

Gender differences in the occurrence of farm related injuries

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Aims: To use national surveillance data in Canada to describe gender differences in the pattern of farm fatalities and severe injuries (those requiring hospitalisation).

Methods: Data from the Canadian Agricultural Injury Surveillance Program (CAISP) included farm work related fatalities from 1990 to 1996 for all Canadian provinces and abstracted information from hospital discharge records from eight provinces for the five fiscal years of 1990 to 1994. Gender differences in fatalities and injuries were examined by comparison of proportions and stratified by sex, injury class (machinery, non-machinery), and age group.

Results: Over the six year period of 1990 to 1996 there were approximately 11 times as many agriculture related fatalities for males compared to females (655 and 61, respectively). The most common machinery mechanisms of fatal injuries were roll-over (32%) for males and run-over (45%) for females. Agricultural machinery injuries requiring hospitalisation showed similar patterns, with proportionally more males over age 60 injured. The male:female ratio for non-machinery hospitalisations averaged 3:1. A greater percentage of males were struck by or caught against an object, whereas for females, animal related injuries predominated.

Conclusions: Gender is an important factor to consider in the interpretation of fatal and non-fatal farm injuries. A greater number of males were injured, regardless of how the occurrence of injury was categorised, particularly when farm machinery was involved. As women increasingly participate in all aspects of agricultural production, there is a need to collect, interpret, and disseminate information on agricultural injury that is relevant for both sexes.

Agriculture is unique as a primary industry in that it is usually a place of residence as well as a place of employment. Internationally, farming is considered to be one of the most dangerous occupations,¹ with the risk of injury being approximately 5–10 per 100 workers per year.² However, occupational injury statistics do not fully describe the scope of injuries and deaths related to farm production activities. Apart from farm operators and hired labourers, other farm residents, including spouses, children and retirees, and visitors are at risk for injury as a result of exposure to farm worksite hazards.

Traditionally, the principal operator of a farm has been the male head of the household. This is clearly changing. In 1951 only 4% of Canadians employed in agriculture were women.³ The latest Canadian census figures indicate that 25% of farm owners or operators are women.⁴ Females comprise 47% of the enumerated farm population. The extent of women's participation in agricultural activities is perhaps underestimated. Reed and colleagues found that about one half of over 1600 rural women from farm households surveyed in Kentucky or Texas described themselves as homemakers, yet they were regularly involved in work with farm animals (40%) and driving a farm tractor (30%).⁵

Epidemiological studies on the safety of agricultural work have tended to focus on farm operators (mostly male). More recent studies have included descriptive information according to sex.^{6,7} Because of differential tasks and roles within the agricultural setting, females and males would be expected to differ in their injury experience. Identifying different patterns of injury through subgroup analysis by sex may allow for more effective targeting of prevention efforts.

With the establishment of the Canadian Agricultural Injury Surveillance Program (CAISP), a standard approach has been developed to collect national data on farm related injuries. According to CAISP, agricultural injuries are defined as unintentional, acute injuries resulting in hospitalisation or

death that occurred during activities related to the operation of a farm or ranch or that involved any hazard of an agricultural environment.⁸ Data collection is not limited to occupational injuries. This provides the opportunity to describe the types and causes of farm injuries for males and females of all ages. The purpose of this paper is to use national surveillance data collected over a recent seven year period in Canada to describe gender differences in the pattern of farm fatalities and severe injuries (those requiring hospitalisation).

SUBJECTS AND METHODS

Fatalities

Farm work related fatalities from 1990 to 1996 were available for analysis using CAISP protocols⁹ from all Canadian provinces. Sources of information included: provincial coroner's offices, police, government agencies including Vital Statistics, and occupational health and safety associations.

Hospitalisations

Confidentiality agreements have been established with all provinces for access to hospital separation data through provincial agencies. The data collection protocol¹⁰ and the CAISP program underwent ethical review, as required.

