Trends in Farm Fatalities, Saskatchewan, Canada: 1990-2004

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ABSTRACT

Objectives: This study was conducted to estimate farm fatality rates and to describe patterns of fatal agricultural injury on Saskatchewan farms from 1990 to 2004.

Methods: We used data available from the Canadian Agricultural Injury Surveillance Program (CAISP) for farm work-related fatalities in Saskatchewan, Canada from January 1990 to December 2004.

Results: There were 251 farm work-related fatalities recorded between 1990 and 2004 in Saskatchewan. The majority (92%) of work-related fatalities were in males. The overall fatality rate was 11.9 (95% CI, 2.0-30.1) per 100,000. The overall age-adjusted work-related fatality rate was 32.1 (95% CI, 19.6-44.6) per 100,000 among males and 3.2 (95% CI, 1.3-5.1) per 100,000 among females. Age-adjusted rate increased from 29.3 (95% CI, 6.9-59.3) per 100,000 in 1990-1994 to 37.1 per 100,000 in 2000-2004 in males. Trend analysis of the fatality rate of all cases showed an average annual increase of 3.8% and it was statistically significant ($p < 0.05$). Bystander and runover injuries contributed to a high proportion of fatalities in children (32.1%) and the elderly population (26.7%).

Conclusion: The burden of injury mortality is substantial and there has been a statistically significant upward trend in injury rate over the 15-year study period. High vigilance is needed on the part of adults to prevent a high proportion of runover injuries in children and the elderly population.

Key words: Injury; surveillance; farm fatality; agriculture; Saskatchewan

La traduction du résumé se trouve à la fin de l'article.

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Agriculture is one of the most hazardous industries with its high rates of fatal work-related injuries.¹⁻³ In Canada, the overall rate of farm-related fatalities has been previously reported at 14.8 per 100,000 farm population in persons over the age of 20 years, and this is almost 3 times greater than the fatality rate for workers in all other industries.³ The economic burden caused by injury in Canada is estimated to be \$11 billion, including direct and indirect costs.⁴

Studies show that people living in rural areas experience higher rates of fatal injuries than do their urban counterparts.⁵ Agriculture was found to be the third most hazardous industry in Canada with respect to rates of fatal injury, and adults aged 60 years and older were over-represented in these fatal injuries.⁶

Saskatchewan is one of Canada's most intensive agricultural provinces. In Saskatchewan, there are 50,598 farm enterprises with 123,385 household residents, representing 12.6% of the total population of the province.⁷ Farming is seasonal and an entire year's income depends upon getting the crop harvested, except for those with dairy, poultry or hogs. Many farms are family operations and children are expected to contribute to the running of the farm. Seniors over the age of 65 in Saskatchewan comprise 22% of the population of towns and villages versus 15% in cities.⁸ Saskatchewan reports the highest male and female potential years of life lost due to unintentional injury in Canada.⁹

In this study, we examined the burden and trends in injury mortality rates in the farm population in the province of Saskatchewan

over a 14-year period. We also examined circumstances surrounding fatality events.

METHODS

We used farm fatality data for the province of Saskatchewan from January 1990 to December 2004 available from the Saskatchewan collaborators of the Canadian Agricultural Injury Surveillance Program (CAISP). Under Section 13 of The Coroners Act, the Coroner conducts investigation into all sudden, unexpected and unnatural deaths occurring in the province of Saskatchewan. Fatality data were identified from the existing mortality databases of the Chief

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Conflict of Interest: None to declare.

Figure 1. Age-standardized fatality rates over time

Coroner's Office, Ministry of Justice and the Occupational Health and Safety Division, Ministry of Advanced Education, Employment and Labour. Deidentified data were abstracted from the records using a standardized abstraction form. A fatal agricultural injury was defined as any unintentional injury resulting in death that occurred during an activity related to the function of a farm or ranch. Fatalities that occurred off the farm or ranch but involved an agricultural activity such as transporting crops or machinery were included. Children and other bystanders who sustained fatal injury due to exposure to farm-work hazards during the study period were also included. The study protocol was approved by the Biomedical Research Ethics Board at the University of Saskatchewan.

Surveillance information available included date of injury, sex and age of the victim, location on the farm of the injury event, nature of injury, body part affected, agent causing injury, mechanism of injury, and an electronic text of circumstances leading to the event. Descriptive statistics were used to summarize the data. We used denominator data provided by the Canada Population Census and the Census of Agriculture 1991, 1996, and 2001 to calculate incidence rates for the study period 1990-94, 1995-99, and 2000-04. The farm population is the number of persons living in the households of farm operators. Canadian farm population is computed by combining the Population Census with the Agriculture Census. We also calculated age-specific and age-adjusted rates using the entire 1996 Canadian farm population as the standard. To estimate population numbers for intermediate years, we assumed that the population of each gender had changed in a linear pattern between census years.

