

Non-tractor, Agricultural Machinery Injuries in Ontario

Lisa Hartling, BScPT, MSc,^{1,2} William Pickett, PhD,^{1,3}
Robert J. Brison, MD, MPH, FRCPC^{1,3}

Agricultural (farm) machinery is responsible for the majority of traumatic agricultural injuries in North America.¹⁻⁴ Machinery accounts for 70% of fatal and 50% of hospitalized farm injuries in Ontario (unpublished data). Of these, farm tractors and power-take-off (PTO) devices are associated with 70% and 40% of fatal and hospitalized machinery injuries, respectively. Many additional types of machinery, however, put Ontario farmers and farm workers at risk for injury.

We examined patterns of agricultural machinery injury among the Ontario farm population using two systems developed for the surveillance of fatal and hospitalized injuries. Specifically, we examined the types of machinery that, after tractors and PTOs, are most commonly associated with fatal and hospitalized farm injuries. Tractor and PTO injuries have been described in a previous article.⁵

The objectives of this study were to: 1) estimate rates of fatal and hospitalized injuries related to the operation of farm machinery in Ontario; and 2) describe the nature of these injuries in terms of age group, sex, mechanism, location, time and severity. The implications of these findings for prevention are highlighted.

1. Centre for Injury Prevention and Research, Kingston, Frontenac & Lennox & Addington/Queen's University Teaching Health Unit, Kingston, Ontario
2. Department of Community Health and Epidemiology, Queen's University
3. Department of Emergency Medicine, Queen's University

Correspondence: Dr. William Pickett, Career Scientist, KFL&A/Queen's Teaching Health Unit, 221 Portsmouth Avenue, Kingston, ON K7M 1V5, Tel: 613-549-1232, Fax: 613-549-7896, E-mail: PickettW@QUCDN.Queensu.ca

TABLE I
Definitions of Farm Machinery

Baler	A machine that makes hay, straw or similar products into large bundles for storage or transportation
Combine	A harvesting machine that heads, threshes, and cleans grain while moving over the field
Harvester	Similar to a combine in that it is used for gathering in field crops
Hay elevator	A conveyer used for elevating and discharging hay from one level to another
Auger	A machine used to elevate grain via a screw-like mechanism, or an instrument used for boring into soil

METHODS

We identified and described: 1) hospitalized farm machinery injuries that occurred in Ontario during the nine-year period ending December 31, 1993; and 2) fatal farm machinery injuries that occurred during the nine-year period ending December 31, 1992. These injuries included those related to any machine or vehicle used in agricultural production other than farm tractors, PTOs and motor vehicles.

Fatalities were identified using registries maintained by the Office of the Chief Coroner, the Registrar General, and the Farm Safety Association. Hospitalized injuries were identified using hospital discharge data, and supplemental data were provided from hospital medical records departments. Detailed descriptions of our surveillance systems can be found elsewhere.^{1,5-7}

Descriptive information obtained for each injury included the following: age and sex of the victim, month and year of injury, geographic region of residence, mechanism of injury, and machine involved. Details about the injury event were collected through abstraction of coroners' files and in-patient records for each fatal and nonfatal injury respectively. Rates

of injury were calculated using age, sex and region-specific denominator data from the 1986 Canada Census of Agriculture.⁸ Relative severities of injury mechanisms were described using case fatality ratios (ratio of hospitalizations:fatalities).

Operational definitions used in this study are presented in Table I.

RESULTS

Overall

We identified 52 fatalities and 1,068 hospitalizations for machinery-related injuries. Three additional hospitalizations resulted in death, and were excluded from the analysis of hospitalizations to avoid duplication. Figure 1 describes the occurrence of some of these injuries by year. The most common types of machinery associated with hospitalized injuries were combines/harvestors (N=142), followed by grain augers (N=116). The most common types of machinery associated with fatalities were also combines/harvestors (N=9), followed by grain augers and farm wagons (8 injuries each).