Agricultural injuries were identified using ICD-9 E-codes.¹¹ Hospital discharge records were searched using mechanism and location of occurrence of injury codes. Where there was more than one admission due to readmission or transfer, only the main treatment record was used. After receiving

Abbreviations: CAISP, Canadian Agricultural Injury Surveillance Program; E-code, external causes of injuries code; ICD 9, International Classification of Diseases, ninth revision; SPSS, Statistical Package for the Social Sciences

Main messages

- Gender is an important factor to consider in the collection, interpretation, and dissemination of information on agricultural injury.
- A greater number of males had farm related injuries; male:female ratios were highest for those over 60 injured by farm machinery.
- Proportionally more women were injured by farm animals; older women had a greater percentage of fractures and injuries from falls.

permission to obtain medical chart data for individual cases from the chief executive officer (or equivalent), hospital staff verified specific information contained in the discharge records and added information about the injury events to standard abstraction forms.

Initial hospital discharge records and supplemental data were available for all but two provinces (Nova Scotia and Newfoundland/Labrador) for the five fiscal years of 1990 to 1994. Agricultural machinery injuries were initially defined as those where the E-code 919.0 (injuries caused by agricultural machinery) was listed on the hospital discharge record. Non-machinery agricultural injuries included those where: (1) a location of injury code indicated a farm or ranch as the location of injury (the fifth digit of the E-code was 1); (2) the accident location code (E849.1) indicated a farm and the E-code was other than 919.0; or (3) a special location code indicated a farm work location.

Data analysis

Gender differences in fatalities and injuries were examined by comparison of proportions using χ^2 analyses and by calculation of sex ratios (defined as the number of events for males relative to females). As the actual population at risk could not be conclusively identified, rates of injury were not calculated. Data management and analyses were done using standard statistical packages: Microsoft Access/Excel, version 6.0, Redmond, WA; SPSS version 10.0; SPSS, Chicago, IL.

RESULTS

Fatalities

There were pronounced gender differences in the number of farm related fatalities and their circumstances. Over the six year period of 1990 to 1996 there were approximately 11 times as many agriculture related fatalities in males compared to females (655 and 61, respectively). Fatalities involving farm machinery were not evenly distributed ($p < 0.05$), either by sex or among age groups (table 1). A large proportion of fatalities (39%) were observed in men over 60 years of age, compared with 12% among women.

The two most common machinery mechanisms of fatal injuries for males were roll-overs (32%) and being run-over (20%), while for females the order was reversed ($p < 0.05$): run-over (45%) and roll-over (24%). Tractors were involved in 65% and 69% of all fatalities for men and women respectively. For males, the two most common causes were for being struck by an object (33%) and animals (14%). Only 19 female fatalities were attributed to non-machinery causes over the seven year period; 37% were due to animals and 32% to being struck by an object.

Analysis by relationship of the deceased to the owner/operator showed significant gender differences. For males, 50% were owner/operators, 10% were children of the owner/operator, and 10% involved hired workers. For females, the

Policy implications

- Surveillance and analysis of farm related injuries and fatalities should distinguish male from female injuries.
- Farm injury prevention programmes should stress gender sensitivity using education, regulation, or engineering approaches.

largest categories of fatalities were of children of the owner/operator (30%) and spouses of the owner/operator (23%), with no males reported as spouses; only 7% of the female fatalities were of owner/operators. Visitors were known to be involved in only 2% of fatalities for both sexes.

Hospitalisations

Gender differences were apparent in the age distribution for injuries requiring hospitalisation ($p < 0.05$; table 2). For hospitalised agricultural machinery injuries, the average ratio of males to females was 9:1. The highest proportion of injuries was found for females under 10 years of age (18%), which contrasted with boys (6%), who had the lowest number of injuries for any 10 year age group of males. The highest ratio of males to females (39:1) occurred for those 70 years of age and over who were hospitalised for machinery related injuries. This pattern is in marked contrast to non-machinery hospitalisations, where the sex ratio shows only slight variation by age.

Men 15–59 years of age had a greater percentage of hospitalisation injuries due to being caught in or entangled in machinery (table 3). Tractors were the most common farm machinery involved in hospitalisation injuries for both males and females at 28% each. The distribution of non-machinery injury causes of hospitalisations show more pronounced differences ($p < 0.05$) according to age group and sex. Females age 60 and above had a relatively higher percentage of injuries by falls. In general, animals were the most common cause of non-machinery related injuries, accounting for one half of injuries for females under 60 years of age. For females, 65% of the animal related injuries were caused by horses and 30% by cows, which contrasts to 38% and 56% respectively for males.

