

Surveillance of Agricultural Injuries in Central Wisconsin: Epidemiologic Characteristics*

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ABSTRACT: We implemented a hospital-based agricultural injury surveillance system in central Wisconsin in November 1986. The geographic area of the study is heavily agricultural, with a predominance of dairy farmers. This report describes the epidemiologic characteristics of the 913 patients seen during the first two years of the surveillance system. The majority of patients were male (77%), between the ages of 19 and 65 years of age (68.4%), and either the owner/operator of the farm (42.4%), or the spouse of the owner/operator (10.5%). Falls accounted for the greatest number of injuries in children younger than 16 years of age and in those older than age 65, while animals were the most frequent cause of injury in those between the ages of 16 and 65 years. Injuries were most likely to occur in the months of June, July, and August, which together accounted for 37 percent of the total number of injuries. Despite the limitations of the descriptive data derived from surveillance systems, such information may be useful for determining the magnitude of a health problem and suggesting hypotheses to account for the apparent distribution of disease and injury.

According to National Safety Council (NSC) estimates, agriculture is among the most dangerous occupations in the United States (National Safety Council, 1990). Each year more than 1,300 deaths in the United States are attributed to agricultural injuries, resulting in an annual mortality rate of 40 deaths per 100,000 workers (National Safety Council, 1990). In addition, the NSC estimates there are about 120,000 nonfatal agricultural injuries per year that require medical attention or result in at least one half day off from work.

The high occupational injury rate in agriculture has been attributed to the unique working conditions of farming, such as the diversity of the work involved, long hours, fatigue, old machinery, lack of training, and solitary work (Cohen, Moll, Maley, & Linn, 1989; Layde, 1989). In addition to the diversity of the risks in agriculture, there is considerable diversity in the work force involved in farming. For example, part-time seasonal workers or

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family members may not regularly be considered part of the agricultural work force, yet are often at risk of agricultural injuries.

Central Wisconsin is rural, with no large metropolitan areas. The primary agricultural enterprises in the region are family-run dairy farms. There is also a substantial amount of vegetable farming, livestock raising (beef cattle, sheep, pigs, and mink), cranberry growing, and ginseng farming. In order to learn more about agricultural injuries in this region, we began the routine collection of surveillance information on all individuals involved in agricultural injuries who sought care at the only emergency medical care facility in a large region in central Wisconsin. We have previously reported clinical characteristics of these injured patients (Stueland, Zoch, Stamas, Krieg, & Boulet, 1990); here we present the epidemiologic characteristics of the people who experienced agricultural injuries in central Wisconsin during a two-year period.

Epidemiologic surveillance has been defined as the "systematic collection, analysis, and interpretation of health data essential to the planning, implementation, and evaluation of public health practice" (Centers for Disease Control, 1986, p. 22). Because of the paucity of data on preventable risk factors for agricultural injuries (Layde, 1990), the primary purpose of this surveillance system was to quantify the burden of agricultural injuries and to suggest hypotheses for their causes. Basic data such as the demographic characteristics of those injured, the agents involved in the injuries, and seasonal and weekly temporal trends of injury occurrence are all useful in that regard and may be of interest to other agricultural injury researchers. Based on the results of this surveillance a more in-depth case-controlled study of preventable risk factors for agricultural injuries is currently underway. In addition, the information from this study on the spectrum and seasonal pattern of injuries and the age of those injured may be of interest to clinicians and health care administrators responsible for providing emergency health care services in rural areas. It may also be useful to public health officials charged with monitoring the health of rural populations, or with planning for future health care personnel demand in rural areas.

Methods

The Marshfield Clinic is a 315-physician multispecialty clinic primarily serving central and northern Wisconsin, but also receiving referrals from throughout Wisconsin and the northern peninsula of Michigan. St. Joseph's Hospital, which is contiguous to the clinic, is a 525-bed acute care hospital with an emergency department treating more than 26,000 patients per year. The clinic's "urgent care area" is located in the hospital, adjacent to the emergency department. The urgent care area provides care for about 14,000 patients per year and is primarily oriented to ambulatory care, particularly

follow-up care for emergency department patients. A joint clinic and hospital medical record system facilitates comprehensive documentation of patient treatments and outcomes.

In November 1986, the staff in the emergency department of the Marshfield Clinic and St. Joseph's Hospital initiated surveillance on all agricultural injury patients seen in the emergency department of the hospital or the urgent care area of the clinic. Agricultural injuries were defined as those injuries associated with machinery, animals, facilities, or the environment at agricultural work sites even if the injured individual was not, strictly speaking, working. Injuries occurring away from the work site while using agricultural equipment were also included. Injuries that might have been employment related, but were due to motor vehicles or were primarily due to recreational activities, were excluded. Data on the circumstances of the accident were collected routinely by emergency department staff at the time of initial care for the injury and recorded on a precoded form. At least three months after the date of the initial injury, the medical record of each injured individual was reviewed to abstract follow-up information on services provided, convalescence, and health outcomes.