The number of hospitalized injuries associated with hay elevators/conveyers decreased substantially from a high of 24 in 1985 to a low of 2 in 1993. There were

no fatalities resulting from hay elevators/conveyers between 1984 and 1992. The number of hospitalizations and fatalities associated with balers, combines/harvestors, grain augers and farm wagons varied over the study period but showed no strong increase or decrease.

Rates by age, sex and region of Ontario

Rates of injury by age group, sex and region are shown in Table II, and show a clear male predominance. Demographic groups at highest risk for injury were men over the age of 60 years and persons from farms in Western and Northern Ontario.

Mechanism of injury

Table III describes the mechanisms of injury for the five most common types of farm machinery injury. The primary mechanism of injury among balers, grain augers, hay elevators/conveyers and combines was entanglement in the machinery. The most common mechanisms among farm wagons were being run over or struck/pinned by the wagon. The most severe type of machinery injury was being run over or struck/pinned by a machine with a case fatality ratio ranging from 2 hospitalizations for each death among grain augers to 13 for balers. Entanglement in the machinery, particularly among baler and combine/harvester injuries, had a higher ratio of hospitalizations to deaths, which indicated that these types of injury are rarely fatal.

Hospitalized injuries: Length of stay, nature of injury and body part

The length of stay (LOS) in hospital associated with machinery-related injuries ranged from 1 to 212 days with a mean of 7.9 days (SD 13.1) and a median of 4 days. The average LOS varied somewhat by machinery type with a low associated with baler injuries (mean 6.9 days (SD 9.3); median 4 days) and a high associated with auger injuries (mean 8.8 days (SD 9.7); median 6 days).

Fractures were the most common nature of injury, accounting for 35% of all primary injuries, followed by cuts/lacerations (16%) and amputations (16%). The leading anatomical sites associated with machinery injuries were the upper (50%) and lower (29%) extremities (particularly the hands and feet).

TABLE II
Injuries Associated with Farm Machinery,
Ontario 1984 through 1993, by Age, Sex and Region

Description	Denominator (1000s)	Fatalities (1984-1992)		Hospitalizations (1985-1993)		Ratio of Hospitalizations to Fatalities†
		n	Rate*	n	Rate*	
Total	240	52	2.4	1068	49.3	20.5:1
Males (by age)	125	48	4.3	932	82.8	19.4:1
0-19	40.2	11	3.0	205	56.6	18.6:1
20-39	30.8	15	5.4	273	98.5	18.2:1
40-59	35.7	13	4.0	281	87.5	21.6:1
60+	17.9	9	5.6	173	107.4	19.2:1
Females (by age)	115	4	—	136	13.2	34.0:1
0-19	40.2	3	—	48	13.3	16.0:1
20-39	34.2	1	—	34	11.0	34.0:1
40-59	31.5	0	—	37	13.1	—
60+	9.2	0	—	17	20.5	—
Region of Ontario						
Western	77.4	24	3.4	446	64.1	18.6:1
Southern	82.2	6	0.8	212	28.7	35.3:1
Central	34.5	9	2.9	154	49.6	17.1:1
Eastern	35.9	10	3.1	174	53.9	17.4:1
Northern	10.5	3	—	81	85.7	27.0:1
Unknown	—	0	—	1	—	—

* Number of injuries per 100,000 persons per year

— Number of injuries too small from which to estimate the rate (n<5)

† Ratio is based on two different but overlapping nine-year periods

TABLE III
Injuries Associated with Farm Machinery, Ontario 1985 through 1993,
by Machine and Mechanism of Injury

