Farm Equipment Injuries in a Rural County, 1980 Through 1985: The Emergency Department as a Source of Data for Prevention

Incidence rates of injury related to farm machinery were estimated for Athens County, Ohio, using data generated as part of the National Electronic Injury Surveillance System (NEISS) of the Consumer Product Safety Commission. The study period was 1980 through 1985. The service area of the principal hospital in the county, which participates in NEISS, closely approximates the population of the county. The population of the entire county and the rural farm population, based on US Census data, were used as denominators in calculation of rates. There were 147 injuries related to farm machinery over a six-year period, 14 of which were coded as occupational. One hundred twelve (84.2%) of these injury victims were men. The annual incidence rate per 1,000 rural farm resident population was 25.6 per 1,000 for children under the age of 14 years and was 55.6 per 1,000 for adults age 25 to 34 years. Annual rates for adults age 35 and up ranged from 13 to 19 per 1,000 rural farm residents. The annual number of tractor rollover injuries decreased during this study period, while the annual numbers of other tractor injuries did not change. Hospital emergency department visits can be used to document the need for and to evaluate injury prevention measures. [Hopkins RS: Farm equipment injuries in a rural county, 1980 through 1985: The emergency department as a source of data for prevention. Ann Emerg Med July 1989;18:758-762.]

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INTRODUCTION

Farming is an occupation with a high rate of on-the-job mortality and serious injury, ranking with mining, construction work, and forestry.[1] Because the vast majority of all injuries do not result in hospitalization, studies based on hospital admissions or death certificates fail to capture much of the morbidity due to injuries and also may give a distorted picture of the relative importance of various causes of injury.[2,3] Data collection from hospital emergency departments can provide information on a wide variety of injuries, although injuries treated in physicians' offices or otherwise not treated by medical services will be missed by such a system. Such data collection could be used on a local level to assess the effectiveness of injury control efforts such as educational programs and changes in design and the use of specific items of farm equipment as well as to aid in planning emergency medical services (EMS).

Most previous studies of injuries in rural areas[4-8] have been practice based rather than population based and therefore have described the characteristics of injured persons but have not been able to calculate rates of such injury by age or sex. Two population-based studies in Ohio[9,10] were not designed in such a way that rates per farm resident could be calculated.

Rivara[11] described national rates of fatal and nonfatal injuries to farm children and adolescents, synthesizing data from the US Census, the National Electronic Injury Surveillance System (NEISS), and death certificate reviews conducted by the Consumer Product Safety Commission and the National Institute of Occupational Safety and Health. Similar syntheses have not been published for adults.

To explore the potential uses of ED data on a local level, we describe rates and characteristics of farm equipment-related injuries and deaths during the years 1980 through 1985 in the small town and rural environment of Athens County, Ohio. The data are based on ED visits at O'Bleness

TABLE 1. *Annual rates among farm residents of farm equipment-related injuries by age group and general population rates for all consumer product-related injuries from O'Bleness Hospital NEISS data, 1980 – 1985*

	Age (yr)						
Age Group	**0 – 14**	**15 – 24**	**25 – 34**	**35 – 44**	**45 – 54**	**55 – 64**	**65 and Older**
Number of nonoccupational injuries	26	28	25	17	16	10	10
Number of occupational injuries	0	5	4	2	1	2	0
Total injuries	26	33	29	19	17	12	10
Rural farm population	169	196	87	165	163	146	127
Rate per 1,000 farm population,* farm equipment injuries	25.6	28.1	55.6	19.2	17.4	13.7	13.1
Rate per 1,000 population, all consumer product injuries	73.8	49.3	39.1	30.0	18.1	14.4	14.4

*Denominator for rate is Athens County farm population by age from US Census, 1980.[15]

Memorial Hospital in the city of Athens and on death certificates.

METHODS

The background and methods for data collection have been described in more detail elsewhere.[12] Athens County is located in southeastern Ohio, a region of wooded, steeply rolling hills with relatively little arable land. Highway access is poor compared with that in most parts of Ohio, thereby limiting economic development. Educational levels and income in rural southeastern Ohio are lower than in most rural parts of the state.

