Scand J Work Environ Health 1992;18:30—3

Work-related deaths in construction painting

by Anthony J Suruda, MD[1]

SURUDA AJ. Work-related deaths in construction painting. *Scand J Work Environ Health* 1992;18: 30—3. Analysis of investigation records of the United States Occupational Safety and Health Administration (OSHA) concerning work-related deaths in Standard Industrial Classification (SIC) 1721, construction painting, showed a higher risk of fatal injury than expected from cohort studies including injuries on and off the job. Work-related death rates were $2.3 \cdot 10^{-4}$/year (ie, three to five times that of general industry). Of the 129 deaths investigated, the largest category was falls (N = 65), followed by electrocution (N = 40) and asphyxiation from solvents or oxygen deficiency (N = 6). Eighteen deaths had other causes. The average OSHA fine for the employer was USD 607.00/fatality. Only 31% of the deaths occurred at firms covered by a union contract. Risk of fatal injury was the highest for small firms with fewer than 10 employees. Cohort mortality studies based on records from unions or large employers probably exclude many small firms and so underestimate the risk of fatal injury to painters.

Key terms: injuries, labor unions, occupational diseases, solvents.

Mortality studies of painters have reported varied risks for deaths from unintentional injuries. Both the study made on the basis of union records by Matanoski et al (1) on painters in the United States (US) (1) and the study of Morgan et al (2) using industrial data reported lower than expected standardized mortality ratios (SMR) for accidents (table 1). In a population-based study of painters in Geneva, Guberán et al (3) found increased deaths from motor vehicle accidents but lower than expected mortality from other types of unintentional injury. For a cohort of 416 Swedish painters Lundberg (4) reported nine deaths from external causes, with eight expected. As deaths from work-related injuries account for only 20% of all US deaths from injuries among persons of working age (5), an analysis of deaths in broad categories such as "all accidents" (International Classification of Diseases, ninth revision, E800—949), which includes both work- and nonwork-related injuries, might not detect excesses in deaths related to work.

Gersh reported that in 1934 US painters had a death rate from falls of $5.7 \cdot 10^{-4}$/year compared with $1.9/10^{-4}$/year for all workers (6). Such a high risk for fatal falls has not been reported in recent studies. The California Occupational Mortality Study (7) found an increase in falls and machinery accidents (SMR 131) among painters in 1979—1981; this value was not statistically significant. In proportionate mortality ratio (PMR) studies which included painters Milham (8) reported an excess of deaths from falls in Washington State (89 observed, 54 expected, PMR 164, $P < 0.05$), and the Pennsylvania Department of Health (9) found a significant increase in deaths from falls (17 observed, 6.7 expected, PMR 254, $P < 0.05$).

Because of an unexpected finding in the US Occupational Safety and Health Administration (OSHA) investigations that painters in the construction industry had high rates of electrocution (10), this study was done to examine further OSHA data concerning the types and circumstances of fatal injury among painters.

Material and methods

OSHA is the regulatory agency within the US Department of Labor which issues and enforces occupational safety and health regulations and which conducts investigations of work-related deaths. OSHA maintains the Integrated Management Information Systems (IMIS) data base containing the results of investigations of approximately 1600 work-related deaths each year, or some 20% (11) to 30% (12) of US work-related deaths. Only 47 US states are included in the data base; California, Michigan, and Washington State maintain data files in a format incompatible with the federal system. The IMIS data base therefore covers only 83% of the US work force. It contains information about the employer, the injured employee, and the nature and cause of injury.

Because of jurisdictional issues and selective reporting, OSHA fatality investigations are concentrated in construction and manufacturing (13). For 1982—1986, the IMIS data base reported an average of 660 fatalities per year in the construction industry; this number was a substantial amount (73%) of the 900 annual deaths from injury in construction which the National Institute for Occupational Safety and Health (NIOSH) identified from death certificates for a comparable period in the same 47 states (14). Almost all of the

[1] Division of Occupational Medicine, Department of Environmental Health Sciences, Johns Hopkins University School of Hygiene and Public Health, Baltimore, Maryland, United States.

Reprint requests to: Dr A Suruda, 944 Chestnut Ridge Road, Morgantown, WV 26505, USA.

Table 1. Mortality studies reporting injury mortality of painters. (SMR = standard mortality ratio)

Author	Study period	Subjects (N)	All external causes (E800—978)[a]			All accidents (E800—950)[a]			Motor vehicle accidents (E810—827)[a]		
			Observed (N)	Expected (N)	SMR	Observed (N)	Expected (N)	SMR	Observed (N)	Expected (N)	SMR
Guberán et al, 1989 (3)	1970—1984	1 916	26	22.7	115	16	12.2	131	12	5.9	203*
Lundberg, 1986 (4)	1961—1981	416	9	8	112	·	·	·	·	·	·
Matonoski et al, 1986 (1)	1975—1979	57 175	·	·	·	157	203	78*	55	72.3	76*
Morgan et al, 1981 (2)	1946—1976	16 243	151	318.2	52*	·	·	·	·	·	·

[a] International Classification of Diseases (ninth revision).
* $P<0.05$.

deaths investigated are due to trauma, and fewer than 1% are from occupational illness. OSHA does not investigate the two leading causes of US work-related deaths, motor vehicle accidents and homicide (15). Deaths in firms of all sizes are investigated, except for agriculture, for which farms with fewer than 11 employees are exempt.