Mechanism of Injury, by Machine	Fatalities (1984-1992)		Hospitalizations (1985-1993)		Ratio of Hospitalizations to Fatalities
	n	Rate*	n	Rate*	
Balers	2	—	85	3.9	42.5:1
Entanglement	1	—	57	2.6	57.0:1
Runover or struck/pinned by fall	1	—	13	0.6	13.0:1
Other/unspecified	—	—	1	—	—
Other/unspecified	—	—	14	0.6	—
Hay elevators/conveyers	0	—	76	3.5	—
Entanglement	—	—	39	1.8	—
Runover or struck/pinned by fall	—	—	26	1.2	—
Other/unspecified	—	—	6	0.3	—
Other/unspecified	—	—	5	0.2	—
Augers	8	0.4	116	5.4	14.5:1
Entanglement	6	0.3	97	4.5	16.2:1
Runover or struck/pinned by fall	2	—	4	—	2.0:1
Other/unspecified	—	—	1	—	—
Other/unspecified	—	—	14	0.6	—
Farm wagons	8	0.4	83	3.8	10.4:1
Entanglement	1	—	6	0.3	6.0:1
Runover or struck/pinned by fall	7	0.3	40	1.9	5.7:1
Other/unspecified	—	—	27	1.3	—
Other/unspecified	—	—	10	0.5	—
Combines and harvestors	9	0.4	142	6.6	15.8:1
Entanglement	4	—	96	4.4	24.0:1
Runover or struck/pinned by fall	5	0.2	11	0.6	2.2:1
Other/unspecified	—	—	15	0.7	—
Other/unspecified	—	—	20	0.9	—
Other/unspecified	25	1.2	566	26.2	22.6:1

* Number of injuries per 100,000 persons per year

— Number of injuries too small from which to estimate the rate (n<5)

