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DATA REPORT

# Deaths and Injuries Involving Elevators or Escalators in Construction and the General Population

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Elevators and escalators are potential sources of serious injuries and deaths to the general public and workers installing, repairing, and maintaining them. Workers are also at risk when cleaning elevator shafts, conducting emergency evacuations of stalled elevators, or performing construction work near open shafts. This Quarterly Data Report provides updated statistics on elevator- and escalator-related fatal and nonfatal injuries using the most recent data and information on injury prevention from multiple sources. Fatality data are from the Census of Fatal Occupational Injuries (CFOI), and nonfatal injury data are from the Survey of Occupational Injuries and Illnesses (SOII). Both datasets were collected by the U.S. Bureau of Labor Statistics (BLS). To calculate injury rates, denominators were obtained from the Current Population Survey. The number of Occupational Safety and Health Administration (OSHA) inspections and corresponding penalties were also estimated. Additionally, the number of elevator- (product code 1889) or escalator- (product code 1890) related injuries (including non-work-related) treated at hospitals in the general population from 2007 to 2017 was calculated using the National Electronic Injury Surveillance System (NEISS) maintained by the U.S. Consumer Product Safety Commission (CPSC). Selected OSHA safety and health regulations and NIOSH Fatality Assessment and Control Evaluation (FACE) program recommendations regarding how to prevent elevator-related injuries and fatalities are summarized in Table 1.

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## KEY FINDINGS

- There is an upward trend in elevator-related fatalities in construction, as the number of deaths and rate has doubled from 2003 to 2016.
- Between 2011 and 2016, 145 construction workers died due to elevator-related injuries, accounting for more than half of such fatalities in all industries.
- The majority (53.5%) of elevator-related fatalities in construction were caused by falls to a lower level, nearly half (47.9%) of which were falls from 30 feet or more.
- About 46% of construction workers with elevator-related nonfatal injuries required 31 days or more off of work to recover.
- Elevator- or escalator-related injuries treated at hospitals among members of the public jumped by more than 30% from 2007 to 2017.

[1] Includes BLS' Occupational Injury and Illness classifications: elevators, escalators, hoists, aerial lifts, and personnel platforms - except truck-mounted (Source codes 3460-3469, 6613, and 6580); BLS, 2012: Occupational Injury and Illness Classification Manual, Version 2.01. Due to changes in the classification system since 2011, the numbers prior to and after that time may not be comparable.

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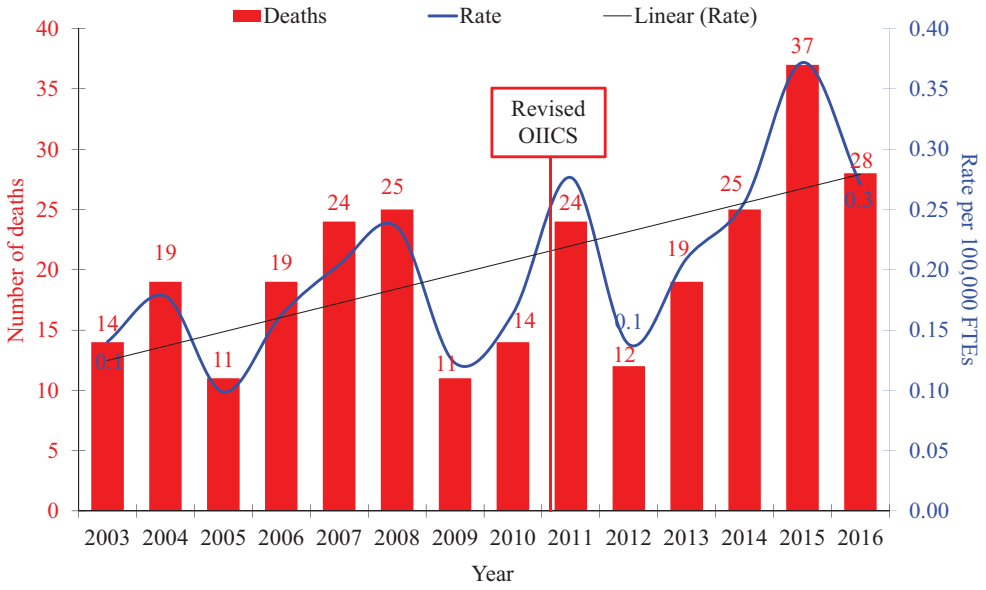
## SECTION 1: Elevator-related fatalities in construction from 2003 to 2016

Elevator-related fatalities in construction fluctuated year-to-year but generally increased over time. The number of such deaths doubled from 14 deaths in 2003 to 28 deaths in 2016, with a peak of 37 deaths in 2015 (chart 1)[2]. The rate of elevator-related deaths among all construction workers jumped from 0.14 to 0.30 per 100,000 full-time equivalent workers (FTEs) during the same period.

**1. Number and rate of elevator-related fatalities in construction, 2003-2016**



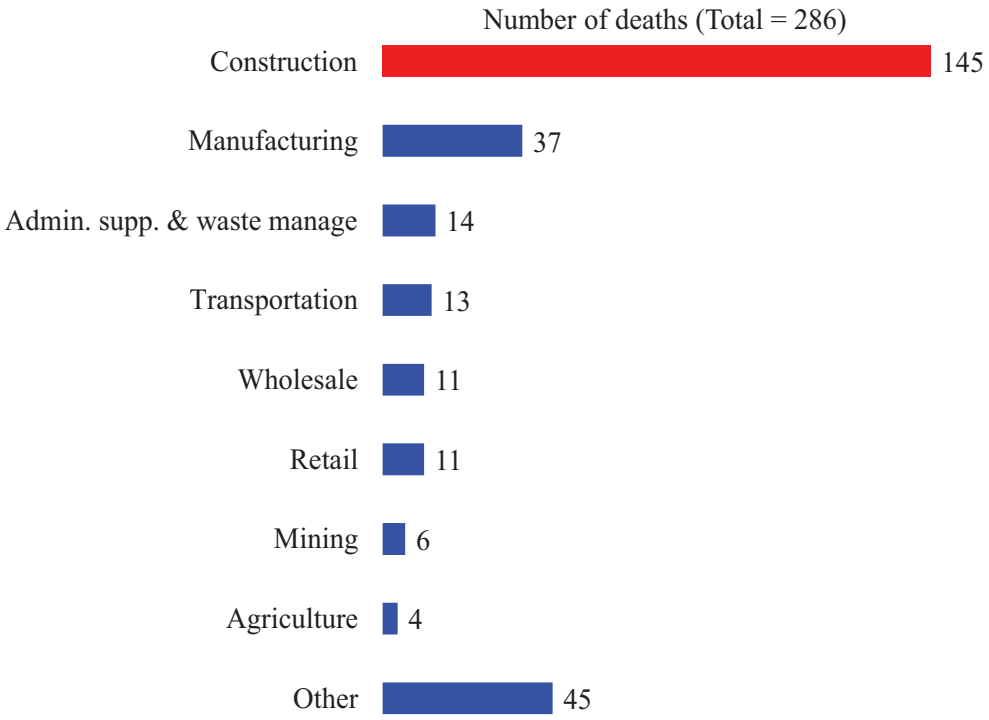

[2] Trendline equation represented in the chart: y = 0.0119x + 0.1123, $R^2$ = 0.4482, p-value = 0.009

***Source***: Fatal injury data were generated by the CPWR Data Center with restricted access to the BLS CFOI micro data. The views expressed here do not necessarily reflect the views of the BLS. Employment data were from the Current Population Survey. Calculations by the CPWR Data Center.

*Section 1: Elevator-related fatalities in construction from 2003 to 2016* Fourth Quarter 2018

From 2011 to 2016, 145 construction workers died due to elevator-related injuries, accounting for more than half (51%) of such fatalities in all industries during that time period. On average, there were about 24 deaths per year, nearly four times as many as in manufacturing, the industry with the second highest number of elevator-related deaths (chart 2).