OSHA fatality investigations are classified by the Standard Industrial Classification (SIC) (16). Of the approximately 500 000 painters in the United States, the Bureau of the Census estimated that, in 1980, 340 000 persons were employed as construction or maintenance painters (17) and that, in 1982, 136 000 were employed by firms in SIC 1721, "painting, paperhanging, and decorating" (18). Painters in other construction trades such as general contracting (SIC 1522) cannot be separately identified due to lack of occupational coding in the OSHA data base.

A printout was obtained of all deaths investigated by OSHA in SIC 1721 for the years 1982—1986. Additional detailed descriptions in the form of abstracts of the accident investigation were available for events in 1984—1986. The data base contained little information on postevent factors such as first aid, emergency medical care, or time from injury until death.

Results

For 1982—1986 the IMIS data base reported 129 deaths in SIC 1721. All 129 were from injury and all occurred at work. All of the deaths occurred among men. The average age was 34.2 (SD 10.8) years. Sixty-five (50%) of the deaths were from falls, 40 (31%) were electrocutions, and 6 (5%) were asphyxiations from solvents, toxic gases, or oxygen deficient atmospheres. Eighteen deaths (14%) were from other causes. The rates of death for SIC 1721 are shown in table 2.

Falls

The 65 deaths were all from falls from heights. The average height of the fatal falls was 46 feet (14 m). Detailed information was available for 45 of the 46 deaths in 1984—1986. Twenty-four (52%) of the falls involved scaffolds. In 21 the painter fell from a scaffold, and in three the scaffold collapsed because of improper bracing, allowing the worker to fall. Fourteen deaths involved suspended scaffolds which fell due to rope or attachment point failure and in which the painter was not attached to a separate lifeline. In six deaths (13%), the painter fell from a ladder, in five from a work platform, and in four from a roof. There were seven falls from other or unknown locations.

Table 2. Work-related deaths in construction painting[a] in 1982—1986 as investigated by the US Occupational Safety and Health Administration.

Cause of death	Deaths (N)	Fatality rate[b] per 10 000/year
All causes	129	2.3
Falls	65	1.2
Electrocution	40	0.7

[a] Standard Industrial Classification 1721, "painting and paperhanging, and decorating," which included 136 128 workers in 1982.
[b] Fatality rates adjusted for employment in 47 states.

The painters killed in falls had a mean age of 35.1 (SD 9.9) years and were significantly older than those who died of all other causes, who had a mean age of 30.9 (SD 12.3) years ($P<0.05$).

Electrocutions

Of the 40 deaths from electrocution, detailed information was obtained for 27 of 28 deaths in 1984—1986. There was one death from lightning, two from low voltage (110 volts, alternating current), and 24 from power lines (high voltage alternating current). In 14 (50%) cases, the painter moved a metal ladder into contact with a power line, and in three a mobile scaffold was rolled over into a power line. The other power line electrocutions also involved inadvertent contact with equipment held or operated by the painter.

Asphyxiation

Six painters died from asphyxiation in confined spaces in five separate incidents. There were three deaths from nitrogen atmospheres, and one each from methylene chloride, chlorine, and nitropropane. In no case, were confined space procedures and air supply respirators in use.

In addition, one of the 65 deaths from falls was of a painter who fell from a suspended scaffold while

spray painting the inside of a tank. The OSHA investigator felt that improper air supply for the painter combined with high air levels of xylene in the tank were important contributing factors.

Firm size

The number of employees of the firm was known for all 129 deaths. Eighty-two (64%) were in firms with fewer than 11 employees. Denominator data on firm size for SIC 1721 is available from the 1982 census of construction industries (18). When the expected number of deaths was calculated on the basis of employment in each size class, the risk of death was significantly increased for small firms (table 3).

Forty (31%) of the 129 deaths occurred in establishments covered by collective bargaining agreements with a union. Small firms were less likely to be covered by union contracts (table 4). The union workers had an average age of 39.4 years, compared to 32.4 years for nonunion workers.

OSHA issued citations for safety violations in 74% of the cases. The average fine paid per fatality was USD 607.00. There was no significant difference in the OSHA citation rate or type of citation for union and nonunion firms. However, union firms paid larger fines, USD 1003.00, on the average, versus USD 393.00 for the nonunion companies.

Table 3. Firm size and risk of fatal injury in construction painting (Standard Industrial Classification 1721) in 1982—1986.