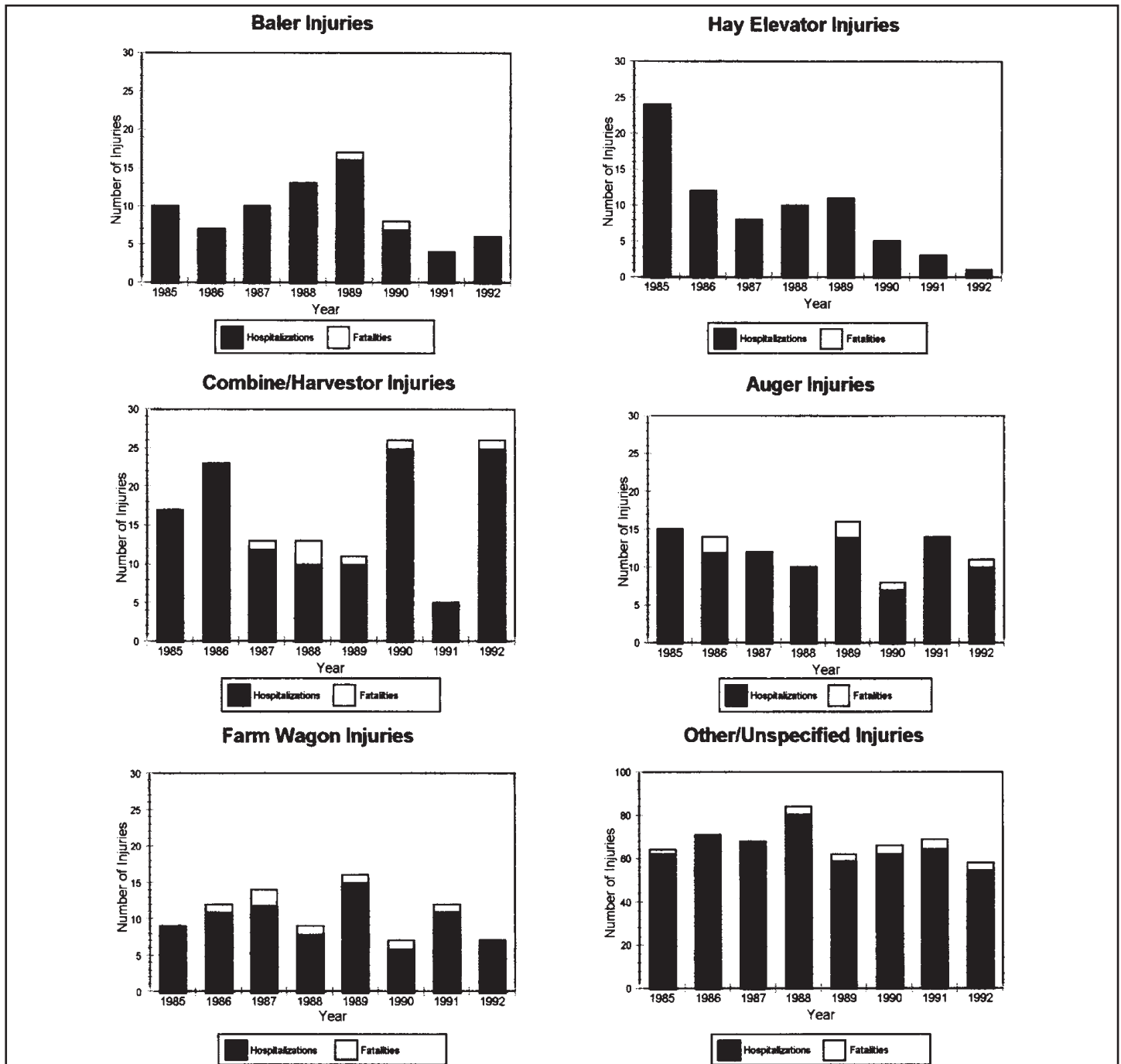


Figure 1. Fatal and hospitalized farm machinery injuries in Ontario, 1985-1992
 This figure presents information solely for those years where both fatality and hospitalization data were available (i.e., 1985-1992).

DISCUSSION

Overall

In addition to tractors and PTO devices, the farm environment contains a wide range of other machinery types that place farm people at risk for injury.^{9,10} These

other types of machinery are responsible for approximately 50 traumatic injuries per 100,000 per year.

Injuries resulting from hay elevators showed a substantial decrease over the surveillance period; much of this observed decline may be attributable to

the introduction of round baling technologies during this time period, which has reduced the need for hay elevators. There was little indication that the annual numbers of injuries related to grain augers, farm wagons, combines and balers were in decline.

Rates by age, sex and region of Ontario

The persons at highest risk for injury in the farm population are males over the age of 60, followed closely by males between the ages of 20 and 39. Older farmers may be more at risk for injury because of physical limitations¹ and slowed reaction times.¹¹ More work is required to determine whether older farmers are at increased risk due to ownership and use of older equipment.¹ The high rate among males aged 20 to 39 may be due to inexperience in young farmers¹ or increased exposure time to hazards.^{1,12,13} Similarly, regional differences in injury rates probably reflect variations in exposure to machinery hazards within our province.

There is one important limitation with respect to our rate calculations. The only denominator data currently available are from the Canada Census of Agriculture, and include "all persons who are members of a farm operator's household, living on a farm in a rural or urban area."¹⁴ People not living on a farm (e.g., some hired workers) are not included, while others who are not at risk for injury are included (e.g., farm residents who are never exposed to the farm work environment). We do acknowledge that our injury rates may be biased, however, they are the best estimates available at this time.

Mechanism of injury

Entanglement in the machine was the most common cause of injury associated with balers, combines, hay elevators and grain augers. The majority of injuries occurred when an individual became entangled in an inadequately shielded part of the machinery. Though the number of

these types of injury is high, the ratio of hospitalizations to fatalities is also high indicating that the majority of these injuries are traumatic but not lethal. The most common mechanism of injury among farm wagon injuries was being run over or struck/pinned by the vehicle. Unlike entanglement injuries, these injuries demonstrated a low ratio of hospitalizations to fatalities indicating that these injuries often result in death.

Injury prevention

These surveillance data indicate priorities for the content and targeting of agricultural safety programs. These include the prevention of: 1) entanglement-type injuries, through improved methods of guarding on all types of farm machinery, but in particular grain augers and balers; 2) runovers, particularly with associated farm wagon use; and 3) injuries among male farmers of all ages, but in particular older (>60 years) farmers and farm workers.

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