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## Fatalities Associated with Farm Tractor Injuries: an Epidemiologic Study

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### Synopsis .....

*Death certificates were used as a source of information to characterize fatalities associated with farm tractor injuries in Georgia for the period 1971-81. In this period, 202 tractor-associated fatalities occurred among residents of Georgia; 198*

*of these persons were males. The annual tractor-associated fatality rate for males based on the population of male farm residents was 23.6 per 100,000; rates of fatal injury increased with age for this population. Persons whose primary occupation was other than farming accounted for more than half of all tractor-associated deaths.*

*Fatal injuries occurred throughout the year but predominantly during the planting and harvesting months. Injuries occurred throughout the day (7 a.m. to midnight), with a peak at 4 p.m. to 5 p.m. Most fatal injuries, 76 percent, resulted when tractors overturned. Fatalities were attributed to crushed chest, exsanguination, strangulation or asphyxia, drowning, and other injuries. Current safety standards for the operation of farm tractors are limited; rollover protective canopies are not required for farm owners or their family members. Descriptive epidemiologic information obtained from death certificates can be used to define injury determinants and to suggest approaches for the further study and prevention of specific types of injuries.*

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**F**ATAL INJURIES ARE A LEADING CAUSE of potential years of life lost before age 65 in the United States (1). Because injuries are major preventable causes of morbidity and mortality, recent health initiatives have proposed objectives to reduce the occurrence of injuries (2,3). However, before effective preventive strategies can be designed or implemented, risk factors related to injury occurrence must be identified (4).

Occupational settings are an important focus for the study of risk factors associated with injuries (5). Because of the diversity of machinery, other physical agents, and environmental hazards on the farm, agricultural workers are at increased risk for a variety of injuries associated with their occupation (6-8). In 1981, the fatality rate for job-related injuries among farm workers ranked second only to

that for workers in the construction industry. One source indicated that tractors are a major cause of farm work-related injuries and fatalities (9). Although tractors were associated with 8 percent of farm work injuries, they accounted for one-third of all fatalities and exceeded the rates for other types of agricultural machinery and trucks, which each accounted for 19 percent of fatal injuries.

Tractor-related fatalities and other injuries associated with farming are a special concern for States with agricultural populations. In this article we use descriptive epidemiology to study fatalities associated with farm tractors in Georgia between 1971 and 1981. The study illustrates how State health departments and other authorities responsible for injury prevention can use death certificates as sources for epidemiologic information concerning

Figure 1. Fatalities associated with farm tractor accidents, by month of death, Georgia, 1971-81

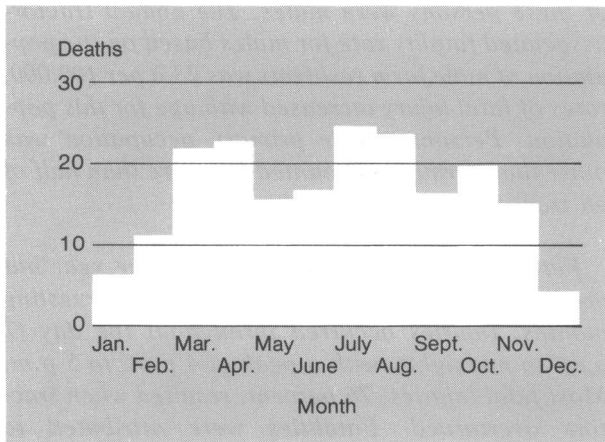
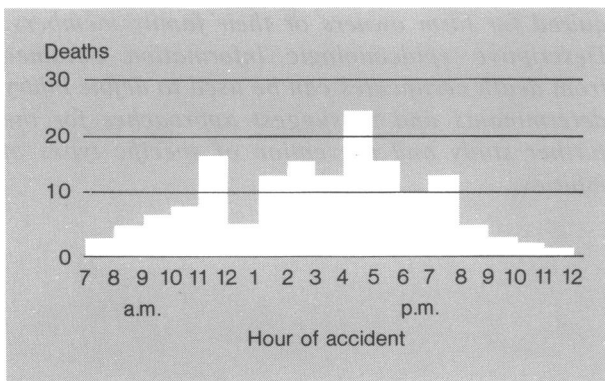


Figure 2. Fatalities associated with farm tractor accidents, by hour of accident, Georgia, 1971-81<sup>1</sup>



<sup>1</sup>Time unknown for 36 cases.

specific types of fatal injuries and how such information can be a basis for designing further studies and preventive recommendations.

