

Injuries among teens employed in the homebuilding industry in North Carolina

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Abstract

Objective—To describe injuries of teens employed in the residential construction industry and to assess whether their injury experiences are significantly different from those of adults in this high risk industry.

Methods and setting—North Carolina homebuilders workers' compensation data for a 41 month period were analyzed. Injuries of teens were identified and described by body part injured, nature, and cause of injury. Proportionate injury ratios were used to summarize and compare the injury experience of teens with those of adult construction workers.

Results—Teens had proportionately more injuries to the eye and foot and fewer injuries to the back than adults. They had more cuts and scratches and fewer sprains and strains. They also had proportionately fewer injuries from falls from elevations and overexertion, injuries that account for a significant cost burden in construction. Consistent with these findings, teens had significantly fewer injuries resulting in medical costs or lost time costs of \$1000 or more.

Conclusions—The analyses indicate that injuries of teens are less serious than those of adults. This finding may indicate that their work exposures are less dangerous than those of adults in comparable broad categories of construction. However, the data also provide documentation of injuries to teens resulting from work at heights, use of power tools, and motor vehicles with the majority of more expensive claims involving one of these exposures. Construction is dangerous work and these results add to the documentation of the need for additional measures to prevent work related injuries among all workers—teens and adults—in this industry.

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More than four million 15–17 year olds in the United States were employed at some point in 1996 and by high school graduation 80% of teens work.¹ Twenty eight per cent of all 15 year olds and 51% of 16–17 year olds in the United States work.² Although information about teens employed in the construction industry is limited, data from a number of sources

document fatal and non-fatal injuries among teens employed in the construction industry.^{3–6}

Construction is one of the largest and most dangerous industries. Individuals working in construction not only have higher rates of work related injuries than other trade groups, but they are also among the most likely to experience serious injuries.⁷ Fatal and lost work time injuries in the construction trades continue to rank among the highest in the United States.^{8–12} The risk of injury does not appear to be equal for all groups of construction workers. Inexperienced workers (less than one year), such as teens, have been described as being at greater risk of having serious work related injury⁷ as have smaller size construction employers.¹³

In residential construction particularly, job sites are small with fewer workers at any given site. The jobs are typically shorter in duration than in commercial construction and the nature of the work changes from day to day. Although there are few sources of information specific to residential construction, there are data that suggest that individuals doing this type of construction are at particularly high risk of injury.^{14 15} Teens may be included in this group. North Carolina, a non-union state, has recently been in the midst of rapid economic expansion with an associated increase in the homebuilding industry. In high growth situations, demand for workers may encourage the hiring of young and inexperienced workers or the extension of hours to meet labor needs. The purpose of this paper was to investigate the injury experience of teens in North Carolina in residential construction and to assess whether their injuries reported through workers' compensation in this high risk industry differ significantly from those of adults.

Methods

DATA SOURCES

Workers' compensation data for these analyses were provided by Builders' Mutual Insurance Company, the self insured compensation fund for the North Carolina Homebuilders' Association (NCHA). In 1995, the fund began providing workers' compensation insurance coverage and claims processing for approximately 7500 active NCHA members and their subcontractors. Subcontractor coverage is required of the prime contractor unless the subcontractor has other workers' compensation coverage and can show a valid certificate of insurance. Most subcontractors in North Carolina elect to be covered by the prime contractor. Contractors are required to report injuries that result in medical costs of \$2000 or

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more or claims that result in lost time from work beyond the day of injury, although some report minor medical claims that do not meet this threshold of severity.

Computerized claims for NCHA members and their subcontractors were obtained for the period 1 July 1996 to 30 November 1999 with personal identifiers and contractor names removed. These data contain standard information including body part injured, nature of injury, and mechanism of injury, using modified American National Standards Institute codes. In addition, data are available on whether the injury required medical care or if it resulted in paid lost time (which occurs in North Carolina after the seventh lost day) and amounts paid for compensation costs and medical care. The occupation, or job, of the injured worker is recorded on the claim. A brief free text description taken from the first report of injury (maximally 120 characters) is also available. Completion of the first report of injury is an administrative requirement; descriptions may be provided directly by the injured or by their foreman or supervisor.

ANALYSES

Injuries of teens were described by body part injured, nature and mechanism of injury. Proportionate injury ratios were used to summarize and compare the injury experiences of teens with those of adult construction workers employed in home building. The proportionate injury ratio analyses are similar to proportionate mortality ratio analyses^{16, 17} commonly used to identify differences among groups when no information is available about the underlying population.