The Chi-square test with continuity correction (Armitage, 1971) was used to assess the independence of contingency table data. Edward's test of seasonality was used to assess the periodic nature of the daily and monthly distribution of injuries (Edwards, 1961).

Results

From Nov. 1, 1986, through Oct. 31, 1988, 913 patients with agricultural injuries fulfilling our case definition were seen at St. Joseph's Hospital emergency department. The age and sex distribution of the injured patients is shown in Table 1. Seventy-seven percent of the injured patients were male. Among preschoolers, males and females appeared to be at similar risk of agricultural injury. For all age groups beyond preschool, however, there were at least twice as many male patients with agricultural injuries as females. The age distribution of agricultural injuries also differs from that typical for occupational injuries which are concentrated in workers 18 to 69 years of age (Waller, 1985). About 27 percent of agricultural injuries in our study occurred to individuals 18 years of age or younger, while 5 percent of agricultural injuries occurred to individuals older than 65 years. Men 19 to 65 years of age accounted for 54 percent of the injuries.

The relationship of the injured individuals to the owner/operator of the farm on which they were injured is shown in Table 2. The group with the greatest number of agricultural injuries were the owner/operators of the farms themselves. Overall, 88.6 percent of the agricultural injuries occurred to the owner/operator or members of his or her immediate family. One

Table 1. Age and Sex Distribution of Patients with Agricultural Trauma, Central Wisconsin: November 1986-October 1988.

Age	Male	%	Female	%	Total	%
0-5	27	(3.8)	21	(10.0)	48	(5.3)
6-15	90	(12.8)	41	(19.5)	131	(14.3)
16-18	50	(7.1)	17	(8.1)	67	(7.3)
19-25	103	(14.7)	21	(10.0)	124	(13.6)
26-45	263	(37.4)	65	(31.0)	328	(35.9)
46-65	130	(18.5)	43	(20.5)	173	(18.9)
>65	40	(5.7)	2	(1.0)	42	(4.6)
Total	703	(100.0)	210	(100.0)	913	(100.0)

Test of Homogeneity: Chi-square_{6df} = 29.65; $p = 0.000046$.

quarter of all the injuries occurred to young children of the farm's owner/operator. Less than 12 percent of agricultural injuries occurred to employees or other visitors to the farm.

The number of farm injuries by sex and month of occurrence are shown in Figure 1. The greatest number of agricultural injuries occurred from June to September. The seasonal variability in the number of injuries was highly significant ($\chi^2_{2df} = 88.49$; $p < 1 \times 10^{-12}$). Men had a substantially greater number of injuries than women in each month.

The distribution of farm injuries by sex and day of the week of occurrence is presented in Figure 2. There is some evidence that the greatest risk of injury, particularly for women, occurred on weekends; the difference in the day-of-the-week distribution of the injuries in men and women was statistically significant ($\chi^2_{6df} = 14.002$; $p = 0.0296$).

The type of agent involved in the injuries for males and females is shown in Figure 3. The most common agent of injury was an animal, followed by falling. The distribution of agent of injury differed for males and females ($\chi^2_{8df} = 56.80$; $p < 10^{-8}$). Females accounted for more than 40 percent of all the animal-related injuries, but for less than 15 percent of the injuries due to tractors or farm implements.

Table 2. Relationship of Patients with Agricultural Trauma to the Farm Owner/Operator, Central Wisconsin: November 1986-October 1988.

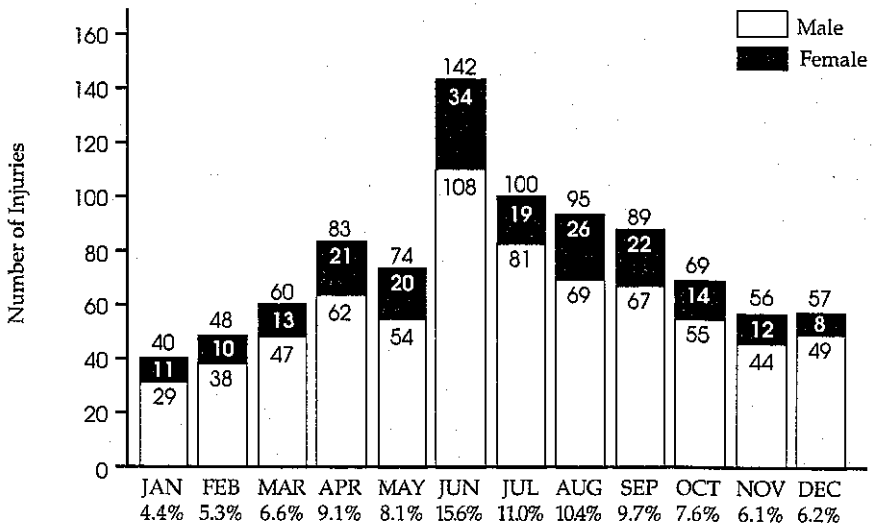
	N	%
Owner	387	(42.4)
Spouse	96	(10.5)
Juvenile Child	228	(25.0)
Adult Child	98	(10.7)
Employee	66	(7.2)
Other	38	(4.2)
Total	913	(100.0)