## Background and Methods

Agricultural industry in Georgia is noted for its production of soybeans, peanuts, tobacco, corn, and wheat. The gross value of major crops produced in 1982 was approximately \$1.6 billion. Farm size and type differ with the physical geography of the State, which is divided into a northern mountainous area, a central plains region, and a southern coastal area. In 1970, over one-third of the State's residents lived in areas classified as rural, and 172,000, or 3 percent, were classified as farm residents.

To characterize deaths associated with farm tractor injuries among Georgia residents, the authors obtained all death certificates listing a farm tractor

injury as a cause or contributory cause of death (International Classification of Diseases, Eighth Revision: E928.0; Ninth Revision: E919.0) for the period 1971-81. Each death certificate was reviewed to obtain demographic data, the occupation, and the residence of the deceased; time and place of injury; mode of death; and events associated with the injury.

Because nearly all of the deaths occurred in males, fatality rates are estimated here only for males. For calculating deaths by age groups, two different denominators are used. One denominator represents the total rural male population, and the other represents only the subgroup of male farm residents. These population estimates are derived from U.S. census data for Georgia for 1970 and 1980 and from U.S. Department of Agriculture projections of the yearly change in national farm population (10-12). Rates for the total rural male population are derived using 1975 denominator estimates based on linear interpolation; rates for male farm residents are derived using 1976 denominator estimates that are based on extrapolation from 1970.

## Results

During the 11-year period, 202 Georgia residents died of tractor-associated injuries: 198 were males and 4 were females; 166 persons were white and 36 were black. The number of deaths per year ranged from a high of 28 in 1975 to only 10 in 1981. Fatal injuries occurred in all months, but predominantly in March, April, July, and August (fig. 1), and they occurred equally throughout the week except for a smaller number on Sunday. The time of injury was recorded for 166 fatalities. There were injuries between 7 a.m. and midnight, with a sharp decline at noon and a peak between 4 p.m. and 5 p.m. (fig. 2).

All of the persons who died lived in rural areas. There were fatalities in 103 of Georgia's 159 counties, predominantly in the mountainous and hilly northern counties (fig. 3). The majority of the 184 fatal injuries (91 percent) occurred on farms, and 18 occurred on roads.

Classification of deaths by 20-year age groups shows 145 deaths of persons older than 40 years (fig. 4). Based on the population of rural residents, the overall annual fatality rate for males was 1.9 per 100,000, and rates increased with age (see table page 332). This trend is also observed in the subpopulation of male farm residents.

Death resulted from a variety of injuries from tractor accidents: 153 persons (75.7 percent) died when tractors overturned; 28 persons (13.9 percent)

were run over by tractors; 6 persons (3.0 percent) died when their tractors fell into a stream or lake; and 15 persons (7.4 percent) died from other types of events. The majority of fatalities were attributed to crushed chest injury:

Cause	Number of	
	Persons	Percent
Crushed chest .....	167	82.6
Exsanguination .....	9	4.4
Strangulation or asphyxia .....	8	4.0
Drowning .....	6	3.0
Other .....	12	6.0
<b>Total .....</b>	<b>202</b>	<b>100</b>

Farming was listed as the primary occupation for 82 persons (41 percent); other primary occupations listed included construction, manufacturing, common laborer, military, sales, mechanic, student, and retired.

### Discussion

Epidemiologic methods and models are fundamental to the study of factors associated with disease causation (13). In addition, epidemiologic methods can be used to formulate policies for disease control and to develop approaches for the prevention of injuries and other specific problems (14,15). Descriptive epidemiologic studies like this one may be helpful in identifying causal hypotheses for further study and in developing recommendations for the prevention of certain injuries.

