CME Article #2

Impact of the OSHA Trench and Excavation Standard on Fatal Injury in the Construction Industry

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Learning Objectives

- Recall the past effectiveness—or lack thereof—of OSHA in lowering injury rates in the workplace, and the influence of the MSHA (Mine Safety and Health Administration) in the coal mining industry.
- Describe the course of fatal injury rates before and after revision of an ambiguous consensus standard governing trench and excavation jobs, along with introduction of a targeted inspection program in 1990.
- Explain whether and how changes in fatality rates depend on the size of construction firms and whether or not workers are unionized.

Abstract

In 1989 the US Occupational Safety & Health Administration revised the excavation and trenching standard. We examined fatal injuries from trench cave-in in the construction industry for five year periods before and after the revision in the 47 US states for which data were available for both periods. There was a 2-fold decline in the rate of fatal injury after revision of the standard, which substantially exceeded the decline in other causes of fatal injury in the construction industry during the same period. The decline was somewhat greater in large business firms but was evident in construction firms of all size classes. The fatality rate from trench cave-in in union construction workers was approximately half that of nonunion workers, but we were unable to determine whether this was best explained by union status, employment of union workers at larger construction firms, or both. This study provides evidence for the effectiveness of OSHA regulation in preventing fatal work injury. (J Occup Environ Med. *2002;44: 902–905*)

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Trench construction work has long been recognized as hazardous.[1] The number of fatal injuries from cave-ins has been estimated to range from 42 to 100 per year in the United States.[2,3] The majority of these deaths are in the construction industry and occur in trenches where the walls are not properly sloped or shored to prevent cave-in.[4]

The effectiveness of the US Occupational Safety & Health Administration (OSHA) in reducing or preventing workplace injury is disputed. Viscusi[5] reported that during the 1970s OSHA enforcement had no effect on injury rates; a later analysis for 1973 to 83 found that OSHA inspections resulted in a 2 to 3% decline in injury rates and the effect was greatest on injuries with the most lost workdays.[6] Robertson[7] argued that the lack of evident effect of OSHA on workplace injury rates was due to failure to control for increases in workers compensation benefit programs in recent years. Kneeser and Leeth[8] noted that evaluating trends in workplace injury was influenced by the reporting effect, where reporting of spurious claims such as Monday-morning sprains might change over time in response to changes in insurance benefits, but that this effect would be minimal when evaluating severe work injuries.

In contrast to OSHA, there is clear evidence for the effectiveness of the Mine Safety & Health Administration (MSHA) in reducing fatal injury in the coal mining industry.[9] There

are significant differences between OSHA and MSHA with respect to standards and enforcement. For example, the MSHA inspector has the authority to shut down all or part of a mine when there is an imminent danger, while the OSHA inspector must obtain a federal court order to close a workplace in similar circumstances.[10]

The first OSHA standard concerning work in trenches was a consensus standard adopted in 1971 which came from the 1969 Construction Safety Act, and which OSHA later recognized was in need of "review and revision."[11] In September 1985 OSHA announced a special emphasis program for enforcement of the existing trench and excavation standard, and in April 1987 issued a *Notice of Proposed Rulemaking* announcing that OSHA intended to revise the standard.[12] The revised standard was issued in October 1989 and was effective January 2, 1990.[11]

The present study was conducted to examine the impact of the revised rule on fatal injuries in the construction industry from trench cave-in. We included in the analysis an examination of the role of establishment size to examine the impact on those construction firms with fewer than 11 employees which are exempt from routine OSHA inspections.[13] In a previous study these small firms accounted for 36% of fatalities from trench and excavation cave-in.[4]

Methods

We examined OSHA investigation reports for 1984 to 1995 in a manner similar to the previous study.[4] Fatality reports containing a description of the incident were available from April 1984 onward. For the period 1984 to 1989, the OSHA data were available for 47 U.S. states and excluded California, Michigan, and Washington State. For the period 1990 to 1995, we restricted the analysis to the same 47 states. We chose the observation period to provide approximately five years of data both before and after the revision of the standard.

All fatal injuries in Standard Industrial Classification (SIC) 1500 through 1799, the construction industry, which were investigated by OSHA were screened for mention of keywords "Trench, Cave, Earth, Dirt, Soil, or Excavation," or for coding of the inspection report field "source of injury" as number 12 (dirt/sand/stone). Records meeting these criteria were then manually reviewed independently by two of the investigators to determine whether the fatality was from a trench or excavation cave-in. In cases of disagreement a third investigator reviewed the record and a final determination was made.

The number of fatalities for 1984 were adjusted to account for only 40 weeks of observation (April through December). Fatality rates were calculated using annual employment data for the construction industry from the Current Population Survey[14](CPS) and excluding employment for California, Michigan, and Washington State. Comparison of fatality rates for union and nonunion firms was conducted using the estimated union/nonunion construction employment from the CPS raw data.[15] Fatality rates for the years before revision of the standard (1984 through 1989) and after the revision (1990 through 1995) were compared using an unpaired two-sample *t* test.

Rate ratios stratified by construction firm size (number of employees) were determined using data from the 1987 and 1992 Census of Construction.[16,17] This is a census of *employers* conducted every five years which includes information on firm size. The years 1987 and 1992 are approximately the midpoints of the 5 year periods before and after OSHAs revision of the trench and excavation standard.