**2. Elevator-related fatal injuries, by major industry, sum of 2011-2016**

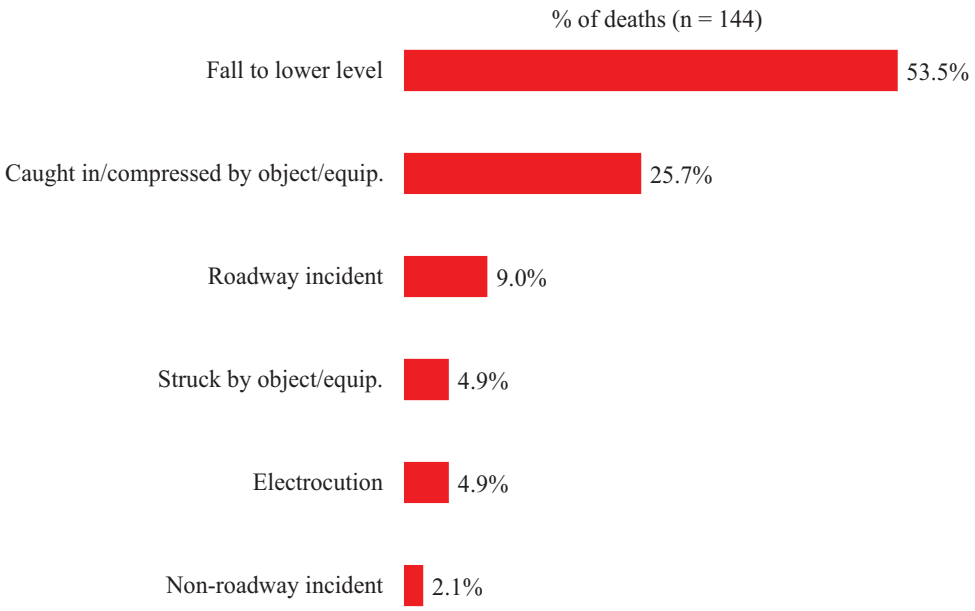



***Source:*** Fatal injury data were generated by the CPWR Data Center with restricted access to the BLS CFOI micro data. The views expressed here do not necessarily reflect the views of the BLS.

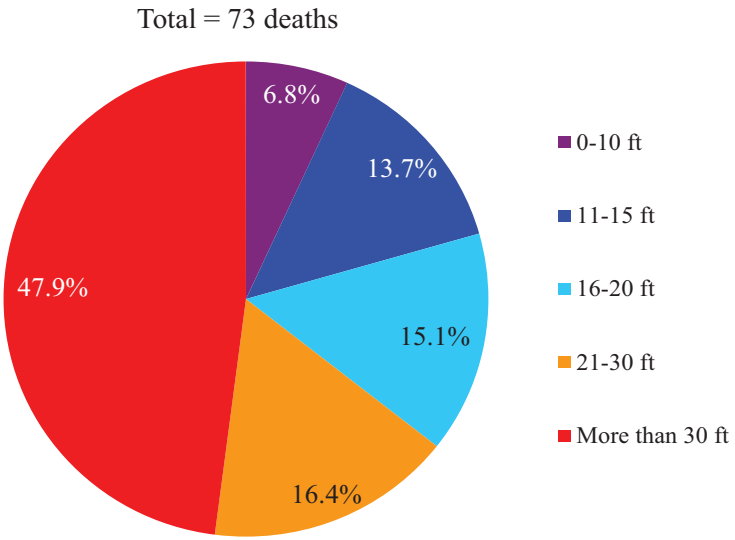
*Section 1: Elevator-related fatalities in construction from 2003 to 2016* Fourth Quarter 2018

The majority (53.5%) of elevator-related fatalities in construction were due to falls to a lower level (chart 3), of which nearly half (47.9%) were from more than 30 feet (chart 4). Being caught in or compressed by an object or equipment was the second-most common cause of elevator-related deaths (25.7%; chart 3).

**3. Elevator-related fatalities in construction, by event or exposure, sum of 2011-2016**




**4. Elevator-related fatalities in construction due to fall to a lower level, by height of fall, sum of 2011-2016***

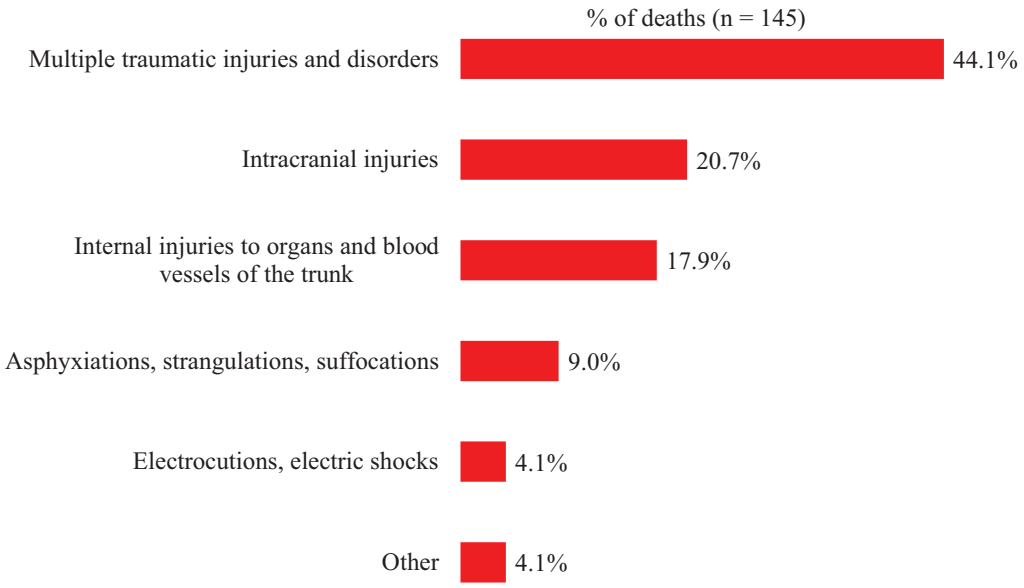



**Note*: Deaths without height information were excluded.
***Source:*** Fatal injury data were generated by the CPWR Data Center with restricted access to the BLS CFOI micro data. The views expressed here do not necessarily reflect the views of the BLS.

*Section 1: Elevator-related fatalities in construction from 2003 to 2016* Fourth Quarter 2018

Over 44% of elevator-related fatalities in construction from 2011 to 2016 were due to multiple traumatic injuries and disorders (e.g., internal injuries involving both head and trunk, blunt force traumas to head and abdomen, head and chest, head and neck; chart 5). Another 20.7% were intracranial injuries, such as crushing head injuries, subdural hematomas, fatal skull fractures, skull fractures accompanied by intracranial injury, craniocerebral trauma, brain contusions, and other similar injuries.

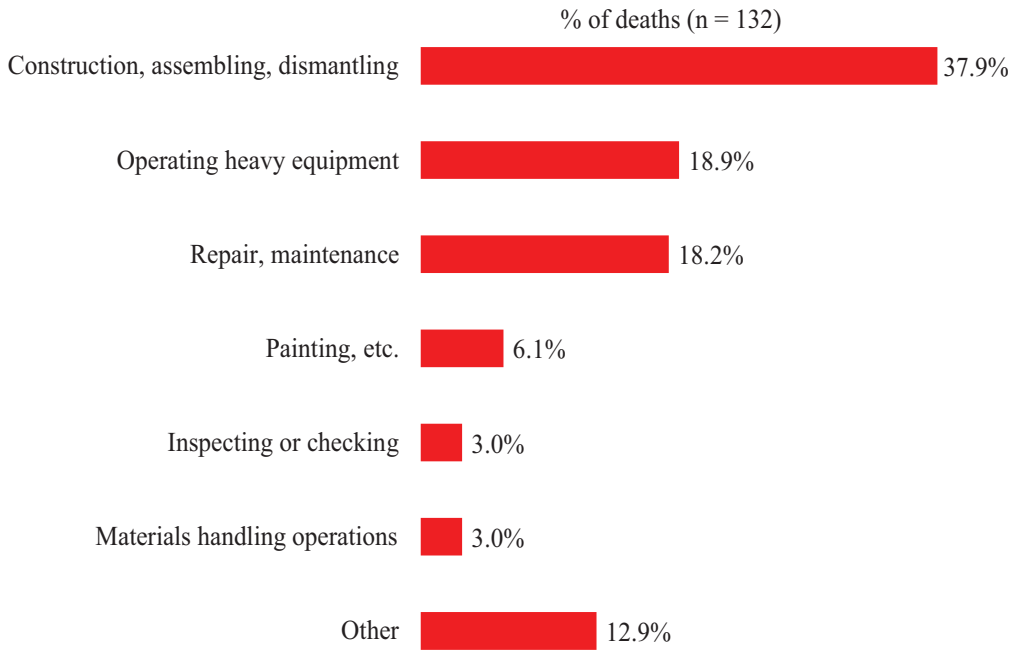
**5. Elevator-related fatalities in construction, by nature of injury, sum of 2011-2016**




***Source:*** Fatal injury data were generated by the CPWR Data Center with restricted access to the BLS CFOI micro data. The views expressed here do not necessarily reflect the views of the BLS.