Descriptive epidemiologic observations can be defined in terms of when and where the injury occurred and by characteristics of the affected persons. Our findings suggest that farm tractor fatalities were associated with seasonal and daily time patterns, were more prevalent in north Georgia, and were more likely to involve older males who were rural farm residents. Explanations for some of these observations seem apparent. For example, the monthly trends suggest that fatal injuries are more likely during planting and harvesting seasons when tractor use may be increased. Other observations, however, suggest hypotheses that warrant further consideration.

Fatal injuries occurred throughout the day with a sharp decline at noon and a peak late in the afternoon. The midday decline could represent decreased tractor use during lunch, and the peak might reflect the period of maximum daily use by both farmers and persons whose primary occupation was other than farming, or alternatively could represent injuries resulting from fatigue. The

Figure 3. Fatalities associated with farm tractor accidents, by place of occurrence, Georgia, 1971-81

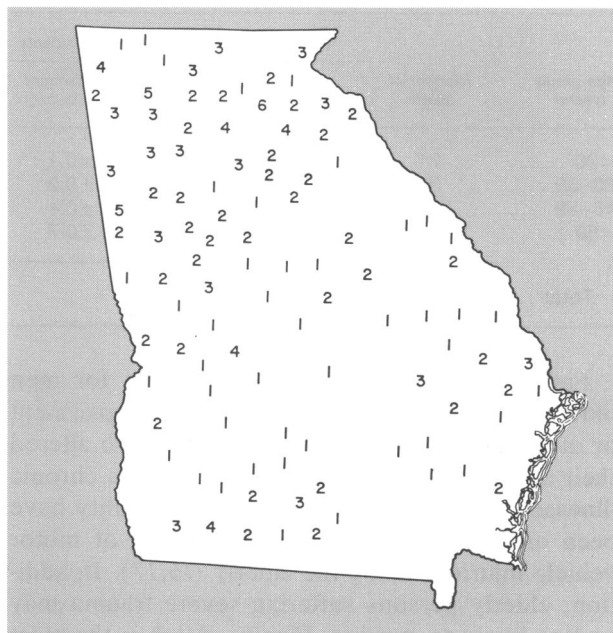
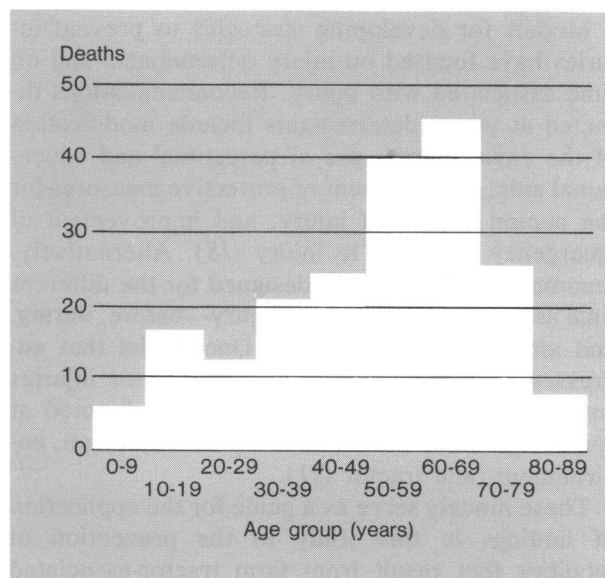


Figure 4. Fatalities associated with farm tractor accidents, by age group, Georgia, 1971-81



greatest number of deaths, 28, occurred in 1975, but the number of deaths declined to 10 in 1981; possible explanations for this trend include a decline in the number of farmers or elderly persons operating tractors and increased use of safer equipment. The concentration of fatalities in north Georgia may be a result of tractors overturning on the hilly terrain there, but might also be related to mechanical characteristics or design features of tractors prevalent in that region.

