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Fatal Injuries to Teenage Construction Workers in the US

Anthony Suruda, MD, MPH,[1]* Peter Philips, PhD,[2] Dean Lillquist, PhD,[1] and Richard Sesek, PhD, MPH[3]

Background *The construction industry is second only to agriculture in the annual number of fatal injuries in workers less than 18 years of age. We examined fatal injury reports for youth and adult workers to determine risk factors for injury and applicability of existing child labor regulations.*

Methods *The US Occupational Safety & Health Administration (OSHA) investigation data for fatal work injuries from 1984 through 1998 were reviewed with respect to type of event, employer characteristics, and apparent violations of existing child labor laws under the Fair Labor Standards Act (FLSA). We also examined whether the employer met exemption criteria for federal enforcement of child labor or OSHA regulations.*

Results *The fatality rate for teenage construction workers age 19 and younger was 12.1 per 100,000 per year, slightly less than for adult workers. Teenage workers who were fatally injured were more likely than adults to have been employed at non-union construction firms (odds ratio (OR) = 4.96, $P < 0.05$), firms with fewer than 11 employees ($OR = 1.72$, $P < 0.05$), and their employers were more likely to have been cited by OSHA for safety violations ($OR = 1.66$, $P < 0.05$) than for firms which were investigated because of a fatality in an adult worker. Fatalities in teenagers were more likely to occur in special construction trades such as roofing. Among fatalities in workers less than 18 years of age, approximately one-half (49%) of the 76 fatal injuries were in apparent violation of existing child labor regulations. We estimated that in 41 of the 76 cases (54%) the employer's gross annual income exceeded the $500,000 threshold for federal enforcement of child labor laws. Only 28 of 76 cases (37%) were at construction firms with 11 or more employees, which are subject to routine OSHA inspections.*

Conclusions *Fatal injuries in teenage construction workers differed from those in adults in that they were more likely to be at small, non-union firms of which a substantial proportion were exempt from federal enforcement of child labor laws and from routine OSHA inspections. Safety programs for young construction workers should include small, non-union construction firms and those in special construction trades such as roofing. We did not identify specific areas for new regulation but the number of fatalities reviewed was small.* Am. J. Ind. Med. 44:510–514, 2003. *© 2003 Wiley-Liss, Inc.*

KEY WORDS: fatality; OSHA enforcement; child labor laws; small businesses; construction industry; labor unions

[1]Department of Family & Preventive Medicine, University of Utah, Salt Lake City, Utah
[2]Department of Economics, University of Utah, Salt Lake City, Utah
[3]Department of Mechanical Engineering, University of Utah, Salt Lake City, Utah
Contract grant sponsor: National Institute for Occupational Safety & Health; Contract grant number: U60/CCU817182.
*Correspondence to: Anthony Suruda, Rocky Mountain Center for Occupational & Environmental Health, 75 South 2000 East, Salt Lake City, UT 84112-5120.
E-mail: tonysuruda@aol.com

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INTRODUCTION

The 1998 Institute of Medicine report ''Protecting Youth at Work'' [IOM, 1998] found that existing child labor regulations fail to address the full range of health and safety hazards, and technologies in the contemporary workplaces in which young workers are now employed. The report advocated a national initiative to develop and provide information and training to reduce the risks and enhance the benefits associated with youth employment.

Although construction provided only 3% of youth employment in 1990 [NIOSH, 1997], the construction industry accounted for the second largest proportion of fatal work injuries for 16- and 17-year-olds (17% of all fatalities), second only to agriculture [Castillo et al., 1994].

In the US, child labor laws defined in the Fair Labor Standards Act (FLSA) apply to agricultural employment before age 16, and employment in non-agricultural occupations before the age of 18. There are 17 work activities proscribed for children in non-agricultural occupations. These are referred to as hazardous orders. Hazardous orders particularly applicable to the construction industry include prohibitions for roofing work, work in trenches and excavations, operation of powered hoisting apparatus or powered woodworking machines, and wrecking and demolition work. Children less than 16 years of age may not be employed in construction.

Small businesses in the US are exempt from certain types of federal regulation. For example, establishments with fewer than 11 employees are exempt from routine Occupational Safety & Health Administration (OSHA) inspections [Mintz, 1984]. With respect to child labor laws, beginning in April, 1990 federal enforcement in the construction industry was restricted by legislative action to business firms with gross annual income exceeding $500,000 by section 3(s)1 of the FLSA (29 US Code).

The present study was conducted to evaluate fatal work injuries among young workers with respect to hazards, safety regulations, union status, and employment in small construction firms. We used OSHA investigation reports for fatal work injuries because they include information on union status, employer size, safety violations, and usually include sufficient information to determine if a work activity was in apparent violation of hazardous orders.

MATERIALS AND METHODS

The study population consists of all US construction workers with a fatal work injury from April, 1984 (when narrative reports were first included in the OSHA data) through 1998, whose deaths were investigated by OSHA. Excluded from the study are fatalities in California, Michigan, and Washington State for 1984–1989 (these data were not maintained in a format compatible with federal data and so were not available from OSHA).