By activity, more than one-third (37.9%) of elevator-related fatalities in construction occurred while the victim was performing assembling or dismantling tasks. Operating heavy equipment (18.9%) and maintenance / repair (18.2%) were the second- and third-highest activities involving such fatalities (chart 6).

**6. Elevator-related fatalities in construction, by activity, sum of 2011-2016**

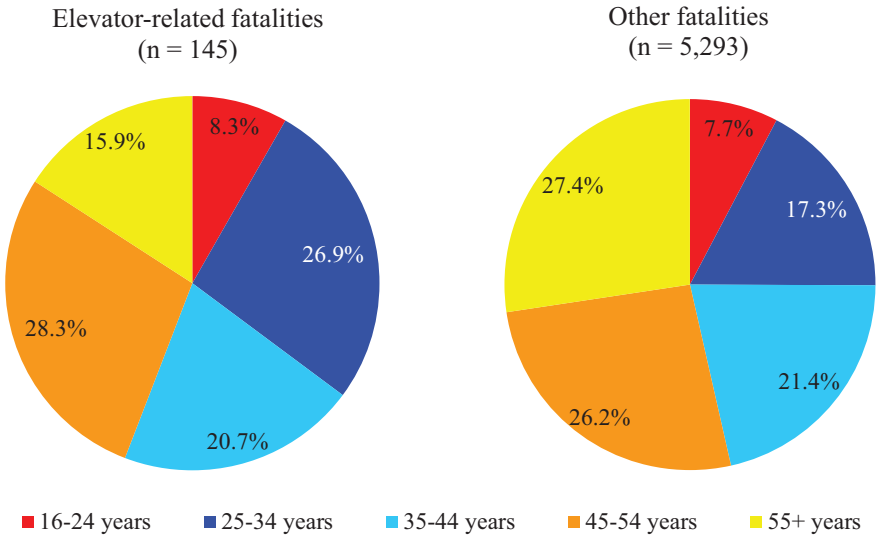



***Source:*** Fatal injury data were generated by the CPWR Data Center with restricted access to the BLS CFOI micro data. The views expressed here do not necessarily reflect the views of the BLS.

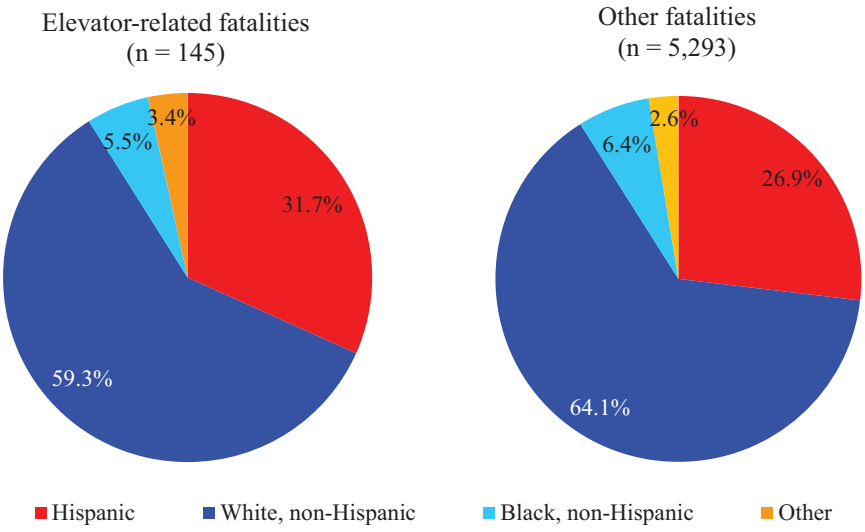
*Section 1: Elevator-related fatalities in construction from 2003 to 2016* Fourth Quarter 2018

The proportion of elevator-related fatalities among younger construction workers was higher than their share in all construction fatalities. Between 2011 and 2016, more than a third (35.2%) of elevator-related deaths in construction occurred to workers younger than 35 years old, while workers in this age group represented a quarter (25.1%) of fatalities by other causes (chart 7). Conversely, workers 55 years and older comprised a smaller share of elevator-related deaths compared to their share of other fatalities (15.9% compared to 27.4%, respectively). Disparities were also found among workers with different racial and ethnic backgrounds. For instance, Hispanic construction workers experienced more elevator-related fatalities than other types of fatalities (31.7% versus 26.9%, respectively; chart 8).[3]

**7. Fatalities by age group, elevator-related versus other fatalities, sum of 2011-2016**



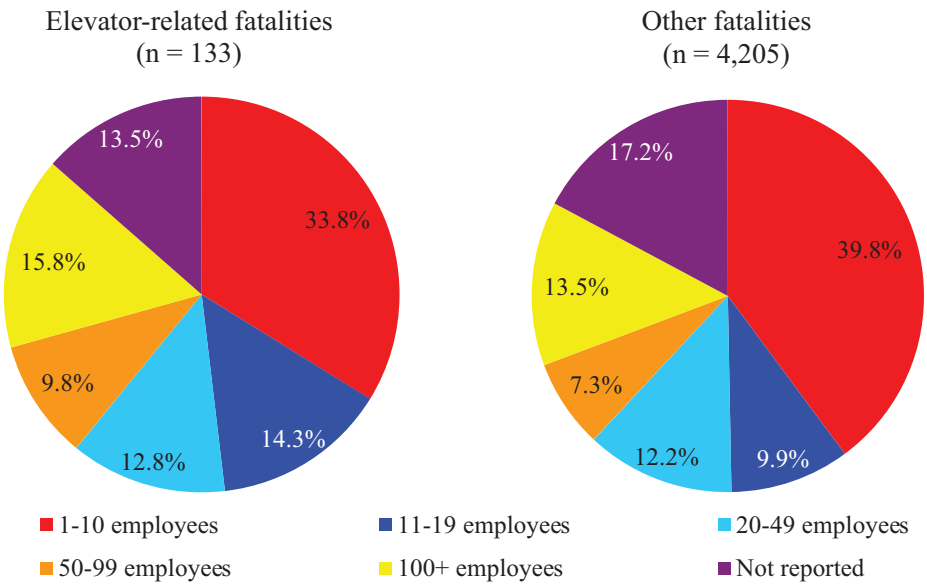

**8. Fatalities by race/ethnicity, elevator-related versus other fatalities, sum of 2011-2016**




[3] The difference among subgroups in construction may not be statistically significant due to small numbers.
***Note***: Other fatalities are non-elevator-related fatalities.
***Source:*** Fatal injury data were generated by the CPWR Data Center with restricted access to the BLS CFOI micro data. The views expressed here do not necessarily reflect the views of the BLS.

Over one-third (33.8%) of elevator-related fatalities occurred at establishments with 10 or fewer employees, lower than their share of other fatalities (39.8%; chart 9). Conversely, establishments with 50 or more employees had a higher proportion of elevator-related fatalities than that of other fatalities (25.6% versus 20.8%, respectively).

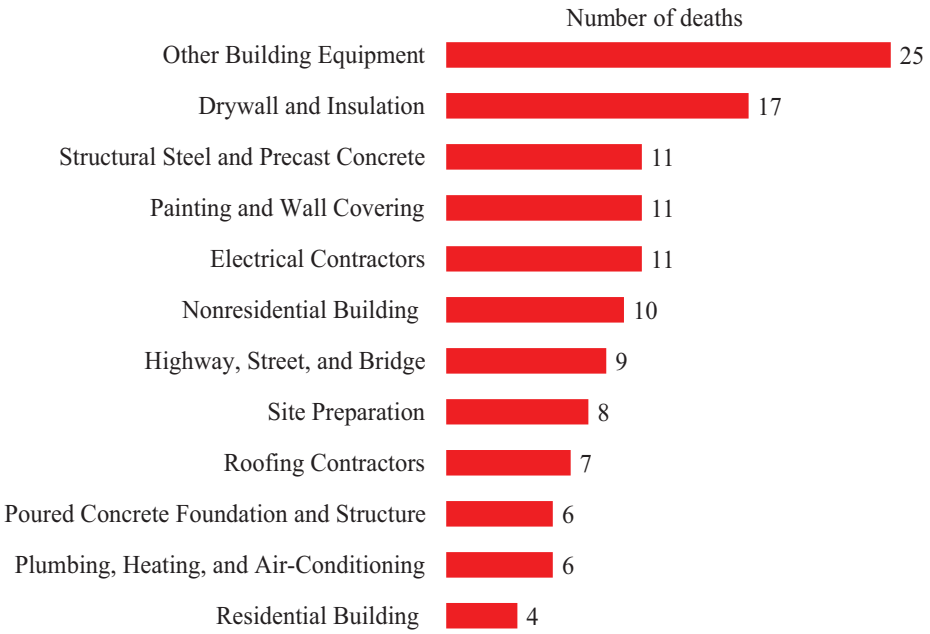
**9. Fatalities by establishment size, elevator-related versus other fatalities, sum of 2011-2016 (Wage-and-salary workers)**




***Note***: Self-employed workers were excluded. Other fatalities are non-elevator-related fatalities.
***Source:*** Fatal injury data were generated by the CPWR Data Center with restricted access to the BLS CFOI micro data. The views expressed here do not necessarily reflect the views of the BLS.