Athens County had a 1980 census population of 56,399[13] and a 1985 estimated state population of 57,500. These figures included 15,000 students at Ohio University (in the city of Athens) and 3,000 students at Hocking Valley Technical College (in Nelsonville).

There were 534 working farms in the county in 1982.[14] (A farm was defined as an enterprise that produced agricultural products worth at least $1,000 a year.) Only 137 farm operators reported no days of work off the farm in 1982, and only 197 reported farming as their principal occupation. The 1980 census estimated the rural farm population of Athens County as 1,053.[13] Farms are small and are mixed operations that concentrate on corn, hay, cattle, and market gardening.

Athens County medical services include two hospitals, the 60-bed Doctors' Hospital in Nelsonville and the 120-bed O'Bleness Hospital in Athens. The city of Columbus, with a full range of large city and university medical services, is 75 miles to the northwest (one and one half hours by car). To the east about 35 miles (55 minutes) is Parkersburg, West Virginia, with two large hospitals that draw some patients from the eastern end of Athens County.

Southeast Ohio Emergency Medical Services, a nonprofit emergency service, operates eight regional EMS units over a six-county area, which includes Athens County. SEOEMS drivers transport patients to the nearest hospital, which is Doctors' Hospital in the western part of the county and O'Bleness Hospital in the central part of the county. O'Bleness and Doctors' Hospitals are also the closest hospitals for some areas of six adjacent counties.

Our study included injuries treated at O'Bleness Hospital between January 1, 1980, and December 31, 1985, for which farm equipment was identified as the source of the injury. The data were collected originally for the NEISS. This system was begun in 1972 by the US Consumer Product Safety Commission as a surveillance system for consumer product-related injuries seen in US hospital EDs. During the study period, both consumer product injuries and occupational injuries were abstracted; motor vehicle injuries were not. Because most farmers are self-employed and most farms are not covered under the Occupational Safety and Health Act, most farm equipment-related injuries are considered by NEISS as consumer product injuries rather than as job-related injuries.

The data available on each record included age of the injured person (in months up to 2 years old, and then in years), sex, date of the ED visit, injured part of the body, type of injury (eg, fracture, abrasion, burn, sprain, contusion), setting at the time of the injury (eg, home, school, work, street), disposition of the case (eg, admitted, treated and released, transferred elsewhere), up to two product codes (of which there are more than 1,000), and an 80-character comment field. Farm machinery injuries were those associated with codes 1004 through 1061 in the NEISS consumer product coding system.[15] Injuries related to home tractors and lawn mowers are not included in this group.

To define a core service area for O'Bleness Hospital's EMS, a simple random sample of 352 records was chosen from the 14,336 NEISS computer records of nonoccupational injuries during the six-year study period. The home addresses of the injured persons were extracted from ED records, tabulated, and compared with the population distribution of the county. Comparison of the sample of NEISS records with ED records showed that data were abstracted by clerical personnel with a high degree of accuracy. For example, no more than three records had an incorrect code for part of the body injured, and no more than 17 had an incorrect code for type of injury.[12]

To determine which areas of Athens County were primarily served by Doctors' Hospital in

TABLE 2. *Number and percentage of farm equipment-related injuries and percentage of all consumer product-related injuries, by type and part of body, from O'Bleness NEISS data, 1980 – 1985*

	Farm Equipment Injuries (N = 147)		All Injuries (N = 14,336)
	No.	%	%
Type of Injury			
Laceration	53	36.1	32.7
Contusion/abrasion	42	28.6	21.1
Fracture	28	19.0	12.6
Sprain/strain	7	4.8	16.0
Other	17	11.6	17.6
Part of Body Injured			
Fingers	23	15.6	14.6
Feet	18	12.2	7.7
Upper trunk	11	7.5	4.1
Knee	12	8.2	4.6
Ankle	7	4.8	8.5
Face	6	4.1	12.2
Other	70	47.6	48.3
Total	147	100.0	100.0

Nelsonville, the ED log of Doctors' Hospital was also reviewed for six one-month periods, and town of residence for persons treated for injuries was tallied.