Employment data for the US construction industry were estimated from the Current Employment Survey, and the proportion of teenagers and adults was obtained from the Current Population Survey for the years 1984–1998. Teenage workers are defined as those age 13 through 19. Fatality rates were determined for teenage workers and for adults aged 20 years and older.

Simple descriptive statistics were calculated. We compared the frequencies of various factors listed in the OSHA investigation reports (e.g., source of injury = electrical apparatus/wiring) and used 2×2 tables comparing the factor of interest among teenage fatalities and the same factor for adults versus all other factors in that category and reported the results as odds ratios.

For purposes of determining whether the $500,000 gross annual income exemption applied to employers who experienced a fatal injury to a worker less than 18 years of age, we estimated gross annual income from the Census of Construction using the number of employees of the construction firm and the Standard Industrial Classification (SIC) of the employer.

The narrative descriptions from the OSHA investigation reports for fatalities in workers less than 18 years of age were reviewed as in a previous study [Suruda and Halperin, 1991] independently by an occupational medicine physician (AS) and an industrial hygienist (DL) who were familiar with hazardous orders. Each report was evaluated with respect to specific hazardous orders [US Department of Labor, 1978] and age violations (construction work is prohibited for those less than 16 years of age). A mechanical engineer who was a safety engineer (RS) also reviewed the reports and served as a tie-breaker in case of disagreement of the two initial reviewers.

RESULTS

For the period 1984–1998 there were 9,344 fatal injuries in the construction industry which were investigated by OSHA, of which 326 were in teenage workers. The fatality rate was slightly lower for teenage workers than for adult construction workers (Table I).

OSHA investigation reports for fatally injured teenagers were more likely than adults to have the nature of injury coded as electric shock (odds ratio (OR) = 1.56, $P < 0.05$),

TABLE I. Fatal Injuries in the US Construction Industry Investigated by OSHA, 1984–1998

	Fatalities	Employment	Fatality rate/10,000
Adults	9,018	70,093,630	1.29
Teenagers	326	2,698,370	1.21

Excludes California, Michigan, and Washington State for 1984–1989; Adults are aged 20 years and older.

the source of injury coded as electrical apparatus/wiring (OR = 1.56, $P < 0.05$), materials handling equipment (OR = 1.54, $P < 0.05$), and motor vehicle (industrial) (OR = 1.76, $P < 0.05$). Teenage fatalities were less likely to have the source of injury coded as working surface (OR = 0.61, $P < 0.05$); working surface is commonly coded as the source of injury for falls from elevation when the victim impacts a floor or other working surface. Teenage fatalities were less likely than adult fatalities to have the type of event coded as fall from elevation (OR = 0.64, $P < 0.05$).

Of the 326 fatal injuries to teenage workers, 76 (23%) were in persons less than 18 years of age to whom child labor laws applied. In 37 of the 76 deaths (49%) there were one or more apparent violations of either existing hazardous orders, age violations (less than 16 years of age), or both. There were 15 age violations (less than 16 years of age) and 28 violations of specific hazardous orders. The most frequently violated hazardous orders were trenching work and roofing (nine each), followed by operating a motor vehicle or being an outside helper (five), demolition work (three), operating a power saw (two), and operation of powered hoisting apparatus (one). Of the 39 fatalities for which we did not determine apparent violations of hazardous orders, there were 14 deaths from electrocution, 14 deaths from being struck by falling objects or equipment, 9 from falls, and 2 drowning. Of the 14 electrocutions, 8 were from service voltage (110 through 277 V AC), 5 were from power line contact with high voltage, and there were no details concerning voltage for 1 death.

The employers of the majority of fatally injured teenagers and adults were in special trade contracting (SIC 17, Table II), which accounts for the greater part of construction employment [Census of Construction Industries, 1987 and 1992]. For teenage workers, the leading five employer SIC codes were 1623 (water, sewer, and pipeline construction) and 1761 (roofing) with 12% of fatalities each, 1611 (highway and street construction, 9% of fatalities), 1731 (electrical contracting, 8% of fatalities), and 1799 (miscellaneous, 7% of fatalities). For adult workers age 20 and older, the leading five employer SIC codes were 1623 (water, sewer, and pipeline construction, 12% of fatalities), 1611 (highway and street construction, 9% of fatalities), 1761 (roofing, 8% of fatalities), 1731 (electrical contracting, 8% of fatalities), and 1791 (structural steel erecting, 7% of fatalities).

TABLE II. Fatal Injuries in the Construction Industry Investigated by OSHA, 1984–1998

	Teen-agers (%)	Adults (%)	All workers (%)
Covered by collective bargaining agreements	8	27	26
At small firms with fewer than 11 employees	41	28	28
SIC 15 (building construction)	11	13	13
SIC 16 (heavy construction)	28	30	30
SIC 17 (special trades)	61	57	57
OSHA cited employer for safety violations	81	72	73

Teenage workers who were fatally injured were more likely than adults to have been employed at non-union construction firms (OR = 4.96, $P < 0.05$), firms with fewer than 11 employees (OR = 1.72, $P < 0.05$), and their employers were more likely to have been cited by OSHA for safety violations (OR = 1.66, $P < 0.05$. Of the 76 fatalities in teenagers less than 18 years of age, only 5 (7%) were at firms which had a collective bargaining agreement with a labor union (Table III).