By construction subsector, the Other Building Equipment contractors (NAICS 23829[4]; involving elevator or escalator installation) had more elevator-related fatalities (25 deaths) than any other construction subsector from 2011 to 2016 (chart 10). The next highest construction subsector was Drywall and Insulation contractors with 17 deaths due to elevator-related injuries.

**10. Elevator-related fatalities in construction, selected construction subsectors, sum of 2011-2016**

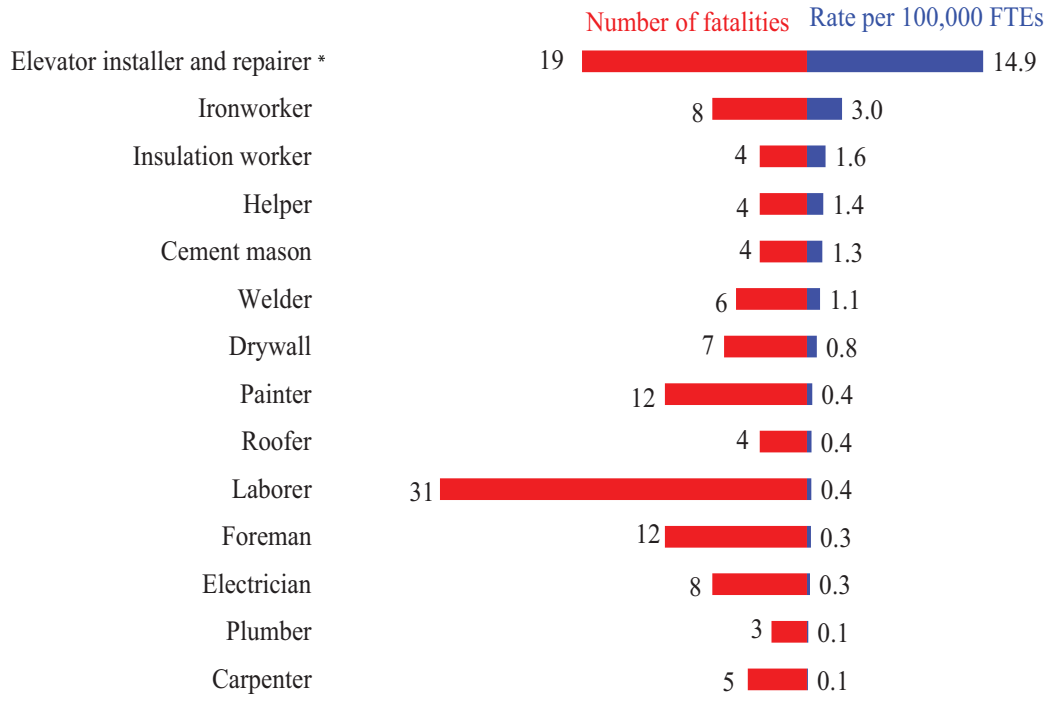



[4] This industry comprises establishments primarily engaged in installing or servicing building equipment (except electrical, plumbing, heating, cooling, or ventilation equipment). The repair and maintenance of miscellaneous building equipment is included in this industry. The work performed may include new work, additions, alterations, maintenance, and repairs.

***Source:*** Fatal injury data were generated by the CPWR Data Center with restricted access to the BLS CFOI micro data. The views expressed here do not necessarily reflect the views of the BLS.

By occupation, elevator installers and repairers had the highest risk of elevator-related deaths in construction, at 14.9 deaths per 100,000 FTEs (chart 11); more than 50 times the rate of such deaths for all construction workers on average (see chart 1). Ironworkers and insulation workers had the second- and third-highest risk of such fatalities, respectively. However, construction laborers had more elevator-related deaths than any other occupation, with 31 deaths from 2011 to 2016.

**11. Number and rate of elevator-related fatalities in construction, selected occupations, sum of 2011-2016**



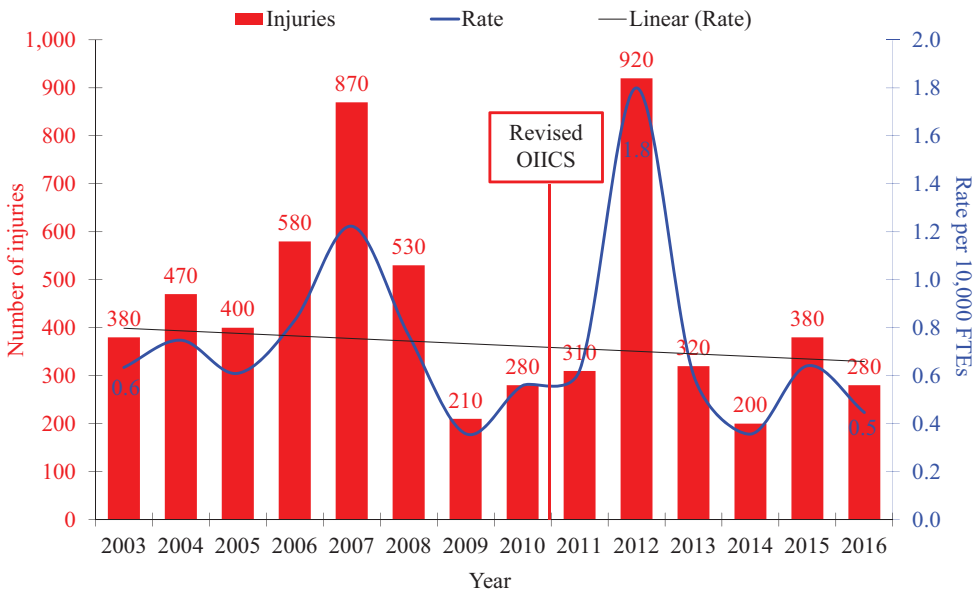

* Standard Occupational Classification (SOC) code 47-4021.

***Source:*** Fatal injury data were generated by the CPWR Data Center with restricted access to the BLS CFOI micro data. Numbers of FTEs were estimated using the Current Population Survey. Calculations by the CPWR Data Center. The views expressed here do not necessarily reflect the views of the BLS.

# SECTION 2: Elevator-related injuries in construction from 2003 to 2016

Unlike fatalities, elevator-related nonfatal injuries in construction generally declined from 2003 to 2016. The number of such injuries reached a high of 920 in 2012 before falling to 280 injuries in 2016, a 70% drop in four years (chart 12). The injury rate followed a similar pattern, spiking to 1.8 injuries per 10,000 FTEs in 2012, and then falling to 0.45 injuries per 10,000 FTEs in 2016, a 75% decrease.

**12. Number and rate of elevator-related injuries in construction, 2003-2016***




*Trendline equation represented in the chart y = -0.0106x + 0.8084, $R^2$ = 0.014, p-value = 0.692

***Source***: Nonfatal injury data were generated by the CPWR Data Center through a special request to the BLS SOII data. The views expressed here do not necessarily reflect the views of the BLS. Employment data were from the Current Population Survey. Calculations by the CPWR Data Center.