Population data for calculation of injury rates in this study were derived from the 1980 US Census[13] and the 1982 Census of Agriculture.[14]

Because persons who die of an injury out of hospital do not ordinarily generate a NEISS record, computerized death certificate files maintained at the Ohio Department of Health were reviewed to identify possible farm equipment-related deaths. For the period 1980 through 1986, all deaths coded to external causes (E-codes 800 to 999) in which an Athens County resident died or the injury or death occurred in Athens County were reviewed to identify deaths related to farm equipment (E-code 919.0). In addition, death certificates and medical examiner reports of all persons dying of injuries in Athens County during this period were reviewed.

RESULTS

Definition of Population at Risk

The easternmost three townships of Athens County, with a combined population of 4,000, were represented by only one visit in the sample; Nelsonville (York Township) was represented by only 11 visits. A core area of Athens County served by O'Bleness Hospital was defined to include the entire county except these four townships. Two hundred eighty-four (80.6%) of the sample ED visits were made by persons from the core area. The ten townships in the core area contained 45,302 persons according to the 1980 census, or 80.3% of the county's population.

The parts of Athens County excluded from the core service area of O'Bleness Hospital are very similar economically and demographically to the rural areas and small towns in adjacent counties whose residents use that hospital. Thus, the population of Athens County is very similar in character and size to the population of O'Bleness Hospital's core service area. To calculate injury rates, the number of injuries in the NEISS dataset has been compared with the 1980 census population of Athens County, which is taken to approximate the population served by O'Bleness Hospital. Similarly, the 1980 rural farm population of Athens County is taken to approximate the rural farm population served by O'Bleness Hospital.

Rates of Injuries and Characteristics of Injured Patients

The crude average annual incidence rate of ED visits for all consumer product injuries for Athens County for all ages was 42.3 per 1,000 population. Age-specific rates are shown (Table 1).

During the six-year period of January 1, 1980, through December 31, 1985, there were 133 injuries related to farm equipment in the database among 14,336 nonoccupational consumer product-related injuries and 14 such injuries among 2,788 occupational injuries. Of the injured persons, 125 (85.0%) were men, 21 were women, and the sex of one had not been recorded.

Emergency visits for these injuries were most common in summer and least common in winter, matching the agricultural cycle. There were 17 to 21 injury visits each month in May, June, July, August, and September; more than 70% of the injuries occurred during these five months. There were no visits for farm equipment-related injuries during January.

While the largest numbers of farm equipment injuries in men occurred in those age 15 to 24 years (32 injuries) and 25 to 34 years (26 injuries),

there were 16 injuries in men age 45 to 54 years. The ratio of the number of farm equipment injuries in men over the six-year period to the number of Athens County farm operators counted in the 1982 Census of Agriculture[13] in each age group is 1:2.7 in those age 25 to 34, 1:9.7 in those age 35 to 44, 1:8.3 in those age 45 to 54, 1:12.9 in those age 55 to 64, and 1:15.7 in those age 65 and over.

The annual incidence rates of injury from farm equipment estimated using the number of injuries by age from the present data as the numerator and the 1980 census rural farm population by age[13] as the denominator are shown (Table 1). Among persons age 45 years or older, annual rates of injuries caused by farm equipment are comparable to rates of all consumer product-related injuries in the general population of the county.

The largest numbers of injuries involved fingers, feet, upper trunk, and knees (Table 2). Finger, foot, and upper trunk injuries appeared to be more common among farm equipment-related injuries than among consumer product injuries, whereas injuries to the face, head, and ankle were less common. Fractures, lacerations, and contusions and abrasions were more common in this set of injuries, and strains and sprains were less common. More than half (11 of 21) of the injuries in women and girls were contusions or abrasions, and 26 of 125 (20.8%) of the injuries in men were fractures.

The admission rate for persons with farm equipment injuries was 11.3% and did not show a trend by age. The admission rate was 2% to 3% for other injuries in this dataset.

Circumstances of Injuries

The type of farm equipment most commonly associated with these nonfatal injuries was the farm tractor, which was involved with 58 (39.5%) of the 147 injuries. Fifty-six of these 58 injuries occurred in men. Twenty-two (37.9%) of the 58 tractor-related injuries occurred to persons more than 44 years old, while only 14 (15.7%) of the remaining 89 farm equipment injuries were to persons in this age group.