Employees in firm (N)	Employment in size class	Observed deaths (N)	Expected deaths (N)	Rate ratio
1—4	34 474	52	32.7	1.59*
5—9	26 103	26	24.7	1.05
10—19	24 317	18	23.0	0.78
20—49	26 691	18	25.3	0.71
50—99	11 266	8	10.7	0.75
100—249	8 811	6	8.4	0.71
≥250	4 467	1	4.2	0.42
Total	136 129	129	129.0	1.00

* $P<0.05$.

Table 4. Union contracts and fatal work-related injuries to construction painters according to firm size.

Employees in the firm (N)	Deaths (N)	Deaths in firms with union contracts	
		N	%
1—4	52	9	17
5—9	26	6	23
10—19	18	7	38
20—49	18	11	61
50—99	8	4	50
≥100	7	3	43
Total	89	40	31

Discussion

This study looked at work-related deaths of construction painters in SIC 1721 investigated by a regulatory agency (OSHA) that places special emphasis on the construction industry (13) and which investigates the majority of deaths that occur at construction worksites. However, the actual number of deaths in SIC 1721 could be greater as neither OSHA nor death certificates identify all US work-related deaths (12).

The work-related death rate for SIC 1721 of $2.3 \cdot 10^{-4}$/year in 1982—1986 was higher than that for the construction industry as a whole ($1.9 \cdot 10^{-4}$/year, OSHA data) and several times the work-related death rate of $0.5 \cdot 10^{-1}$/year for general industry for the same period as reported by the US Bureau of Labor Statistics (15) or that of NIOSH of $0.7 \cdot 10^{-4}$/year (14). Because of limited coverage, OSHA investigation data cannot be used to generate rates for all industry.

The work-related death rate from falls, $1.2 \cdot 10^{-4}$/year, is 20 times the rate of $0.06 \cdot 10^{-4}$/year for general industry reported by the Bureau of Labor Statistics or NIOSH (14, 15). The rate for electrocution, $0.8 \cdot 10^{-4}$ painters/year, is also several times that for general industry of $0.05 \cdot 10^{-4}$/year (14, 15).

Some of the difference in rates between SIC 1721 and general industry may reflect the relatively hazardous nature of construction painting, which employs about 25% of US painters. The high rates of fatal injury may not be the same for other painters, who might have less exposure to work at high elevations or in confined spaces.

Fatal falls among painters remain as much an occupational health problem today as they did 50 years ago in the time of Gersh (6). Lack of adequate fall protection in the form of scaffold guardrails, nets, lifelines, and safety belts caused the majority of severe injuries then as it did in the present study. Failure of a painter to connect his safety belt to a lifeline when painting from a suspended scaffold was the single most common cause of deaths associated with scaffolds in SIC 1721 and is a cause which is clearly preventable.

Failure to use fall protection while working at heights has been studied for nonfatal injuries. The Bureau of Labor Statistics studied 778 workers identified from 1982 compensation reports for workers who were injured in falls from heights of three or more feet (≥3.3 m) (19). Five hundred sixty-seven (78%) reported working regularly at heights of 10 feet (3 m) or more and only one-half of these persons indicated that guardrails or personal fall protection was required by their company for such work, even though such equipment was available at the job site. Improved safety training and enforcement should be targeted towards increasing the use of fall protective measures.

Acute toxicity from solvent exposure was known to be involved in one of the 65 fatal falls. None of the other reports mentioned whether solvent-based paint

was in use on the day of the fatal fall. Hunting (20) reported that, in a prospective study of union painters using oil-based paints, exposure to solvents was associated with slips and falls. Boat builders are another occupational group exposed to solvents, and they are known to be at increased risk of fall injury (21). The role of solvent exposure in severe occupational falls is an area needing further study.

Fatal electrocutions in SIC 1721 were mainly due to painters moving equipment in the vicinity of overhead power lines. OSHA already prohibits the use of metal ladders by those engaged in electrical work, and NIOSH estimates that metal ladders account for 4% of the approximately 400 electrocutions at work in the United States each year (22). The use of nonconductive fiberglass extension ladders would have prevented at least 14 deaths in the present study, as would have maintaining the recommended 10 foot (3 m) clearance between equipment and overhead power lines.

Union officials estimate that 50% of construction painters were covered by union contracts at the time of this study (Rodney Woolford, personal communication, 1988). However the proportion so covered in SIC 1721 is unknown. Therefore it is not possible to assess the fatality risk of union versus nonunion companies.

This analysis of OSHA investigation data shows that construction painters are at high risk of fatal injury, particularly from falls and electrocution. Specialized data sets like OSHA's that focus solely on work-related deaths can identify groups at risk that are not identified by cohort mortality studies which analyze deaths from all injury causes. Cohort studies of painters which use union or industry records are likely to exclude the small firms whose workers have the greatest risk of fatal injury, and therefore they probably underestimate the risk of death from unintentional injury.

Acknowledgments

The author wishes to thank Mr R Woolford of the International Brotherhood of Painters and Allied Trades, Mr T Tyburski, Mr J Katalinas, and Mr B Beveridge of OSHA, Ms J Russell of the NIOSH Division of Safety Research, and Dr W Marine.

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Received for publication: 18 March 1991