Annual fatality rates per 100,000 males in accidents associated with farm tractors, Georgia, 1971-81

Age group (years)	Number of deaths	Farm residents		All rural residents	
		Rate	Standard error	Rate	Standard error
<20 .....	21	6.7	±1.5	0.5	±0.1
20-39 .....	32	22.3	±4.0	1.1	±0.2
40-59 .....	65	27.6	±3.4	3.1	±0.4
≥60 .....	80	54.1	±6.1	6.4	±0.7
Total ...	198	23.6		1.9	

Fatality rates may have been highest for men older than age 60 because of physiologic impairment or other age-related reasons that may have altered their ability to operate the tractor. Certain chronic illnesses, cardiovascular disease, and senility have been associated with an increased risk of motor vehicle injuries among the elderly (16,17). In addition, elderly persons suffering severe trauma may be less likely to survive. Finally, death is the most extreme consequence of tractor injuries; it is possible that a greater number of nonfatal, but serious or disabling, injuries result from tractor accidents.

Models for developing strategies to prevent injuries have focused on injury determinants and on time associated with injury. Recommendations directed at injury determinants include modification of the environment, use of perceptual and educational aids, enhancement of protective measures for the person at risk of injury, and improvement of emergency response to injury (18). Alternatively, recommendations can be designed for the different time associated with risk for injury—before, during, and after the injury (19,20). One model that addresses only the problem of farm tractor injuries suggests that preventive measures be directed at specific points in the relationship between man, environment, and tractor (21).

These models serve as a guide for the application of findings in this study to the prevention of fatalities that result from farm tractor-associated injuries. The large proportion of fatalities associated with rollovers implies the need for improved measures to protect the operator when tractors overturn. Commercial measures such as different types of rollbars or reinforced protective cabs have long been available. The use of such automatic or passive measures of protection is an important means of prevention because no individual action is required by those who are protected (22). However, current safety standards do not require the use of these protective measures by farm owners or their

families. In addition, a previous study of this problem in Wisconsin indicated that the promulgation of recommendations for voluntary use of rollover protective measures did not reduce the rate of fatalities associated with tractor injuries (23).

The increased risk of injuries among farm families with certain characteristics and of tractor-related fatalities among older men and the involvement of persons whose primary occupation was other than farming suggests that educational efforts could be directed at specific groups (24). However, the importance of safety education as a means for preventing injuries among farmers has recently been questioned and has been generally undocumented in other areas (25). Finally, the descriptive epidemiology has identified north Georgia as an area where effective preventive measures should be intensified.

Our study employed a descriptive epidemiologic approach to the problem of fatalities associated with farm tractor use. Future research efforts directed at this problem and at other types of agricultural injuries could employ analytic epidemiologic techniques such as case-control and cohort study designs. These analytic approaches would permit examination of the importance of specific potential risk factors such as experience and training of the operator, surface angle and other physical characteristics of the terrain, and presence or absence of certain safety features.

This study has shown how death certificates are potential sources of epidemiologic information about specific types of fatal injuries. For certain types of fatalities, death certificates may provide details that permit elucidation of events contributing to the injury. Details from death certificates might also lead to hypotheses that can be studied by using other sources for data not recorded on death certificates such as the experience of the operators, safety features of the tractor, and evidence of alcohol present in the operator at the time of injury. Obtaining descriptive epidemiologic information about persons with fatal injuries and characterizing associated events are important steps in the inception, design, and implementation of preventive strategies.

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## ***Campylobacter jejuni* Infection in Colorado: Unexplained Excess of Cases in Males**

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### **Synopsis** .....

*Between January 1, 1981, and December 31, 1982, the Colorado Department of Health received reports of 1,185 culture-confirmed cases of Cam-*

*pylobacter jejuni infection. Incidence rates were highest among infants less than 1 year old and among persons aged 20-29 years. The distribution of cases by sex showed a predominance among males at all ages except 40-59 years, the most marked predominance occurring in infants under 1 year. The higher rates for males were also significant for all ages combined, for ages 10-19 years, and for ages 5-9 years.*

*Neither Salmonella nor Shigella infections reported in Colorado during the same period showed the preponderance among males found for C. jejuni infections. Giardia infections, however, showed a weak male predominance, especially among children less than 10 years old.*

*The preponderance of C. jejuni cases among males disclosed by this study was remarkable. The reasons for this phenomenon are not clear and need further research.*

**C**AMPYLOBACTER JEJUNI is now well recognized as a common cause of enteritis in man (1). Cases

have been linked to exposure to contaminated food (2), water (3,4), animals (5,6), and raw milk (7,8)