Twelve of these 58 tractor-related injuries were sustained when a tractor overturned, usually onto the driver. Five of these 12 persons were hospitalized, four with fractures and one with laceration as their most severe injury. Nine of these 12 injuries occurred during the first two years, and the remaining three injuries occurred over the last four years of the study period (Table 3). The number of tractor injuries not attributed to overturns did not show a downward trend over the study period.

TABLE 3. *Injuries related to tractors, by type and year, Athens County, 1980 – 1985*

	Year						
	1980	1981	1982	1983	1984	1985	Total
Overturns, fatal	1	0	0	1	0	1	3
Overturns, nonfatal	5	4	0	0	2	1	12
Other	4	9	11	3	13	6	46
Total	10	13	11	4	15	8	61

In eight cases, the patient's foot, leg, or both was run over by the tractor. At least seven of the 57 tractor injuries occurred when the tractor was clearly stationary. In six other cases, the patient's extremity got caught between the tractor and an immovable object such as a tree, fence post, or wall. In nine cases, the patient's body struck or was struck by a piece of the tractor, such as the steering wheel.

The next most common type of farm equipment associated with injuries was hay-processing equipment (14 injuries), followed by farm mowers (13), farm wagons (11), tillage equipment (eight), chains (seven), farm conveyor belts (six), and crop pickers (five). These types of equipment together account for 43.5% of the farm equipment-related injuries. Ten of the 13 injuries related to mowers were lacerations.

Deaths Associated With Farm Equipment

During the study period, three additional incidents involving farm tractors resulted in fatalities in Athens County. One incident occurred in 1980, one in 1983, and one in 1985. All three decedents were between 55 and 60 years old; two were men and one was a woman. All three incidents were overturns that resulted in massive head and chest injuries. The injured persons died at the scene and therefore were not entered in the NEISS dataset. One additional fatality occurred in a woman who fell out of a hay wagon on a county road. She was hospitalized and appears in the NEISS dataset. Her cause of death was coded as a highway injury, rather than a farm machinery injury, on her death certificate.

DISCUSSION

Community hospital ED data can be used to generate population-based estimates of incidence of the injuries included in the system for a single community if the hospital serving that community has a sufficiently discrete service area. Such a system can lead to hypotheses about local causes of injuries and can serve as a method to evaluate the effectiveness of local injury prevention programs. Generating such hypotheses and evaluating program effectiveness are among the primary purposes of a surveillance system.

The data on tractor rollover injuries show a gradual decline in the number of such injuries, both fatal and nonfatal, over the study period, whereas other kinds of injuries related to tractors showed no decline. This observation is consistent with the gradual adoption of voluntary safety standards for tractors, including the installation of rollbars on tractors without enclosed cabs. In 1977, an estimated 12.5% of Ohio tractors in use had rollover protective structures;[9] by 1982, this estimate had risen to 23.4%.[10] Athens County data alone would not be sufficient to decide whether the observed recent fall in fatalities is attributable to installation of rollover protective structures, to a decrease in rollover incidents, or to chance. Such a conclusion would need to depend on more detailed analysis of the cir-

cumstances surrounding the injuries that do occur and the prevalence of rollover protective structures on tractors in use locally.

Not all persons injured by or while using farm machinery are farm residents as defined by the 1980 census, and thus the farm equipment injury rates shown (Table 1) for rural farm residents may be overestimated. Nonetheless, the high farm equipment injury rates, especially in adults more than 25 years old, are striking. The rates of farm equipment-related injury are comparable to the injury rates from all consumer products for all residents of the county, and the injuries tend to be more severe, as judged by the frequency of hospitalization and the types of injuries. As seen in other studies,[15] persons injured by tractors tended to be older than persons with injuries from other types of farm equipment.

CONCLUSION

Monitoring of injury patterns at the local level using hospital ED data may be a useful way to assess the effectiveness of local injury prevention measures. Methods similar to those described here could be used to document the circumstances leading to specific types of injury, as well as the population groups at highest risk for these injuries, in many communities served primarily by one ED. Likely candidates for such surveillance efforts might include motor vehicle injuries in young drivers or in children young enough to be covered by infant restraint laws, injuries to bicyclists, falls in the home by the elderly, or injuries related to organized sports.

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