We used a Poisson regression model to test for evidence of a trend in fatality incidence rates as a function of calendar year. The GENMOD procedure with a Poisson distribution was used to evaluate trends over time (using SAS release 9.1). We used the following regression model: $\text{Ln}(\lambda_{\text{year}}) = \beta_0 + \beta_1 (\text{Year})$. Here the natural log transformation ensures that the model-based predictions of rates are constrained to be greater than or equal to zero. We estimated the percent change in injury rate by exponentiation of the coefficients from the fitted model.⁷ In our study, a 0.05 alpha level was used for statistical significance.

RESULTS

There were 251 work-related farm fatalities from 1990 to 2004 in Saskatchewan. Of these, 232 (92%) were males with a mean age of

Figure 2. Age distribution of farm fatalities compared with farm population (Census 1996), Saskatchewan, 1990-2004 **Table 1.** Farm Fatalities by Age Group in Males (n=232), Saskatchewan, 1990-2004

Age Group (yrs)	1990-1994 N (Rate per 100,000)	1995-1999 N (Rate per 100,000)	2000-2004 N (Rate per 100,000)
<15	8 (9.5)	10 (11.8)	4 (5.4)
15-29	9 (11.5)	9 (12.3)	9 (15.3)
30-59	24 (13.6)	33 (20.0)	28 (19.3)
≥60	30 (77.0)	38 (95.8)	30 (53.8)
Overall (95% CI)	71 (29.3) (6.9-59.3)	90 (24.3) (9.7-38.9)	71 (37.1) (5.2-68.9)

Table 2. Fatal Work-related Farm Injuries by Circumstances, Saskatchewan, 1990-2004

Common Circumstances Leading to Fatality	N (%)
Age <15 Years	
1. Bystander and run over	9 (32.1)
2. Fell from tractor/truck and then run over	8 (28.6)
3. Rollover while driving a tractor	5 (17.9)
4. Hit by animal	2 (7.1)
5. Hit by an object	2 (7.1)
6. Fell from truck while loading bales	1 (3.6)
7. Electrocuted	1 (3.6)
Age 15-59 Years	
1. Rollover while driving a machine	20 (16.4)
2. Pinned or struck by machine	16 (13.1)
3. Clothes entangled in machine	14 (11.5)
4. Motor vehicle-related fatalities	14 (11.5)
5. Run over by unmanned machine	11 (9.0)
6. Electrocution by contact with power line	8 (6.6)
7. Poisoning with hydrogen sulphide	8 (6.6)
All others	31 (25.4)
Age ≥60 Years	
1. Bystander and run over	27 (26.7)
2. Falling bale/grain box	13 (12.9)
3. Pinned or struck by machine	10 (9.9)
4. Hit by animal	10 (9.9)
5. Burns	6 (5.9)
6. Rollover	6 (5.9)
7. Motor vehicle-related fatalities	6 (5.9)
All others	23 (22.8)

49 years (SD=22). The overall fatality rate was 11.9 (95% CI, 2.0-30.1) per 100,000. The overall age-adjusted work-related fatality rate was 32.1 (95% CI, 19.6-44.6) per 100,000 among males and 3.2 (95% CI, 1.3-5.1) per 100,000 among females.

Figure 1 shows farm fatality rate by gender and by year, 1990 through 2004. Throughout the study period, farm fatality rates for males were consistently higher. Age-adjusted rate increased from 29.3 (95% CI, 6.9-59.3) per 100,000 in 1990-1994 to 37.1 per 100,000 in 2000-2004 in males. Trend analysis of the fatality rate in

Table 3. Causative Agent, Location of Injury, Place of Death and Relationship With the Victim of Farm Fatality, Saskatchewan, 1990-2004