The observed proportions of claims among teens were compared to that expected had they had the same injury experience as the adults in the same trade groups. The categories of trade groups used for these analyses are the same as those used in other analyses of construction workers in North Carolina.¹⁵ This technique is analogous to indirect adjustment but with an adjustment for trade instead of age. Proportionate analyses were performed by body part injured, nature of injury, mechanism of injury, and categories of paid lost time and medical costs. Confidence intervals were calculated (95%) and statistical significance of observed to expected ratios was assessed using a χ^2 test with one degree of freedom.

The distribution of costs for medical care and compensation were calculated, and the free text descriptions of injuries in the top 7% of costs were reviewed in detail. Descriptions of injuries from the text data for teens under the age of 18, who are subject to protection under child labor regulations, were also reviewed by a representative of the North Carolina Department of Labor to identify possible violations of child labor laws. Proportionate analyses were not conducted comparing those under the age of 18 to all others due to the limited number of claims for this age group resulting in low counts in many strata.

Results

During the 41 month period between 1 July 1996 and 30 November 1999, 9205 work related injuries occurred among workers employed in the homebuilding industry. Age was missing from 1832 claims (19.9%). There were no systematic differences in the claims for which age was missing compared to those with this information based on the distributions of month of injury, nature, body part or mechanism of injury.

Individuals under the age of 20 at the time of their injury filed 347 claims; 74 of these individuals were under the age of 18. As expected, there was a marked increase in the frequency of injuries in summer months for individuals under age 18 consistent with summer employment, with 52% of injuries among teens occurring in June, July, or August. There was also an increase in the frequency of injuries in June and July for those 18 and 19 years old, a likely indication that a portion of this age group of workers are summer employees.

The distribution of claims filed by teens and the proportionate injury ratios by body part injured, injury nature, and mechanism of injury are presented in table 1. Injuries were most common to the hand or fingers and the lower extremity. The nature of injuries described most frequently were lacerations and sprains or strains. The injuries of teens most often resulted from being struck by something or from being cut. These teens also experienced 29 falls from elevations—injuries that often result in serious injuries. Fourteen (48%) of these falls resulted in fractures and the remainder resulted in sprain/strains, contusions or cuts. Teens had proportionately more injuries

Table 1 Proportionate injury analyses by body part, nature, and mechanism of injury among teens (age 15–19) in the North Carolina homebuilding industry, 1996–99

Description of injury	No (%) observed injuries	PIR* (95% CI)
A. Body part injured		
Head	8 (2.3)	0.9 (0.38 to 1.6)
Eye	41 (11.8)	1.4† (0.99 to 1.8)
Back	28 (8.1)	0.5† (0.32 to 0.68)
Upper extremity	40 (11.5)	0.9 (0.65 to 1.2)
Hand/fingers	89 (25.6)	1.0 (0.83 to 1.3)
Lower extremity	55 (15.9)	1.0 (0.72 to 1.2)
Foot/toes	35 (10.1)	1.7† (1.2 to 2.3)
Other	51 (14.7)	1.2 (0.90 to 1.6)
B. Nature of injury		
Sprains/strains	57 (16.4)	0.6† (0.42 to 0.71)
Cuts/scratches	134 (38.6)	1.3† (1.1 to 1.5)
Fracture	34 (9.8)	0.9 (0.63 to 1.2)
Contusion	43 (12.4)	1.1 (0.79 to 1.4)
Foreign body	37 (10.7)	1.4 (0.97 to 1.9)
Other	42 (11.8)	1.2 (0.82 to 1.6)
C. Mechanism of injury		
Burn	6 (1.7)	1.4 (0.52 to 2.8)
Caught	9 (2.6)	1.0 (0.47 to 1.8)
Cut	70 (20.2)	1.2 (0.90 to 1.5)
Fall from elevations	29 (8.4)	0.6† (0.41 to 0.86)
Fall same level	16 (4.6)	0.8 (0.43 to 1.8)
Motor vehicle	6 (1.7)	1.5 (0.54 to 2.9)
Overexertion	34 (9.8)	0.5† (0.31 to 0.62)
Struck by	117 (33.7)	1.5† (1.2 to 1.8)
Eye injury	30 (8.6)	1.3 (0.88 to 1.8)
Other	30 (8.6)	1.2 (0.78 to 1.6)

*Proportionate injury ratio (PIR) = 1 indicates observed proportion of injuries = to expected based on injury experience of adults in same trade group. Example: PIR = 1.3 represents 30% more than expected; PIR = 0.6 represents 40% less than expected.