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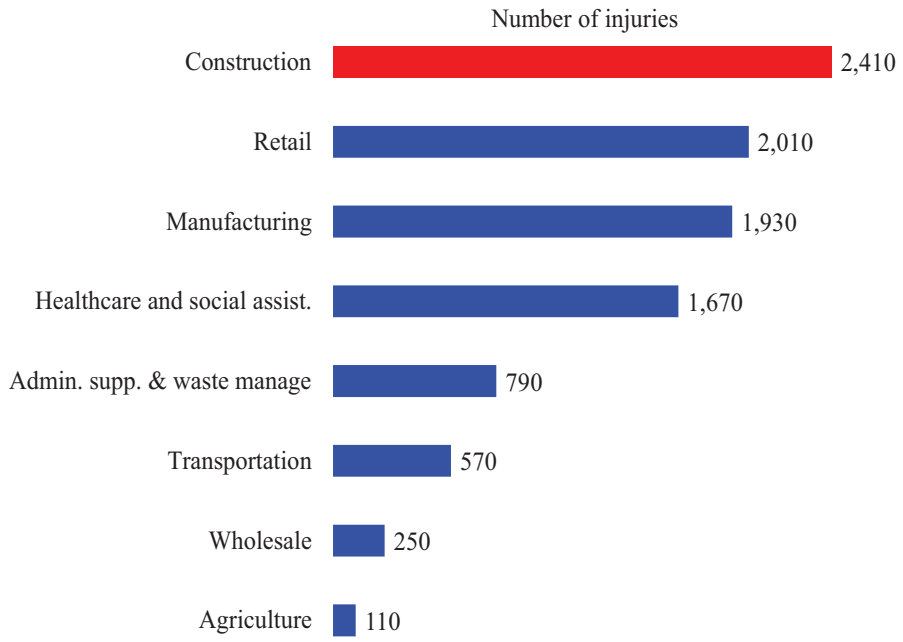
Despite the overall decline in injuries, the construction industry still had the highest number of elevator-related injuries among all major industries in the U.S. (chart 13). From 2011 to 2016, 2,410 construction workers suffered elevator-related injuries, followed by retail (2,010) and manufacturing (1,930) workers, respectively.

**13. Elevator-related injuries, selected major industries, sum of 2011-2016**




***Source:*** Nonfatal injury data were generated by the CPWR Data Center through a special request to the BLS SOII data. The views expressed here do not necessarily reflect the views of the BLS

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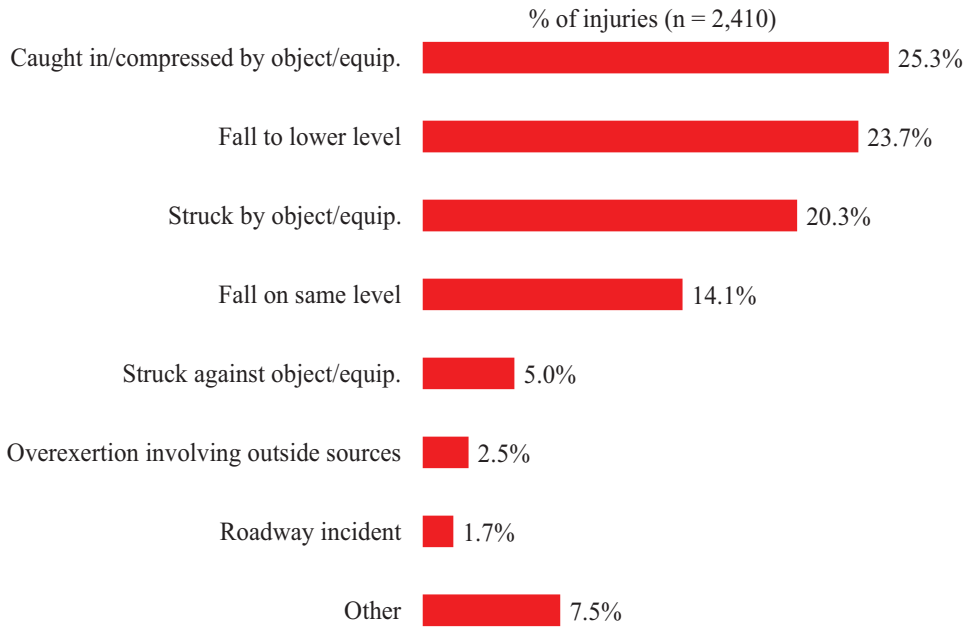
The causes of elevator-related nonfatal injuries differed from fatal injuries. Being caught in or compressed by an object or equipment was the most common cause of elevator-related injuries (25.3%), followed by falls to a lower level (23.7%), and being struck by an object or equipment (20.3%; chart 14).

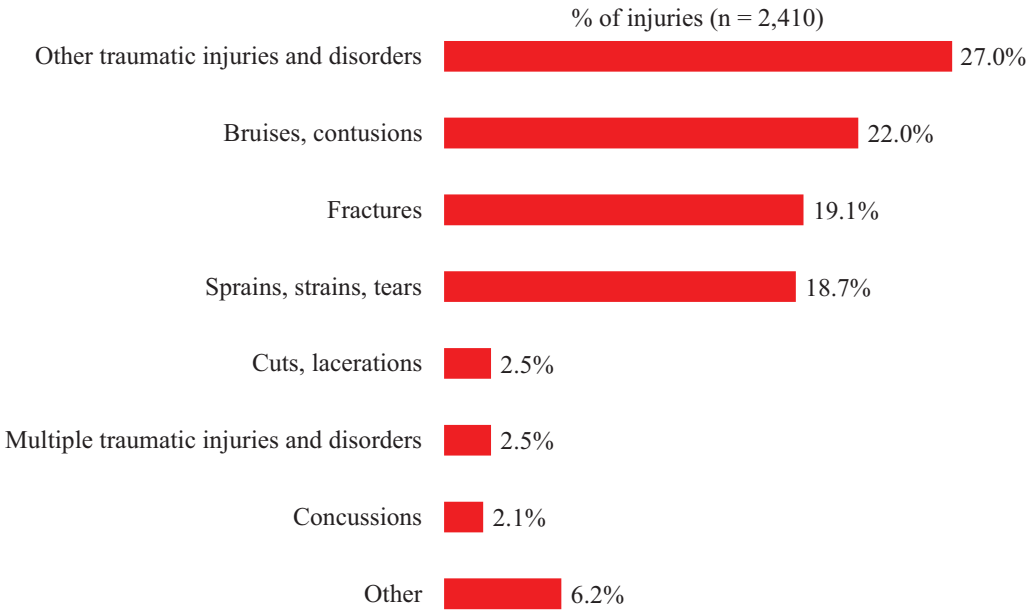
**14. Elevator-related injuries in construction, by event or exposure, sum of 2011-2016**




***Source:*** Nonfatal injury data were generated by the CPWR Data Center through a special request to the BLS SOII data. The views expressed here do not necessarily reflect the views of the BLS.

In terms of the nature of injury, other traumatic injuries and disorders comprised 27% of elevator-related injuries in construction between 2011 and 2016, followed by bruises and contusions (22%; chart 15). Other common injuries were fractures and sprains, strains, and tears, at about 19% for each category.

**15. Elevator-related injuries in construction, by nature of injury, sum of 2011-2016**

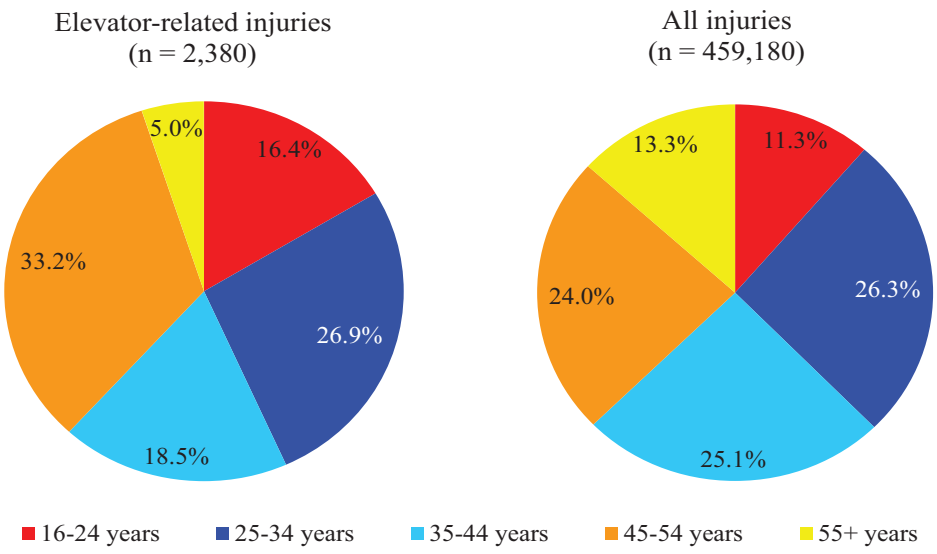



***Source:*** Nonfatal injury data were generated by the CPWR Data Center through a special request to the BLS SOII data. The views expressed here do not necessarily reflect the views of the BLS.