Results

For the 11 year period there were 522 fatalities from trench cave-in. The number declined from 67 in 1984 to 23 in 1995, a 66% decrease. This was substantially greater than the 27% decline in fatal injuries from all other causes investigated by OSHA in the construction industry during the same period, which is shown in Fig. 1. The fatality rate from trench cave-in for 1984 to 1989, before revsion of the standard, was 13.5 per million workers per year, and from 1990 to 1995 the rate was 6.8 per million workers per year, a decline of 50% ($P < 0.05$).

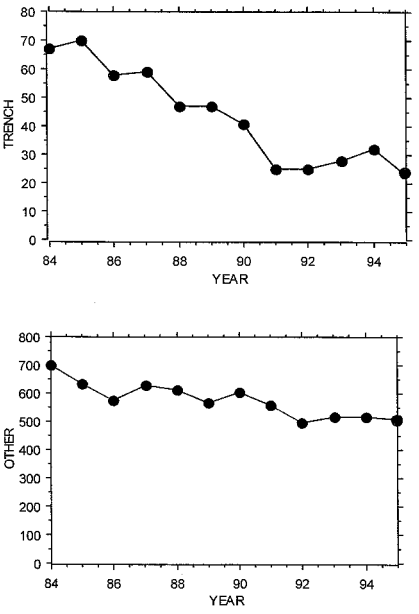

Fig. 1. Comparison of fatal injuries from trench cave-in with fatal injuries from other causes in the U.S. Construction Industry 1984–1995. (Note: excludes California, Michigan, and Washington State.)

Information on the number of employees in each construction firm (firm size) was available for 506 of 522 cases. Fatality rates among construction firms of various size are shown in Table 1 and were, on average, reduced by 50% after the revision. The decline in the fatality rate from trench cave-in was greater in business establishments with 11 or more employees, which accounted for 48% of deaths in 1984 to 89 and 42% of deaths in 1990 to 1995 ($P < 0.05$).

Only 60 (11%) of the deaths from 1984 to 1995 were in firms covered by a collective bargaining agreement with a labor union. The fatality rate

TABLE 1
Fatality Rates by Establishment Size Using Employment Data from the 1987 and 1992 Census of Construction

Firm Size	1984–1989 Fatalities	1987 Employment	Fatality Rate/ 1,000,000
1–4	70	526,858	22.14
5–9	48	622,778	12.85
10–19	58	702,925	13.75
20–49	71	882,993	13.40
50–99	49	528,305	15.46
100+	39	966,518	6.73
Firm Size	**1990–1995 Fatalities**	**1992 Employment**	**Fatality Rate/ 1,000,000**
1–4	36	581,347	10.32
5–9	32	585,838	9.10
10–19	47	643,526	12.17
20–49	27	748,768	6.01
50–99	17	425,408	6.66
100+	12	912,359	2.19

TABLE 2
Comparison of Union and Non-Union Fatality Rates Using Estimated Union Employment in Construction from the Current Population Survey

	Deaths	1984–1995 Employment	Fatality Rate/ 1,000,000/year
Union firms	60	10,502,000	5.71
Nonunion firms	462	39,165,000	11.80

Note: excludes California, Michigan, and Washington State.

from trench cave-in among union construction workers was approximately one half that of nonunion workers (Table 2). The proportion of fatalities that were at firms with union contracts was greater for firms with 11 or more employees (17% of fatalities) than for smaller firms (5%, $P < 0.05$).

Discussion

The 2-fold decline in fatality rates following OSHAs special emphasis program for trenches and excavations and the 1989 revision of the trench and excavation standard is similar to the 2-fold drop in fatality rates in coal mining seen after passage of the 1969 Coal Mine Safety and Health Act.[10] The decline in fatal injuries in mining was clearly evident within 5 years of passage of the 1969 Coal Mine Safety & Health Act and the decline in fatal injuries from trench cave-in is evident after a similar time period following OSHA's announcement of a special emphasis program of inspections of trenches and excavations and revision of the standard.

The decline in fatalities is consistent with effectiveness of the OSHA special emphasis program and revision of the standard but could be due other factors, such as a general decline in workplace fatal injury during the period of observation[18] and a decline in construction activity in the 1991 to 1992 recession. The decline in fatal injuries from trench cave-ins was substantially larger (66%) than that for other causes of fatal injury (a 27% decline) in the construction industry that were investigated by OSHA (Fig. 1), and the decline persisted after the economic recovery that began in 1992.

It is unlikely that the observed decline was due to large construction firms sub-contracting out trench and excavation jobs to smaller firms as the decline in fatality rates was found in both large and small firms (Table 1).

This study provides evidence that a targeted inspection program along with revision of a previously ambiguous consensus standard is effective in reducing fatal workplace injury. This study indicates the usefulness of a multidisciplinary research team that included a labor economist who was able to estimate union/nonunion construction employment for the period of interest. Limitations of this study include reliance on OSHA investigation data, which are less comprehensive than death certificate data, the lack of data before 1984, and the unavailability of employment data solely for construction firms that dug trenches and excavations. The Bureau of Labor Statistics' *Census of Fatal Occupational Injuries* is the most comprehensive source of information on fatal workplace injury but does not contain data for years before 1992. With respect to employment data, the Census of Construction was useful in examining the role of firm size, which is related to the ability of OSHA to conduct routine, unannounced inspections. Information on union status would be a useful addition to the Census of Construction that might assist in distinguishing the influence of larger firm size and union status on fatal work injury in the construction industry.

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