The 76 fatalities in workers less than 18 years of age occurred at 76 different construction firms. The mean estimated employer gross annual income of these firms was $786,509, with a range of $93,976–$4,232,829. In 41 of 76 fatalities (54%) the estimated employer gross annual income exceeded the $500,000 threshold for federal enforcement of child labor laws (Table III). If the income level were lowered by legislative action to $250,000, the percentage covered by federal enforcement would rise to 79%. If the threshold were lowered to $100,000, all but one of the fatalities would have been covered. Only 5 (7%) of the 76 firms had union contracts and these were all special trade contractors (SIC 17) with estimated employer gross annual incomes ranging from $596,535 to $1,133,013. Of the 76 fatalities, only 28 (37%) were at construction firms with 11 or more employees, which are subject to routine OSHA inspections.

DISCUSSION

The fatality rate from work-related injury for teenage construction workers was slightly less than for adults (Table I) using annual employment from CPS. The true rate is probably greater because the available employment data do not fully account for part-time or temporary employment of young workers [IOM, 1998] and so overestimate youth employment. Using estimates of the number of hours worked annually for 1994–1998, the Bureau of Labor Statistics reported that youths in construction jobs had approximately twice the risk of fatality compared to construction workers aged 25–44 [Barkume et al., 2000].

Existing hazardous orders prohibited the work activity involved in approximately one-half (49%) of the 76 fatal injuries to workers less than 18 years of age. Of the remaining fatalities in this age group, the largest single activity involved electric shock, but there was no other factor common to these fatalities, most of which were from service voltage (110–227 V AC) In our opinion this finding alone is not

TABLE III. Estimated Employer Annual Gross Income of Construction Firms Which had a Fatal Injury Investigated by OSHA for a Worker Less Than 18 Years of age, 1984–1998, by SIC and Union Status

	<$100,000	$100,000–250,000	$250,000–500,000	>$500,000	Total
Building construction (SIC 15)					
All fatalities	0	0	1	9	10
Union firms	(0/0)	(0/0)	(0/1)	(0/9)	(0/10)
Heavy construction (SIC 16)					
All fatalities	0	4	4	10	18
Union firms	(0/0)	(0/4)	(0/4)	(0/10)	(0/18)
Special trade contractors (SIC 17)					
All fatalities	1	11	14	22	48
Union firms	(0/1)	(0/11)	(0/14)	(5/22)	(5/48)
Total (SIC 15–17)					
All fatalities	1	15	19	41	76
Union firms	(0/0)	(0/0)	(0/0)	(5/41)	(5/76)

sufficient evidence for promulgation of a new hazardous order but this hazard deserves inclusion in education and training activities. In 2002, the National Institute for Occupational Safety and Health submitted a list of recommendations to the Department of Labor concerning promulgation of new hazardous orders including a recommendation [NIOSH, 2002, p 101] that all construction work be prohibited for workers less than 18 years of age, based on an analysis of injuries and fatalities in the construction trades and of health hazards in construction.

We found that teenage workers who were fatally injured were more likely than adults to be employed at small, nonunion firms (Table II) and at firms that were cited for safety violations at the time of the OSHA inspection related to the fatal injury. With respect to the $500,000 gross income exemption for federal enforcement of child labor laws, this exempted 46% of fatalities among workers less than age 18, which is less restrictive than the exemption for routine OSHA inspections for firms with fewer than 11 employees, which exempted 48 of 76 (63%) firms in this group. Although these firms are exempt from routine OSHA inspections efforts should be made to target them for training and for inclusion in OSHA consultation programs for the construction industry.

This study identified work-related deaths in teenage construction workers as differing from those in adults according to the type of work activity. Whether such activities, such as work in the vicinity of materials handling equipment or industrial motor vehicles are more common among teenage workers or whether teenagers are less likely than adult workers to follow safe work practices in these circumstances can not be determined from this study. For example, fatal injuries in teenagers were more frequently in SIC 1761 (roofing) than fatal injuries in adult workers. Lacking appropriate denominator data for employment of teenagers and adults in this construction trade limits our ability to determine the comparative risk of fatal injury for teenagers and adults in this trade. The Census of Construction Industries does not currently include information on worker age by SIC, establishment size (number of employees), or union status. This information would improve the ability to calculate injury rates by age for each SIC and to estimate the risk of young worker injury in the various construction trades. In the absence of such information we recommend that the relative frequency of fatal injury in teenage workers serve as the basis for targeting additional training and education efforts to prevent work injury.

Other limitations of this study include the incomplete coverage of OSHA fatality inspections, which do not include municipal workers in states with federal OSHA plans. That we studied only fatal injuries, which are uncommon, rather than all injuries limits the conclusions that can be drawn from this study. There were only 76 fatal injuries in workers less than 18 years of age which were the basis for our analysis of hazardous orders.

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