*Section 2: Elevator-related injuries in construction from 2003 to 2016* Fourth Quarter 2018

By age group, construction workers aged 16-24 were overrepresented among elevator-related injuries compared to their share of all injuries (16% versus 11%; chart 16). Workers ages 45 to 54 years were also more likely to have an elevator-related injury than all injuries (33% versus 24%, respectively).

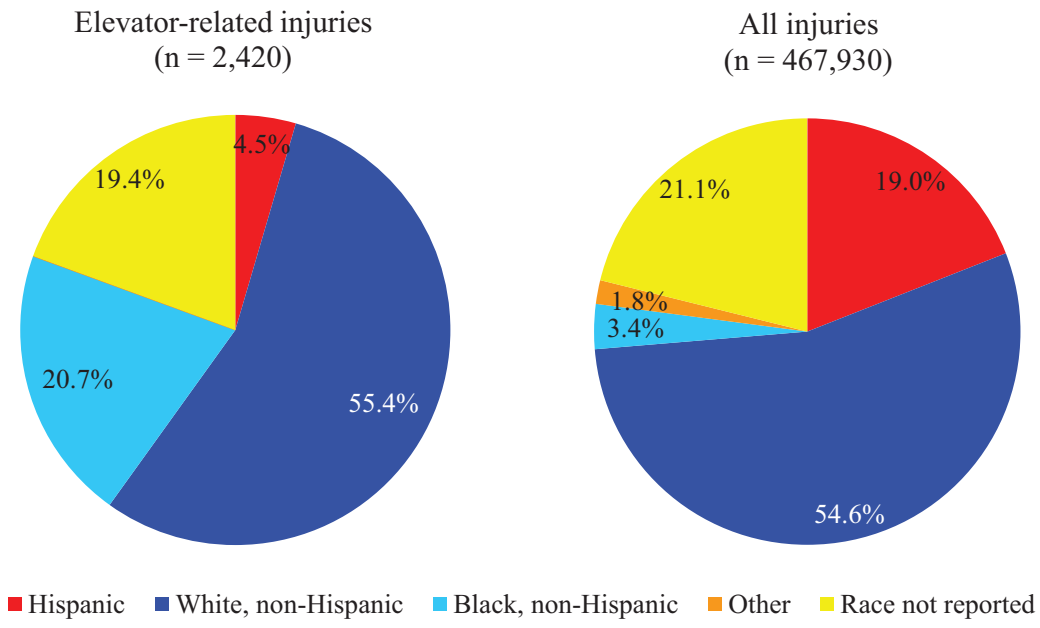
**16. Nonfatal injuries in construction by age group, elevator-related versus all injuries, sum of 2011-2016**




***Note***: Cases without age information were excluded.
***Source:*** Nonfatal injury data were generated by the CPWR Data Center through a special request to the BLS SOII data. The views expressed here do not necessarily reflect the views of the BLS.

Unlike elevator-related fatalities, black, non-Hispanic construction workers were more likely to have elevator-related nonfatal injuries compared to their share of all injuries (21% versus 3%, respectively; chart 17). However, Hispanic workers were less likely to experience elevator-related injuries than all injures (5% versus 19%, respectively).[5]

**17. Nonfatal injuries in construction by race/ethnicity, elevator-related versus all injuries, sum of 2011-2016**

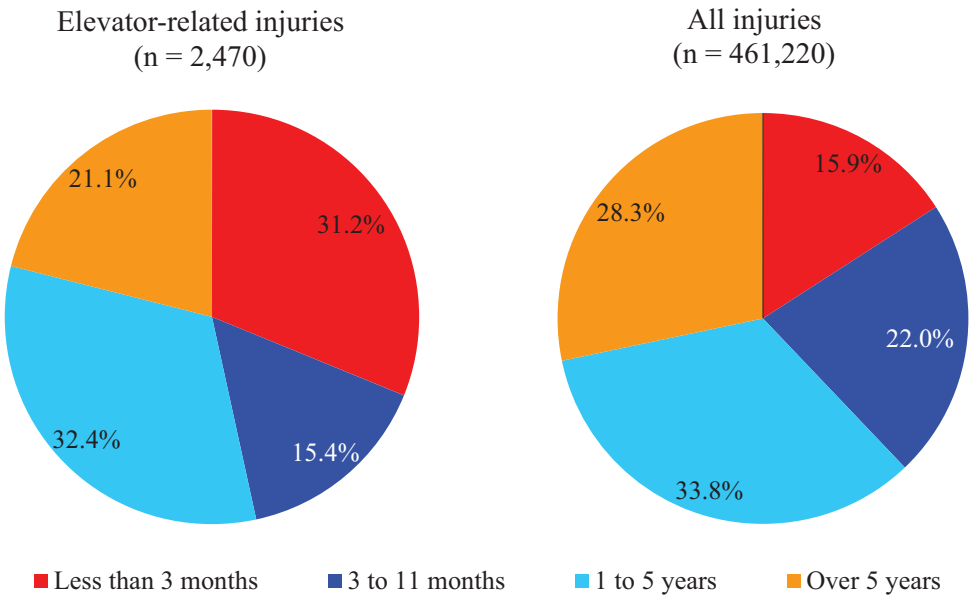



[5] The estimates may not be reliable since the data source is a sample survey and the sample size for the subgroups is small.

***Source:*** Nonfatal injury data were generated by the CPWR Data Center through a special request to the BLS SOII data. The views expressed here do not necessarily reflect the views of the BLS.

Elevator-related injuries were more common among new workers. Almost a third (31.2%) of elevator-related injuries occurred to workers who had been on the job for less than 3 months, nearly twice their share of all injuries (15.9%; chart 18).

**18. Nonfatal injuries in construction by length of service with employer, elevator-related versus all injuries, sum of 2011-2016**




***Note***: Cases without length of service information were excluded.
***Source:*** Nonfatal injury data were generated by the CPWR Data Center through a special request to the BLS SOII data. The views expressed here do not necessarily reflect the views of the BLS.

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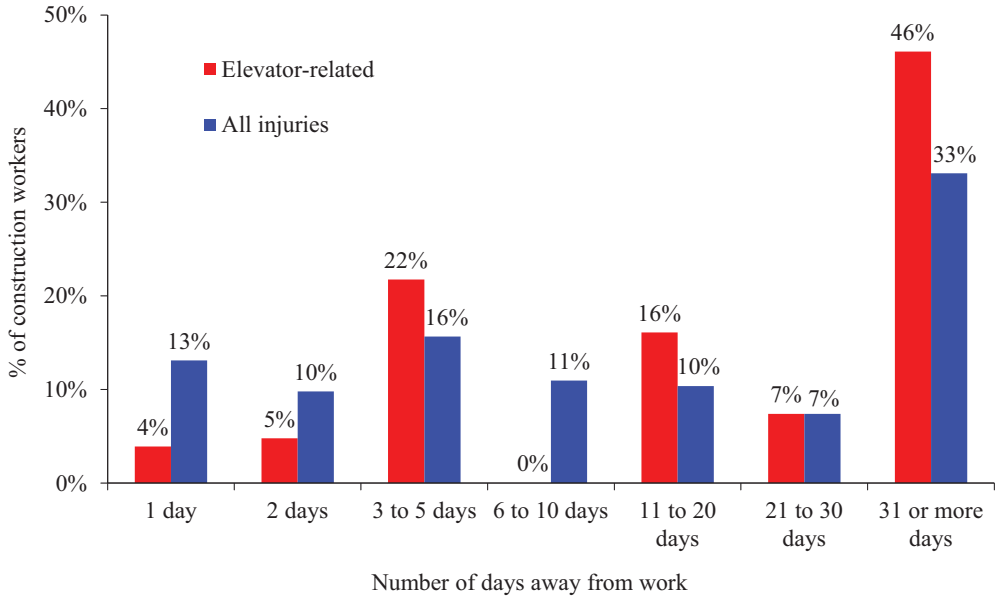
Elevator-related injuries need more time to heal than other types of injuries. Close to half (46%) of construction workers who suffered elevator-related injuries took 31 days or more away from work due to the injury, while a third (33%) of construction workers with all types of injures took as much time off from work (chart 19).