The distribution of agent of injury for people of different ages is shown in Table 3. The most common cause of agricultural injuries in preschoolers and the elderly was falls, while animals were the most common agent of injury in all other age groups.

Discussion

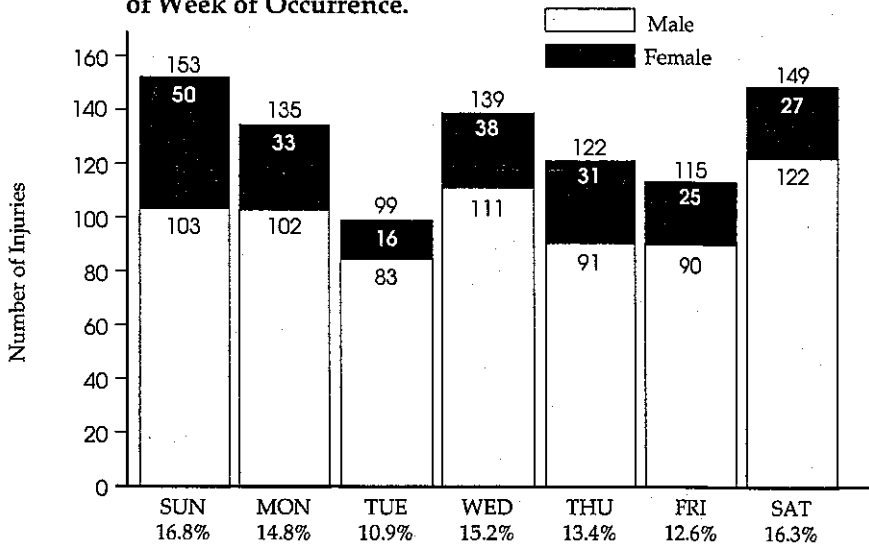
Before discussing the results of this study, it is worth considering some of the limitations of the study data. By the nature of the data collected and the study design, these results are descriptive. There is no detailed information gathered on potential risk factors for injuries or on the detailed circumstances of the injuries. Neither do we have a control or comparison group of uninjured farmers or farm residents from which to draw inferences on the expected frequency of various characteristics of the injured farm residents. Although most patients seen at St. Joseph's Hospital were primary care patients who live in the immediate area and sought initial care at the St. Joseph's Hospital emergency room, there were some secondary or tertiary care patients who were initially seen elsewhere but were then referred to Marshfield for specialty care. The mixture of primary care and referral patients

Figure 1. Number of Farm Injuries in Males and Females by Month of Occurrence.



Information in this figure is for November 1986 through October 1988, and was gathered from St. Joseph's Hospital/Marshfield Clinic, Marshfield, WI, records.

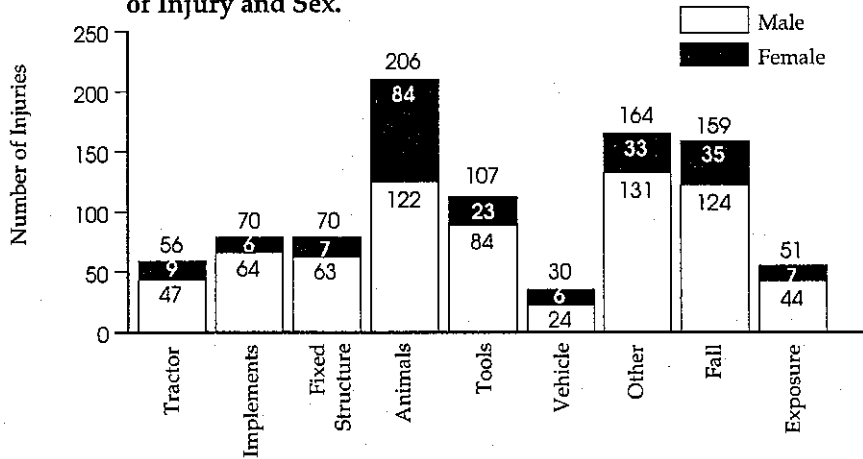
Figure 2. Number of Farm Injuries in Males and Females by Day of Week of Occurrence.