Comparison of main diagnoses according to age group and sex (data not shown) showed a higher percentage of fractures (52%) for females 60 years or older, in comparison to 40% for males in this age group. Males had a consistently higher percentage of lacerations.

DISCUSSION

Differences between males and females were apparent in the patterns of farm related injury. Injuries to males predominated. The highest ratios of male to female injuries were for fatalities and hospitalisations from agricultural machinery, particularly among men over age 60. Overall, we found ratios of males to females of 9:1 and 11:1 respectively for machinery related hospitalisations and fatalities. The extent of these differences in the number of farm injuries between the sexes has been corroborated in other surveys.^{12–13} Work related fatalities in the US agricultural sector from 1980 to 1989 showed a more extreme difference (101 deaths for females versus 6610 for males).¹⁴ This result may be misleading if fatalities to females were not recognised as being work related.

The disparity between the sexes in mechanism of injury involving farm machinery most likely reflects differences in exposure. For example, a 1992 Canadian community survey showed that 92% of men drove agricultural machinery, in

Table 1 Agricultural fatalities in Canada by class of injury, gender, and age group (1990–96)

Age	Machinery*			Non-machinery			Combined*		
	Males n (%)	Females n (%)	Ratio	Males n (%)	Females n (%)	Ratio	Males n (%)	Females n (%)	Ratio
<14	48 (10)	15 (36)	3:1	8 (4)	4 (21)	2:1	56 (9)	19 (31)	3:1
15–59	227 (49)	24 (57)	9:1	118 (61)	11 (58)	11:1	345 (53)	35 (57)	10:1
60+	187 (41)	3 (7)	62:1	67 (35)	4 (21)	17:1	254 (39)	7 (11)	36:1
Total	462	42	11:1	193	19	11:1	655	61	11:1

*p<0.05.

comparison to 35% of women.³ We found that tractors were involved in the majority of cases, but the leading mechanism of fatality was roll-over for males and run-over for females. The high risk of machinery related fatalities, particularly involving tractors, has been well documented.¹⁵ We found that for non-fatal injuries for both sexes, the leading mechanism of machinery injury requiring hospitalisation was being caught or entangled in machinery.

The lowest sex ratios were for non-machinery causes of hospitalisations; on average for every female injured there were three male injuries. The disparities in prevalence of injury appear to be reduced with decreasing severity of injury. Rivara¹⁶ found that the ratio of male to female farm related deaths was 5.6 in comparison to 2.4 for emergency department injuries.

Causes of non-machinery agricultural fatalities and hospitalisations were age and sex dependent. For females under age 60, a greater percentage of injuries were due to animals, whereas older women had a higher percentage attributable to falls. Studies in Manitoba, Canada and Australia indicate that animals are a common source of farm related injury, particularly among girls.^{17, 18} Falls are recognised to be a common cause of unintentional non-fatal injury and deaths among females,¹⁹ accounting for almost 90% of deaths in the USA for those over age 65.²⁰ Risk factors for the elderly include visual impairment, and gait and balance disturbances.²¹

A greater percentage of women over age 60 than men were diagnosed with fractures. Degenerative changes with aging, such as osteoporosis may be important factors. The extreme sex ratio of over 60:1 was observed for fatalities caused by agricultural machinery for men age 60 and above. The high risk of injury and death from farming activities among older men has been identified in previous studies^{22, 23} and attributed to the onset of age related physiological changes, such as slowing of reaction time and more working hours on the farm after retirement. The gender disparity in fatalities may also reflect less participation and hence less exposure among older females.

When considering farm safety the entire family must be taken into account as all are exposed to the work environment.²⁴ Among females, a large percentage of fatalities were observed for children. A Minnesota survey found a more extreme percentage in that over one half of all females who had severe or fatal farm injuries were children under 10 years of age.¹² Hazardous work conditions in agriculture create a unique problem by affecting those not directly employed in farming activities. Children are particularly vulnerable to severe injury or death due to their small bodily size and immature development.