**19. Nonfatal injuries in construction by number of days away from work, elevator-related versus all injuries, sum of 2011-2016**




***Source:*** Nonfatal injury data were generated by the CPWR Data Center through a special request to the BLS SOII data. The views expressed here do not necessarily reflect the views of the BLS.

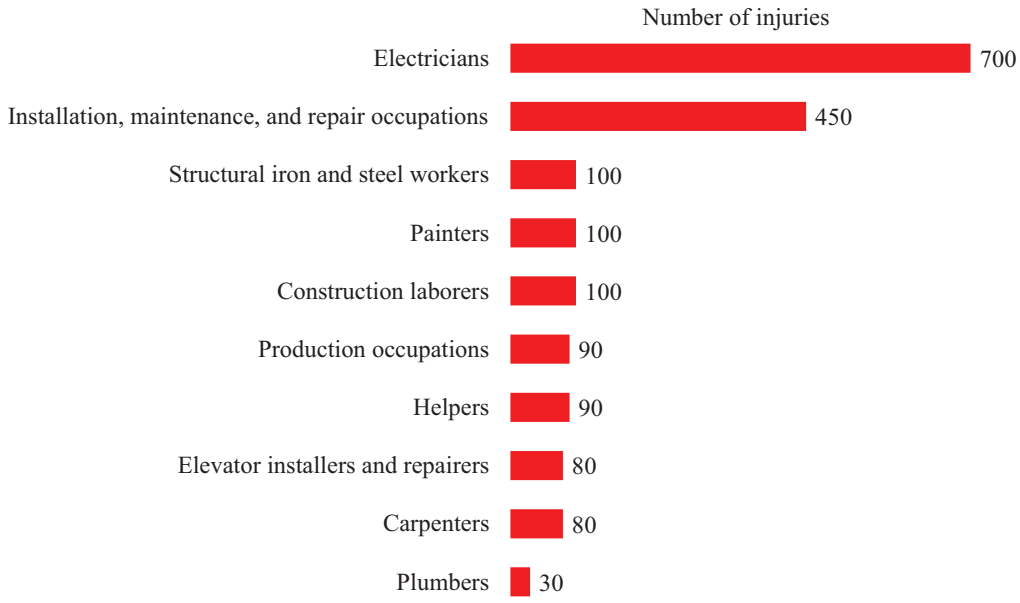
By construction subsector, the Electrical and Wiring contractors had the highest number of elevator-related injuries in construction from 2011 to 2016 (780 injuries). The next highest subsector, Nonresidential Building contractors, had half as many injuries (390) during this same time period (chart 20).

**20. Elevator-related injuries in construction, selected construction subsectors, sum of 2011-2016**


***Source:*** Nonfatal injury data were generated by the CPWR Data Center through a special request to the BLS SOII data. The views expressed here do not necessarily reflect the views of the BLS.

By occupation, 700 electricians in construction reported elevator-related injuries from 2011 to 2016, more than any other occupation. Installation, maintenance, and repair occupations[6] were the second highest at 450 injuries (chart 21).

**21. Elevator-related injuries in construction, selected construction occupations, sum of 2011-2016**




[6] SOC 49-0000 is a major occupational category, including multiple occupations, such as Elevator Installers and Repairers, Electrical and Electronics Repairers, Commercial and Industrial Equipment, Heating and Air Conditioning Mechanics and Installers, etc.

***Source:*** Nonfatal injury data were generated by the CPWR Data Center through a special request to the BLS SOII data. The views expressed here do not necessarily reflect the views of the BLS.

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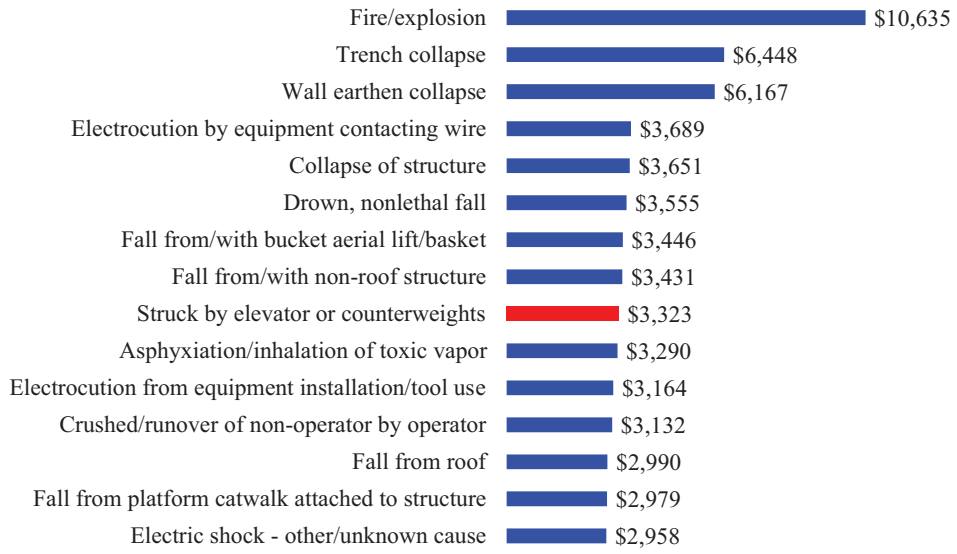
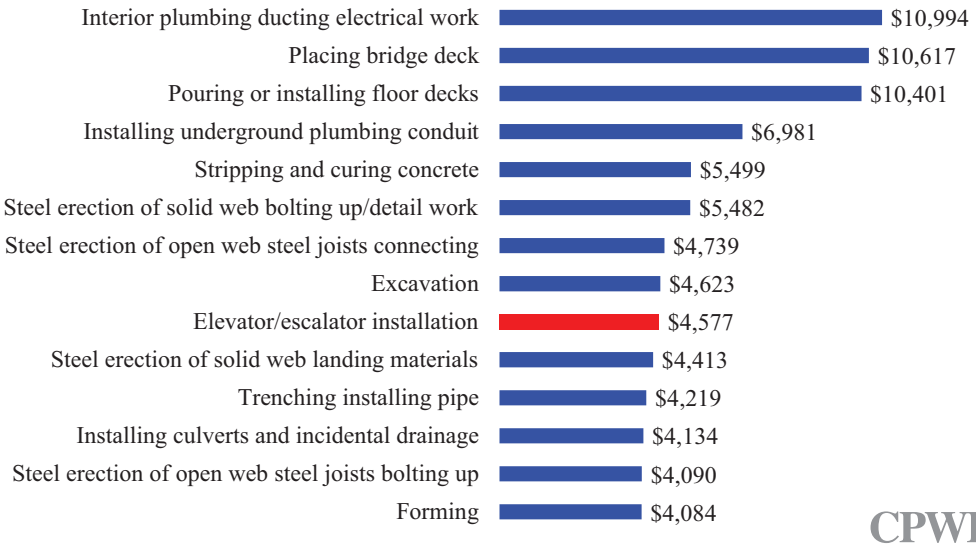
## SECTION 3: OSHA penalties

Between 2003 and 2016, OSHA conducted investigations of 117 elevator-related deaths including 53 elevator-related deaths due to being struck by elevators or counterweights, and 221 nonfatal cases involving elevator/escalator installations. Although the number of cases inspected was relatively small, the penalties for both fatal and nonfatal cases were among the top ten causes of injury. Penalties for struck-by elevators or counterweights averaged $3,323 per case (chart 22), while penalties for nonfatal injuries during elevator/escalator insallation deaths averaged $4,577 per case (chart 23).

