

proved laboratory methods, including the use of two enrichment incubation temperatures to increase *Salmonella* culture sensitivity, would allow for early detection of deficiencies in egg handling and processing, and could eliminate *Salmonella* egg contamination as a potential cause of disease in the community. □

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ABSTRACT

Analysis of 1980-1985 death certificate data for the United States indicated that an average of 369 occupational deaths per year involved agricultural machinery as the external cause of death. Out of all agricultural machine-related deaths, tractors accounted for 69 percent. Over half of these tractor-related deaths were rollovers. There is a need for public health programs to affect greater use of rollover protective structures (ROPS) on farm tractors. (*Am J Public Health*. 1991;81:766-768)

Agricultural Machine-Related Deaths

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Introduction

Fatalities among farm machine operators present a conspicuous injury target for public health action.¹⁻³ Farm tractors are known to be particularly deadly,⁴⁻⁶ but prevention programs appear to be floundering.

As a first step toward the establishment of priorities for fatality prevention programs in agriculture, we decided to examine the National Traumatic Occupational Fatality (NTOF) data base maintained by the National Institute for Occupational Safety and Health (NIOSH).^{7,8} Previous analysis of NTOF data for the years 1980-85 had shown that the Agriculture, Forestry, and Fishing industry had a fatality rate of 20.7 per 100,000 workers, a rate 2.6 times higher than the national average for all industries of 7.9 deaths per 100,000 workers.⁷

Methods

Death certificate data in NTOF were reviewed to identify persons killed while working with machines. Machine-related fatalities were identified by codes E919.0 to E919.9 according to ICD-9. Next, the type of machine involved in each machine-related fatality across all United States industries was ascertained by reviewing the description of the cause of death on the death certificate. All agricultural tractor-related fatalities were then categorized and compared by the Standard Industrial Classification (SIC) for the industry in which the incident occurred.⁹ Age at death was determined for those fatalities associated with tractors, augers, hay balers, combines, and other agricultural machines.

TABLE 1—Machine-related Occupational Fatalities, All US Industries, 1980–85

Machine Type	Frequency*	Percent of Fatalities
Agricultural machines, E919.0	2216	43.8
Lifting machines, E919.2	1029	20.3
Mining, earth drilling machines, E919.1	467	9.2
Earthmoving, excavating machinery, E919.7	458	9.0
Other specified machinery, E919.8	441	8.7
Unspecified machinery, E919.9	237	4.7
Metalworking machinery, E919.3	88	1.7
Transmission machinery, E919.6	78	1.5
Woodworking machinery, E919.4	47	0.9
Total	5061	99.8**

*Values are based on the 90.6 percent of case records in the NTOF data file that have ICD codes.
**Sum differs from 100 due to rounding.

TABLE 2—Frequency of Agricultural Machine-Related Fatalities (E919.0), All US Industries, 1980–85

Agricultural Machine	Fatalities	Percent
Tractor	1523	69
Auger/elevator	61	3
Combine	53	2
Hay Baler	42	2
Brush hog/mower	40	2
Loader/skidder	37	2
Corn picker	26	1
27 other machines	108	5
Unspecified machine	326	15
Total	2216	101

*Sum differs from 100 due to rounding.

Results

The search of NTOF cases identified 5,061 machine-related fatalities coded E 919.0 to 919.9 (Table 1). Agricultural machines were involved in 2,216 deaths, an annual average of 369 deaths per year. The second ranking machine category on the list is lifting machines (cranes, forklifts, etc.) which averaged 170 fatalities annually, less than half that of agricultural machines.

The seven types of agricultural machines with greatest fatality frequency are listed individually in Table 2. Machines with a frequency less than 1 percent were combined into one category. The final category includes fatalities in which the type of machine was not specified on the death certificate. These data indicate that tractors are involved in the vast majority of agricultural machine-related fatalities. All other agricultural machines are involved in far fewer fatalities when compared to tractors.

Tractor overturns were the single most important event in fatalities involving tractor operators. Of the tractor-related fatalities in the NTOF data set, 52 percent were rollovers. Another 16 percent involved the victim being run over, such as instances in which an operator fell off the tractor and was run over. About 7 percent of the tractor-related fatalities were associated with the power-takeoff.

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Farm tractors are used in many industries. For example, using farm tractors to pull cut timber in logging operations is considered to be a manufacturing industry activity. Of farm tractor-related fatalities, 59.3 percent occurred in the agriculture, forestry, and fishing industry, while manufacturing, services, and construction industries each contributed over 5 percent to the national death toll. Victims over 50 years old accounted for 62 percent of farm tractor-related fatalities, and victims over age 60 accounted for 44 percent of farm tractor-related fatalities.

Discussion

The findings reported here are similar to those reported in studies of farm fatalities in Wisconsin⁵ and Georgia.⁶ All of these investigations found that tractor overturns accounted for the largest proportion of farm deaths (Wisconsin 52 percent; Georgia 76 percent; US 52 percent.)

