construction compared to those in nonresidential construction. The lack of specific fall prevention methods and regulations may contribute to the higher rates of fall deaths in residential construction (Kaskutas *et al.*, 2013, 2010; Sa *et al.*, 2009; Choi, 2006; Lipscomb *et al.*, 2008).

To reduce and eliminate fall injuries, it is imperative to enforce OSHA regulations (OSHA, 2013a, 2013b, 2010). Residential construction companies should have a written fall protection program that specifies what type of fall protection is available, provide adequate training for workers, and enforce fall protection programs. Additional methods that reduce or eliminate fall exposures should also be considered, such as fabrication and preparation of elevated components on the ground level and then later positioned mechanically. Contractors must identify fall protection devices and methods to protect the workers while constructing residential structures. While this may be difficult for small- or medium-sized contractors, increased availability of equipment rental may be an efficient way to improve the widespread use of effective fall protection technologies for small construction companies. Fall protection device manufacturers and the building components industry should collaborate to test the Personal Fall Arrest Systems (PFAS); this will help generate definitive evidence about the safety of PFAS in various applications. Even though resources such as fall prevention programs and protective equipment are necessary, they are less effective without adequate training. Therefore, effective safety training programs should be provided to all construction workers who are exposed to potential fall hazards in performing their job.

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