	Age <15 Years N (%)	15-59 Years N (%)	≥60 Years N (%)	Total N (%)
Agent				
Tractor	12 (42.9)	38 (31.1)	36 (35.6)	86 (34.3)
Motor vehicle accident	9 (32.1)	24 (19.7)	17 (16.8)	50 (19.9)
Farm machines	0	26 (21.3)	16 (15.8)	42 (16.7)
Others	7 (25.0)	34 (27.9)	32 (31.7)	73 (29.1)
Location of injury				
Field/Farmyard	13 (46.4)	69 (56.6)	57 (56.4)	139 (55.4)
Barn/shed/grain bin	3 (10.7)	8 (6.6)	7 (6.9)	18 (7.2)
Farm road	9 (32.1)	25 (20.5)	10 (9.9)	44 (17.5)
Other	3 (10.7)	8 (6.6)	16 (15.8)	27 (10.8)
Unknown	0	12 (9.8)	11 (10.9)	23 (9.2)
Death occurred				
At the scene	19 (67.9)	89 (73.0)	75 (74.3)	183 (72.9)
En route	3 (10.7)	7 (5.7)	2 (2.0)	12 (4.8)
In hospital	3 (10.7)	20 (16.4)	23 (22.8)	46 (18.3)
Unknown	3 (10.7)	6 (4.9)	1 (1.0)	10 (4.0)
Who found				
Family members	12 (42.9)	36 (29.5)	39 (38.6)	87 (34.7)
Relatives	12 (42.9)	8 (6.6)	11 (10.9)	31 (12.4)
Neighbour	0	8 (6.6)	12 (11.9)	20 (8.0)
Employee	0	30 (24.6)	7 (6.9)	37 (14.7)
Others	4 (14.3)	17 (13.9)	11 (10.9)	32 (12.7)
Unknown		23 (18.9)	21 (20.8)	44 (17.5)
	28 (100.0)	122 (100.0)	101 (100.0)	251 (100.0)

all study subjects showed an average annual increase of 3.8% and it was statistically significant ($p < 0.05$).

Higher fatality rates were observed in study subjects under 15 years and in those 60 years and older (Table 1, Figure 2).

Table 2 shows the most common circumstances of farm fatality among various age groups. The most common mechanism of injury was being run over by farm machinery or vehicles, accounting for 60.7% of deaths among those <15 years of age. Most often the machinery involved was being operated by a member of the farm family.

A total of 122 deaths occurred among people age 15 to 59 years. Rollover of farm machinery was the leading cause of death, with 53% of fatalities having occurred when the machine was being operated on an incline or on rough ground, 18% when the operator lost control during transport of the equipment on roadways and 17% when the load was being shifted. The second leading cause of death was being struck or pinned by a farm machine or vehicle. In half of these cases, the injury event occurred due to failed or improper blocking while the victim was working beneath the machine. Entanglement in farm machinery was the third leading cause of death in this age category. The farm work being performed at the time of the injury event included grinding feed (35.7%), operating an auger (28.6%) and clearing the plugged intake of a baler (14.3%). Motor vehicle-related fatalities were due to collisions of farm equipment or vehicles with other road traffic. Contributing factors included poor visibility, poor lighting on farm machinery, excessive speed and loss of control. The running over of an operator who had dismounted the farm machine occurred most often when the operator attempted to jumpstart (bypass start) a tractor or when the unmanned machine slipped into gear. Electrocutions occurred most frequently when a farm machine came into contact with a high voltage overhead power line, and poisoning occurred during operations involving the handling of liquid manure.

There were 98 work-related fatalities among persons 60 years old and over. In these cases, the main mechanisms of injury were being run over by an unmanned machine or the operator or passenger falling from a moving machine and being subsequently run over. The second leading cause of death was being struck by an object, primarily large round bales. This was followed by events where the

victim was pinned or crushed by machinery while repairing or inspecting beneath a raised machine. Fatalities involving being struck or crushed by animals occurred most often while the victim was performing routine chores in a feedlot or corral.

Table 3 shows causative agent, location of injury, place of death and relation of the victim with the person who first noticed the death. Farm tractors accounted for the majority of work-related farm fatalities in each age group (tractor runaway, rollover, and motor vehicle accidents). More than half of fatalities occurred in the field and farmyard, followed by on farm roads. Death occurred at the site of injury in the majority (72.9%) of cases, followed by death in hospital (18.3%) and en route to hospital.

DISCUSSION

The overall fatality rate in the farming population of Saskatchewan was comparable to the national average (11.6 per 100,000) noted in earlier studies.³ Although outside of agriculture, workplace injuries are more common, the significant upward trend in the fatality rate noted in this study is disturbing. It contrasts with the downward trend in the farm fatality rate over time in the United States^{10,11} and Australia.¹²

The reported injury rate in the agriculture industry has varied across studies depending on the study period, the source of information and the geographic location of the study population. For example, the fatal injury rate calculated using census-based denominator data was 24.69 per 100,000 worker-years and the rate calculated using Current Population Survey data was 19.97 per 100,000 worker-years.¹³ In Australia, the overall fatality rate was 20.6 per 100,000 for the study period 1989-1992.¹⁴ Age-adjusted and gender-specific rates in this study (32 per 100,000 in males and 3.2 per 100,000 in females) compare with the US fatality rates of 30.9 per 100,000 in males and 3.0 per 100,000 in females.¹⁴ Earlier studies indicated a significantly higher incidence of job-related fatalities in Canada compared to the United States.^{15,16}