†Statistically significant ($p < 0.05$).

CI = confidence interval.

Table 2 Proportionate injury analyses based on costs for medical care or paid lost time among teens (age 15–19) in the North Carolina homebuilding industry, 1996–99

Associated costs	No (%) observed injuries	PIR* (95% CI)
A. Medical costs		
No medical costs	65 (18.7)	1.1 (0.87 to 1.4)
< \$500	205 (59.1)	1.2† (1.03 to 1.4)
\$500–999	27 (7.8)	0.79 (0.50 to 1.1)
\$1000–4999	27 (7.8)	0.61† (0.40 to 0.86)
\$5000 and more	23 (6.6)	0.62† (0.39 to 0.90)
B. Paid lost time		
No paid lost time costs	294 (84.7)	1.1 (0.99 to 1.3)
< \$500	19 (5.5)	1.3 (0.79 to 2.0)
\$500–999	8 (2.3)	1.1 (0.45 to 1.9)
\$1000–4999	18 (5.2)	0.61† (0.36 to 0.93)
\$5000 and more	8 (2.3)	0.24† (0.10 to 0.44)

*Proportionate injury ratio (PIR) = 1 indicates observed proportion of injuries = to expected based on injury experience of adults in same trade group. Example: PIR = 1.3 represents 30% more than expected; PIR = 0.6 represents 40% less than expected.

†Statistically significant (p<0.05).
CI = confidence interval.

to the eye and foot or toes and fewer injuries to the back than adults. They had more cuts/scratches and fewer sprains or strains. They had proportionately more injuries that resulted from being struck and fewer injuries that resulted from overexertion and falls from elevations. Medical costs ranged from zero to \$69 860 with a mean of \$1263 and a median of \$181. Amounts paid for lost time ranged from zero to \$34 590 with a mean of \$513 and a median of zero. For proportionate analyses, claims were stratified into categories of medical and lost time costs including no costs, less than \$500, \$500–999, \$1000–4999, and \$5000 and greater (table 2). Teens had significantly fewer injuries that resulted in medical or lost time costs of \$1000 or more and more injuries with less than \$500 in medical costs.

There were 26 injuries which resulted in at least \$5000 in medical costs or \$2000 in costs for paid lost time among teens. Nine (35%) of these costly injuries among teens involved falls from elevations. The surface from which these teens fell included roofs (n=2), ladders (n=2), scaffolding (n=1), opening in subflooring (n=1), a walkboard (n=1), a truck (n=1), and a forklift (n=1). Six (23%) involved power tools including saws, nail guns, and a drill. Five

(19%) involved the injured being struck by framed walls that fell (n=3), a roof that collapsed (n=1), and a stack of plywood (n=1). Three of the costly injuries (12%) involved motor vehicles including a truck, a forklift, and a tractor. The most costly injury was the result of a roof falling on the injured, followed by an individual whose shirt was caught in a drill, and an individual who fell from the back of a truck. Four of these more serious injuries occurred among teens under the age of 18 including two falls from elevations, an injury associated with a nail gun, and an injury sustained when helping to raise a wall.

Of the remaining 70 injuries reported by teens under the age of 18, the majority were minor medical claims involving no paid time off from work. This finding is consistent with the proportionate analyses results of all teen injuries. Over half were described as cuts, scrapes, or lacerations (n=17; 24%); poison ivy (n=9; 13%); foreign bodies in the eye (n=5; 7%); or contusions (n=5; 7%) from a variety of situations. There were four injuries (5%) which appeared from the brief text descriptions to be probable violations of child labor laws and six (8%) that represent possible violations. The descriptions of these 10 injuries and the related labor violations are presented in table 3. Three of the four more costly claims described above among workers under the age of 18 involved probable violations of child labor laws, including a fall from the back of a truck, an injury involving a nail gun, and an injury to a 15 year old helping to raise a wall.