Information in this figure is for November 1986 through October 1988, and was gathered from St. Joseph's Hospital/Marshfield Clinic, Marshfield, WI, records.

$$\chi^2_{6df} = 14.00271 \quad p = 0.0296$$

Figure 3. Number of Farm Injuries in Males and Females by Agent of Injury and Sex.



Information in this figure is for November 1986 through October 1988, and was gathered from St. Joseph's Hospital/Marshfield Clinic, Marshfield, WI, records.

Table 3. Number of Patients with Agricultural Trauma by Agent of Injury and Age, Central Wisconsin: November 1986-October 1988.

	Age Group							Total
	0-5	6-15	16-18	19-25	26-45	46-65	>65	
Tractor	3	11	2	7	15	14	4	56
Implements	1	9	7	11	22	16	4	70
Fixed	4	12	5	8	27	11	3	70
Animals	5	25	17	32	81	41	5	206
Tools	1	20	4	19	45	13	5	107
Other Farm Vehicle	3	5	4	3	11	4	0	30
Fall	22	25	4	12	49	32	15	159
Exposure	4	5	4	10	23	5	0	51
Other	5	19	20	22	55	37	6	164
Total	48	131	67	124	328	173	42	913

will limit the ability to generalize the study results to other trauma centers that have a different mix of primary care and referral patients. Finally, because most of the farming in our area is dairy farming, our study does not provide detailed information about the types or characteristics of injuries occurring in other agricultural settings.

Despite these limitations, several useful inferences can be drawn. The sheer volume of agricultural injuries seen in a single emergency room is noteworthy. There were more than 900 patients whose agricultural injuries were severe enough to seek medical attention during a two-year period at a single hospital. The frequency of farm injuries seen in our emergency department is not surprising, however, in light of the rural setting of Marshfield and of the high frequency of agricultural injuries. The National Safety Council has estimated that 4 to 5 percent of all farmers are injured in an agricultural accident annually (National Safety Council, 1982, 1990). The age and sex distribution of the victims of agricultural injuries is somewhat surprising. Only 54 percent of all the farm injuries occurred to males between 19 and 65 years of age, who correspond most closely to the traditional distribution of "farmers." A higher proportion of injuries in our study were incurred by youngsters 15 years of age and under, compared with the results of a NSC survey that was conducted in 31 states primarily in the 1970s (National Safety Council, 1982). The change in economic conditions and the resulting trend in supplemental off-farm employment by at least one of the adults on the farm may have contributed to the increasing occurrence of farm injuries in young children, because the adult remaining on the farm often has child care responsibilities as well as farm chores.

Compared with studies that deal with the most severe farm injuries that result in hospitalization or death (Cogbill & Busch, 1985; Hansen, 1986; National Safety Council, 1982), our data on the agents involved in agricultural injuries showed a relatively lesser role of tractors and other farm implements and vehicles. Animals were the most common agent of injury and accounted for an appreciable number of injuries in all age groups. Injuries from falls were also a frequent occurrence and were the leading cause of injury in young children and adults older than 65 years.

There was also a marked seasonal pattern in the occurrence of agricultural injuries. The highest number of injuries occurred during the months from June through August, while substantially fewer injuries occurred during the winter months. The seasonal pattern may simply reflect the number of hours worked at different times of the year or may also reflect the concentration of more hazardous farming activities in the fair weather months. The pattern of injuries by day of week indicates that there was no decrease in injuries on the weekends when there is a drop-off in most other occupationally related injuries. In fact, there was a suggestion that the greatest frequency of injuries to women occurred on the weekend days (when they may have been helping out on the farm after having worked a

full week at an off-farm job). Further research is needed to determine if the distribution of weekend injuries corresponds to the actual number of hours worked on the weekends or if there is an additional risk due to fatigue, stress, or other factors.

This descriptive report adds to our knowledge of the characteristics of individuals injured in agricultural accidents. This report also describes an emergency room-based surveillance system for agricultural injuries that may be a more efficient way to collect information on agricultural injuries than farm-based surveillance, which has been widely utilized in the past (Jansson, 1987). The National Academy of Sciences report *Injury in America* (National Research Council & Institute of Medicine, 1985) lays out a national agenda for injury research that proceeds from surveillance through identification of risk factors and interventions to the testing and widespread implementation of effective interventions. If progress is to be made in reducing the toll of agricultural injuries, more detailed analytic, and epidemiologic studies will be required to elicit information on risk factors and specific circumstances of injuries along with appropriate control data. Such studies should lead to the development of interventions which, if proven effective, may help to reduce the toll of agricultural injuries.

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