In this study, both men and women aged 60 and older and children accounted for a disproportionately high number of farm fatalities compared to the proportion of the farm population they represent. Men aged 60 and older had a fatality rate of more than 3 times that for adults age 15 to 59. High fatality in older people in

this study concurs with similar findings in Canada, other developed and developing countries.^{6,17,18} Huston et al.¹⁹ examined farm fatalities in Saskatchewan between 1955 and 1967 (total n=247) and noted that people aged 60 years and over accounted for 22.7% of all farm fatalities compared to 40.2% of fatalities in our study. Children contributed to 11.1% of fatalities in this study compared to 27.9% in the previous study by Huston et al. Adults contributed to almost half of fatalities then (49.4%) and now (48.6%). This demands high vigilance on the part of adults to prevent a high proportion of runover injuries in children and the elderly population. These are avoidable deaths. Long-term intervention will be needed to change this behaviour.^{20,21} Rollover played a key role in fatal injuries among adults in particular as well as among children and old people. Studies show that the majority of tractors operate without rollover protective structures (ROPS) in the farm despite their proven effectiveness in reducing fatalities from tractor overturns by more than 80%.^{22,23}

The CAISP data form describing the circumstances surrounding the injury event was helpful in determining different types of hazards in the workplace for children, adults and the elderly population. To reduce farm fatalities, the training needs to be customized for specific age groups.

LIMITATIONS

Strengths of our study include our use of population-based data to determine trends in injury rate over a period of fifteen years. There are a number of limitations in this study. The study does not capture all the dimensions of injury burden. Burden also includes economic costs, lost productivity, potential years of life lost, and mental stress to the family. There were small numbers of fatalities in females and in some age categories for males, therefore rates need to be interpreted with caution. The use of the Canadian census and Agricultural census may not account accurately for people living on but not actually working on farms (for example, working in nearby towns) or conversely who work on but do not live on farms (for example, daily wage earners). We used a regression method to estimate farm populations for the denominator data between census years assuming a linear reduction of population between the census years of 1991, 1996 and 2001.

CONCLUSION

Farming remains a dangerous occupation in Saskatchewan and there is a clear need to initiate evidence-based prevention and intervention programs to reduce the rising fatality rates, especially among young children and the elderly.

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RÉSUMÉ

Objectifs : Estimer les taux et décrire la structure des accidents mortels survenus dans les exploitations agricoles de la Saskatchewan entre 1990 et 2004.

Méthode : Nos données sur les accidents agricoles mortels survenus en Saskatchewan, au Canada, entre janvier 1990 et décembre 2004 sont tirées du Programme canadien de surveillance des blessures en milieu agricole (PCSBMA).

Résultats : On a enregistré 251 accidents agricoles mortels entre 1990 et 2004 en Saskatchewan. La majorité (92 %) des accidents mortels liés au travail sont survenus chez des hommes. Le taux global d'accidents mortels était de 11,9 (IC de 95 %, 2,0-30,1) p. 100 000. Le taux global d'accidents du travail mortels rajusté selon l'âge était de 32,1 (IC de 95 %, 19,6-44,6) p. 100 000 chez les hommes et de 3,2 (IC de 95 %, 1,3-5,1) p. 100 000 chez les femmes. Le taux rajusté selon l'âge a augmenté, passant de 29,3 (IC de 95 %, 6,9-59,3) p. 100 000 en 1990-1994 à 37,1 p. 100 000 entre 2000 et 2004 chez les hommes. L'analyse des tendances des taux d'accidents mortels, tous cas confondus, fait état d'une augmentation annuelle moyenne de 3,8 %, et cette hausse est significative ($p < 0,05$). Les blessures de tiers et les écrasements ont contribué à la proportion élevée d'accidents mortels chez les enfants (32,1 %) et les personnes âgées (26,7 %).

Conclusion : Le fardeau des accidents mortels est considérable, et l'on observe un mouvement de hausse significatif dans les taux de blessures sur les 15 années de l'étude. Une stricte vigilance est de mise de la part des adultes pour prévenir une grande proportion des blessures liées aux écrasements chez les enfants et les personnes âgées.

Mots clés : accidents; surveillance; accidents agricoles mortels; agriculture; Saskatchewan