Discussion

STRENGTHS AND CONTRIBUTIONS OF THE STUDY
These analyses provide information about injuries of teens in the residential construction industry in a non-union state—a group that is difficult to identify and study. We know of no other reports focused on injuries among teens in residential construction. Builders' Mutual Insurance Company may not insure high risk contractors, but they do cover the majority of homebuilders in the state. The findings document that work exposures of teenagers in

Table 3 Violations of child labor regulations, injuries, and types of work among teens under 18 years of age in the North Carolina homebuilding industry, 1996–99

Labor violation	Brief description of injury	Type of work
Teen <18 years old cannot operate motor vehicle on public road*	Tire blew out and he lost control of the van; fractured finger (if driving on public road)	Carpentry
Teen <18 years old cannot operate nailgun*	Walking with nail gun. Gun bumped leg causing gun to fire; punctured right lower leg (if using nailgun)	Carpentry
Teen <18 years old cannot operate nailgun*	Nailing a board—nail missed board hitting left foot (if using a nailgun)	Carpentry
Teen <18 years old cannot operate nailgun	Nailing two pieces of lumber together using nail gun—nail ricocheted off edge of wood; punctured right leg above knee	Carpentry
Teen <18 years old cannot operate nailgun	Using nail gun when gun went off in hand; punctured center of left hand	Concrete construction
Teen <18 years old cannot work on roof	Working on a roof	Roofing
Teen under 16 years old cannot work on construction site	Standing a wall up; wall slipped and swung around knocking claimant into brace; dislocated hip (15 year old)	Carpentry
Teen under 18 years old cannot drive on public road or work as an "outside helper"	Company vehicle struck in rear by another car (if driving on a public road or working as an "outside helper" on the truck)	Mechanics and repairers
Teen under 18 years old cannot operate lifts*	Was on a lift—got off wrong; twisted right foot (if operating the lift)	Masonry
Teen under 18 years old cannot work as an "outside helper"	Fell out of back of truck: 6 ft drop; cut chin and elbow (if working as an "outside helper" on the truck)	Landscaping

*If condition is in parentheses the activity represents violation of child labor regulations.

†"Outside helper" is defined by federal child labor rules as any individual, other than the driver, whose work includes riding on a motor vehicle outside the cab for the purpose of assisting in transporting or delivering goods.

residential construction are not limited to summer months—even for teens under the age of 18. The proportionate analyses appear to indicate that injuries of teens are less serious than those of adults and may indicate that their work exposures are less dangerous than adults in comparable broad categories of construction trades.

Our finding of fewer back injuries among teens is consistent with results from a study of work injuries among teens in West Virginia, which employed similar proportional analyses but was not limited to the construction industry.¹⁸ These findings are somewhat surprising since it is likely that unskilled teens would be assigned manual materials handling tasks that would place them at risk for back injuries. It is possible that teens may be less prone to injuries associated with these tasks, particularly injuries related to cumulative trauma over the course of working life. Younger inexperienced union carpenters, but not necessarily teens, in drywall installation have been reported to be at greater risk of injuries from being struck by objects.¹⁹ The decreasing risk of injuries with age and time in the union, as well as the nature of the injuries, suggested that they were related to training and/or experience and appear consistent with our findings among teens in the homebuilding industry.

While some aspects of these analyses are reassuring, it is important to recognize that because the injuries of teens do not appear to be as serious as those of adults in this high risk trade does not mean that they did not experience serious injuries. The limited free text descriptions of the injuries to teens clearly document exposure to, and injuries resulting from, work at heights, use of power tools—drills, nail guns, saws—and motor vehicles including company vehicles, forklifts, trucks, and tractors. In fact, the vast majority of more expensive claims involved one of these three exposures. The National Institute for Occupational Safety and Health's Fatality Assessment Control Evaluation Program, a case based surveillance project, has described deaths among two teens under the age of 17 from falls from a roof²⁰ and from a forklift.²¹ The circumstances surrounding these fatalities are strikingly similar to two of the more costly injuries among these teens in the homebuilding industry. Construction is dangerous work and these results add to the documentation of the need for additional measures to prevent work related injuries among all workers—teens and adults—in this industry.