Education, enforcement, and engineering control are often cited as the avenues for prevention of occupational injuries and fatalities. The mandatory education approach to farm tractor safety has not yet received sufficient emphasis. Some training is available through voluntary organizations such as the 4-H and Future Farmers of America. However such training is voluntary. It is unnecessary to pass a test, as is the case with obtaining a license to operate a motor vehicle, unless the tractor driver is age 14–16 and employed by someone not in the family.¹⁰ For all other farm tractor drivers, no license of any kind is required. Furthermore there is no competency-based certification program for tractor operators.

The enforcement approach also has problems. In its annual appropriations bills for the Occupational Safety and Health Administration (OSHA) in the US Department of Labor, Congress has consistently attached a rider which denies OSHA the authority to inspect farms with fewer than 11 employees. This exempts 89 percent of US farms which may choose to comply or not comply with federal safety standards, free of an OSHA inspection. Unlike some consumer products, which may not be sold in the US if they do not meet regulations of the Consumer Product Safety Commission, the sale of farm machinery is not regulated for safety. Because most farm workers are not covered by OSHA enforcement, regulating farm machine safety at the point of sale has been suggested as a promising way to protect farm workers from machine hazards.

The engineering approach involves efforts at preventing rollovers, as well as protecting operators if a rollover does occur by fitting tractors with rollover protective structures (ROPS). Much effort has already gone into the design of ROPS for tractors, and industry-accepted voluntary standards call for the provision of ROPS on new tractors. OSHA has a requirement that employers must have ROPS on new tractors built since October 25, 1976. One of the difficulties encountered in this approach is the fact that farm tractors tend to be used for so many years that replacement of older tractors with newer, safer tractors is proceeding very slowly. There is also a problem with some farmers removing ROPS from new tractors. Considering all these factors, during the next 10 or 20 years it is unlikely that the percentage of tractors with ROPS will increase rapidly unless

some significant changes take place. Although engineering has provided the technology for preventing most fatalities due to tractor rollovers, it appears that voluntary implementation is very slow.

In Sweden a very significant reduction in tractor rollover fatalities has been brought about by requiring rollover protection on farm tractors.¹¹ Between 1961 and 1983, Sweden was able to drop its annual fatality rate for tractor overturning from 12 per 100,000 farmers to 1 per 100,000 farmers. This was accomplished through regulations introduced periodically between 1959 and 1981.

It will take cooperative action, including input from farmers, to develop creative prevention programs to solve this difficult problem. Education, enforcement, and engineering will work if they are supported by the common interest of a united agricultural

public health community. Achieving this unity is a crucial goal for the 1990s. □

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A Cross-sectional Study of Pulmonary Function in Autobody Repair Workers

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ABSTRACT

This study evaluated pulmonary function in workers from 39 autobody repair shops. Based on 152 White male workers with known smoking status, the mean percent predicted FEV₁, FVC, and FEV₁/FVC were 93.6, 96.8, and 96.6, respectively. Twenty-three percent of workers had a FEV₁/FVC ratio less than the fifth percentile. Isocyanate levels ranged from nondetectable to 0.06 parts per million (STEL = 0.02 ppm). No shop had an adequate respiratory protection program. We concluded that there was an increase in abnormal pulmonary function in autobody workers. Three recommendations were made to shop owners: functional paint booths should be maintained, respiratory protection programs should be developed, and isocyanate-free paints should be used. (*Am J Public Health*. 1991; 81:768-771)

Introduction

Approximately 700 autobody repair shops employ an estimated 3,500 individuals in Minnesota (Minnesota Department of Labor Relations, Personal Communication). Autobody repair involves hammering dents, removing damaged parts, welding, grinding, abrasive blasting, filling with styrene putty, sanding, and spray painting.^{1,2} Workers may be exposed to hazards including isocyanates, metals in paint, solvents, dusts, and noise.^{2,3} Despite possible adverse health effects,⁴⁻⁷ there has been little epidemiologic investigation of the autobody repair industry.^{1,8-10} This study examines pulmonary function in autobody repair workers.

Methods

Sampling Protocol

Autobody repair shops listed in the Twin Cities Yellow Pages were randomly selected for study. Shops were included in the study if: 1) they had 20 or fewer employees; 2) at least half of establishment

income was from autobody repair; and 3) they were located within the Twin Cities metropolitan area. Shop owners were asked questions regarding the inclusion criteria. The owners of eligible shops were asked to participate.

A questionnaire was given to each shop manager regarding shop age, size, number of cars repaired, ventilation, and repair materials. Sampling for toluene diisocyanate (TDI), total particulates, and solvents (acetone, benzene, methyl ethyl ketone, toluene, xylene, trichloroethylene, and mineral spirits) was done in all

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