**22. Average OSHA penalty by cause of fatalities, 2003-2016**




**23. Average OSHA penalty by cause of injury, 2003-2016**




***Source***: U.S. Occupational Safety and Health Administration, 2003-2016 Integrated Management Information System. Calculations by the CPWR Data Center

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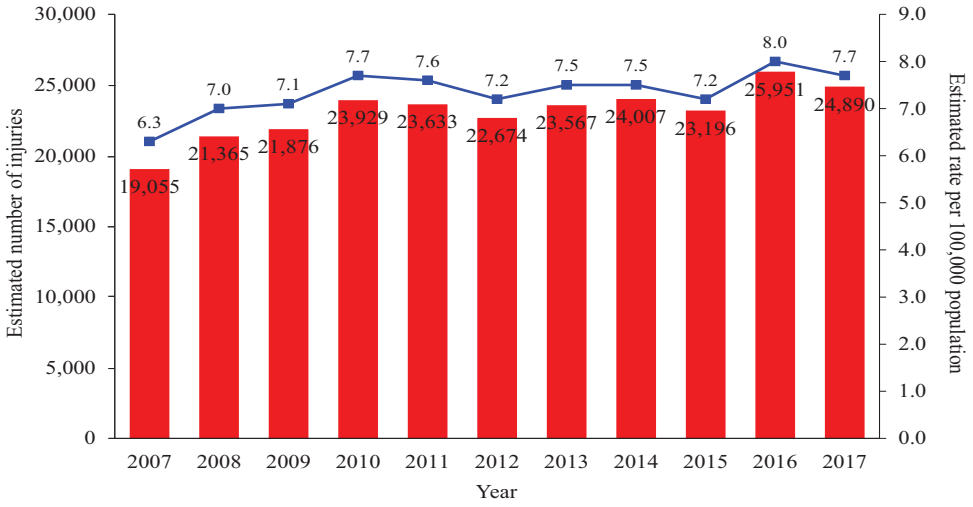
## SECTION 4: Elevator or escalator injuries treated in hospitals, all population

A number of serious injuries related to elevators and escalators occurred among members of the public. The U.S. Consumer Product Safety Commission (CPSC) collects data on consumer product-related injuries occurring in the United States using a probability sample of U.S. hospitals with emergency departments through the National Electronic Injury Surveillance System (NEISS). Estimated numbers from the NEISS data show that elevator- or escalator-related injuries treated at hospitals (including work and non-work-related injuries) jumped by more than 30% from about 19,000 in 2007 to nearly 25,000 in 2017 (chart 24), of which more than 10% were injuries to children younger than 15 years old.

**24. Estimated elevator- or escalator-related injuries treated at hospitals in the U.S., 2007-2017**




***Source***: U.S. Consumer Product Safety Commission, 2007-2017 National Electronic Injury Surveillance System. Calculations by the CPWR Data Center.

## SECTION 5: Injury Prevention in Construction

Many of the elevator- and escalator-related deaths and injuries could have been prevented if adequate protection and safe work practices and procedures had been in place. The following table summarizes recommendations from investigators with the NIOSH Fatality Assessment and Control Evaluation (FACE) program, as well as selected OSHA regulations and guidance for elevator-related injury prevention.

**Table I: FACE recommendations and OSHA requirements to prevent elevator-related injuries and fatalities**

| Categories | FACE Recommendations | OSHA Requirements |
|---|---|---|
| Personal Protective Equipment (PPE) | Provide functional personal fall arrest systems (PFAS) | • All employers are required to provide fall protection systems [1926.502(a)(1)]<br>• Personal fall arrest systems (PFAS) shall be inspected prior to each use for wear, damage, and other deterioration, and defective components shall be removed from service [1926.502(d)(21)] |
| | Provide protective equipment and enforce proper use of PFAS | • All PPE must be provided by the employer at no cost to employees [1926.95(d)]<br>• The employer is responsible for requiring the wearing of appropriate PPE any time it is necessary to protect workers [1926.28(a)] |
| Equipment | Provide proper equipment for the task | • Walking/working surfaces are required to have structural integrity to safely support employees [1926.501(a)(2)]<br>• Employer must maintain equipment properly and ensure its adequacy, even if it is supplied by the employee [1926.95(a, b)]<br>• Employers shall permit only employees qualified by training or experience to operate equipment and machinery [1926.20(b)(4)] |
| | Install safety protection | • Guardrail systems, safety net systems, or PFAS are required on any surface with an unprotected side 6 feet or more above a lower level [1926.501(b)(1)]; well, pit, shaft, or excavation [1926.501(b)(7)(ii)]; or dangerous equipment [1926.501(b)(8)(ii)] |
| | Prevention through Design | • All moving parts of equipment should be guarded if they create a hazard for workers [1926.300(b)(2)] |
| Training | Provide safety training | • Employer shall instruct each employee to recognize and avoid unsafe conditions [1926.21(b)(2)]<br>• Training must be provided to any employee who may be exposed to fall hazards, on topics which include the nature of fall hazards in the work area, the use and operation of protections, and the procedures for using and inspecting the fall protection systems to be used [1926.503(a)] |
| | Train local emergency medical services on worksite safety | • The employer must have medical personnel available, including provisions for prompt medical attention in case of serious injury, and in the absence of an accessible infirmary, clinic, hospital, or physician, someone with valid verifiable first-aid training should be available, and first aid supplies must be easily accessible [1926.50(a-d)] |
| Safety Management | Conduct job safety analysis (JSA) and develop a safety checklist | • Employers must designate competent persons to frequently and regularly inspect job sites, materials, and equipment [1926.20(b)(2)]<br>• While safety checklists are not required, OSHA provides checklists to help ensure workers stay free of hazards that cause injuries |
| | Ensure safe worksite conditions | • Employers must initiate and maintain accident prevention programs [1926.20(b)]<br>• Areas where work is in progress should be lighted [1926.26]<br>• Hazardous substances like dusts and fumes should not exceed specified limits [1926.57(a)]<br>• The employer should ensure electrical equipment is free from recognized hazards that are likely to cause death or serious physical harm [1926.403(b)(1)] |
| | Designate competent safety monitor | • Employers must designate a competent person to monitor the safety of other employees who can recognize fall and other hazards and who will warn employees who are unaware of fall hazards or acting unsafely [1926.502(h)(1)] |

## Discussion and Conclusion

The construction industry experiences more elevator-related fatal and nonfatal injuries than any other major industry sector. From 2011 to 2016, elevator-related incidents caused 145 deaths and 2,410 severe injuries among construction workers. Although nonfatal injuries involving elevators declined over time, both the number and rate of such fatal injuries increased in recent years. More than one-third of elevator-related fatalities occurred while the victim was performing assembling or dismantling tasks, and the majority of elevator-related fatalities in construction were due to falls to a lower level. Elevator installers and repairers had the highest risk of fatal injuries among all construction occupations. Younger construction workers had a higher risk of both fatal and nonfatal injuries involving elevators than their older counterparts. While Hispanic workers had a higher risk of elevator-related fatal injuries, they were less likely to experience nonfatal injuries related to elevators. Moreover, about 25,000 people in the general public were treated at hospitals due to elevator- or escalator-related injuries in 2017, and the number jumped by 30% in the last decade.

To ensure the safe operation of elevators and the protection of employees, OSHA requires employers to assure that employees who install and maintain elevators are adequately trained and knowledgeable about proper installation, wiring, and maintenance procedures. Organizations such as the American Society of Mechanical Engineers (ASME) have set standards for the construction and maintenance of elevators and escalators and their safe operation. In addition, NIOSH FACE reports have provided specific recommendations on how to prevent elevator-related injuries based on case evaluations (*see* Table I). Given that the majority of elevator-related fatalities are caused by falls to a lower level, employers should ensure that workers who perform tasks involving elevators or escalators are protected from falls when the potential for falls exist. Moreover, the increased number of elevator- or escalator-related injuries among the general population suggests that elevator or escalator safety should be enhanced not only for workers, but also for the general public.

## Table References


- OSHA Safety and Health Regulations for Construction, https://www.osha.gov/laws-regs/regulations/standardnumber/1926
- OSHA Worker Safety Series: Construction, Safety Checklists, https://www.osha.gov/Publications/OSHA3252/3252.html
- NIOSH Fatality Assessment and Control Evaluation (FACE) Program, https://www.cdc.gov/niosh/face/default.html

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## Data Sources

- U.S. Bureau of Labor Statistics, 2003-2016 Census of Fatal Occupational Injuries
- U.S. Bureau of Labor Statistics, 2003-2016 Survey of Occupational Injuries and Illnesses
- U.S. Bureau of Labor Statistics, 2011-2016 Current Population Survey
- U.S. Consumer Product Safety Commission, 2007-2017 National Electronic Injury Surveillance System
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## About the CPWR Data Center

The CPWR Data Center is part of CPWR – The Center for Construction Research and Training. CPWR is a 501(c)(3) nonprofit research and training institution created by North America's Building Trades Unions, and serves as its research arm. CPWR has focused on construction safety and health research since 1990. The Quarterly Data Reports – a series of publications analyzing construction-related data, is part of our ongoing surveillance project funded by the National Institute for Occupational Safety and Health (NIOSH).

Please visit CPWR's other resources to help reduce construction safety and health hazards:

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