LIMITATIONS

This work utilized workers' compensation claims data from a large group of homebuilders in North Carolina, and there are limitations to any analyses based on workers' compensation claims. Factors which influence whether an injured worker chooses to file a claim, such as knowledge of workers' rights or fear of reprisal for reporting, influence the data that are available for analyses. The information presented in the brief text descriptions of injury is not reported, collected, or recorded in any standard manner. In addition to these limitations

inherent in the use of compensation data, Builders' Mutual Insurance Company will drop coverage for members that have excessive losses. The safety manager for the fund openly discourages the hiring of teens under the age of 18, raising the possibility that these injuries are not representative of higher risk contractors. Thus, our findings may be an optimistic appraisal of the injury experience of teens working on residential sites.

We had no exposure information, and even though our proportionate analyses compared the injury experience of teens with adults in similar trades, this does not mean that they were performing similar tasks or had similar exposures. In fact, our findings provide some indication that teens do not perform the same tasks as adult residential workers. These administrative data provide no information on training in construction tasks or health and safety. We do not have any information about the knowledge of child labor laws for those under the age of 18—nor of the contractors who hire them or the individuals who supervise their work on job sites. We had no information about the population at risk, so we could not calculate rates of injury.

The fact that age was missing on 20% of the claims raises concern about a biased presentation. To assess the potential magnitude of error we performed analyses assuming all claims missing age were those of adults and again assuming they were all teens. With the missing assumed to be adults there were minimal changes in our findings. As expected based on the frequency of claims, when the missing are all assumed to be teens, an unlikely scenario, the findings are diminished somewhat and make the injury experience of teens look more like those of adult construction workers. In the latter case, injuries to the foot and toes remain significantly elevated among teens. None of the categories of injury nature were significantly different from adults. Overexertion injuries of teens remain proportionately less than those of adults and struck by injuries remain elevated. The proportionate injury ratio for motor vehicle injuries become significantly raised at 2.6.

Limitations of proportionate analyses are well recognized.^{16 17 22} Because the sum of all proportionate ratios (expressed as weighted fractions) must equal one, an excess in one type of injury must be offset by a deficit in another. The magnitude of the ratios for any given injury category in our analyses is thus dependent upon the magnitude of the other ratios. However, studies have shown that proportionate mortality ratios are useful indicators of disease risk, and we believe they do provide a reasonable method for making comparisons such as these.

Implications for prevention

Even though the injury experience of teens on residential sites appears to be less serious than that of adults, some of our findings raise concerns at a policy level. Some of the injuries among these teens involved violations of child labor laws; others involved activities which are

legal under current regulations but which place teens at significant risk. By example, teens under age 18 are prohibited from working on roofs in North Carolina, but they are allowed to work at heights on other surfaces. The work surfaces from which these teens fell—roofs, scaffolds, ladders, joists, openings, and walkboards—are all reported as dangerous surfaces among adults in the homebuilding industry; with ladders being the most common surface from which residential construction workers fall.¹⁵ Given the challenging nature of providing adequate fall protection among adults working in residential construction¹⁵ and the well documented costs of injuries resulting from falls,^{9 23-25} it would seem prudent to limit exposure to heights among teen workers regardless of the work surface. Insurers, such as the self insured group from which we obtained these data, could institute policy changes for their insured contractors before changes were made in child labor regulations.

Residential construction sites present significant challenges for enforcement of any safety regulations including those related to child labor. The sites are small and dispersed, few workers are present on site at any given time, and the site changes daily. Teen and adult workers need to be aware of existing child labor regulations. This topic should be included in training programs for youth in schools and in technical classes where they may learn construction trade skills. It is also an appropriate topic for site specific tool box safety talks where teens will be working. Young and inexperienced workers, even those no longer covered under child labor regulations, are likely to benefit from mentoring on construction sites. This may be particularly important in a non-union environment, such as North Carolina, where more formal apprenticeship training does not occur.

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Key points

- Based on proportionate analyses of workers' compensation data, injuries of teens employed in the homebuilding industry are less serious than those of adults in similar trade groups.
- Teens had proportionately more injuries to the eye and foot and fewer injuries to the back than adults, and teens had more cuts and scratches and fewer sprains and strains.
- Teens had proportionately fewer injuries from falls from elevations and overexertion, injuries that account for a significant cost burden in construction.
- Despite these findings, teens did have injuries that resulted from work at heights, use of power tools, and motor vehicles; the majority of more expensive claims were associated with one of these exposures.
- Some injuries among teens involved violations of child labor laws; others involved activities which are legal under current regulations but which place teens at significant risk.
- Construction is dangerous work and there is the need for additional measures to prevent work related injuries among all workers—teens and adults—in this industry.

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