Differences in the extent of exposure to agricultural activities, ergonomic aspects of the agricultural environment in relation to body size and physiology, and variations in the nature of agricultural tasks are likely to contribute to gender and age differences in the patterns of injuries and fatalities. A 1995 Wisconsin study found lower average hours of farm work for women (20 hours versus 50 hours for men)⁶ as did a 1995 study in Ontario, Canada in which 23% of females (versus 62% of males) performed farm work at least 40 hours a week.²⁵ In Canada, over the past two decades there has been an increase in the number of hours per week and weeks per year worked on the farm by women,³ and this pattern would be expected to continue.

A strength of our study was that it was not limited to compensable injuries or to a particular worker subgroup. A further advantage is that national data were collected systematically from hospital sources, with no reliance on volunteer reporting. These two factors provide a broader picture of the extent of injuries attributed to agricultural production. A limitation is the lack of accurate denominator data from which to calculate rates. For instance, Canadian census data on farm populations does not include hired labourers. Furthermore, there is no detailed exposure data available, such as hours of farm work or type of farm, from the fatality and hospitalisation data sources.

Gender is an important factor to consider in the interpretation of fatal and non-fatal farm injuries. As women

Table 2 Agricultural injuries requiring hospitalisation in Canada† (1990–94 fiscal years), according to class of injury, gender, and age group

	Machinery*					Non-machinery*				
	Males		Females		M:F ratio	Males		Females		M:F ratio
	n	%	n	%		n	%	n	%	
0–9	236	6	70	18	3:1	212	7	107	10	2:1
10–19	360	13	59	15	6:1	349	11	169	16	2:1
20–29	379	10	39	10	10:1	357	11	104	10	3:1
30–39	563	15	55	14	10:1	579	18	190	18	3:1
40–49	551	15	60	17	8:1	542	17	161	15	3:1
50–59	528	14	62	16	8:1	468	15	123	12	4:1
60–69	537	15	34	8	16:1	423	13	108	10	4:1
70+	390	11	10	3	39:1	253	8	76	7	3:1
Total	3644	100	398	100	9:1	3183	100	1038	100	3:1

†Data were unavailable for two provinces, Newfoundland and Nova Scotia.

*p<0.05.

Table 3 Agricultural injuries requiring hospitalisation in Canada† (1990–94 fiscal years), according to mechanism, age group, and gender

	Age 0–14				Age 15–59*				Age 60+			
	Males		Females		Males		Females		Males		Females	
	n	%	n	%	n	%	n	%	n	%	n	%
Machinery												
Caught in/entanglement	123	30	28	27	874	38	69	28	256	28	10	23
Pinned or struck by machine or object	72	18	17	16	652	28	58	23	225	24	6	14
Fell from machine	76	19	22	21	269	12	52	21	180	19	12	27
Run-over	90	22	18	17	171	7	22	9	111	12	8	18
Roll-over	15	4	3	3	103	4	16	6	60	6	4	9
Motor vehicle collision	12	3	6	6	17	1	4	2	4	1	0	0
Other/unknown	21	5	10	10	222	10	29	12	91	10	4	9
Total	409	100	104	100	2308	100	250	100	927	100	44	100
Non-machinery*												
Fall	121	32	60	29	427	20	131	20	207	31	88	48
Crushed or struck by animal	106	28	103	50	741	35	335	52	237	35	56	30
Struck by/against/ between objects	75	20	16	8	477	22	92	14	111	16	17	9
Overexertion	0	0	1	1	163	8	42	6	50	7	9	5
Radiation/toxic/noxious substances	20	5	13	6	161	7	22	3	23	3	7	4
Fires	22	6	3	1	66	3	10	1	25	4	3	2
Temperature extremes/electric current	7	2	4	2	27	1	7	1	8	1	1	1
Other/unknown	23	6	7	3	71	3	8	1	15	2	3	2
Total	374	100	207	100	2133	100	647	100	676	100	184	100

†Data were unavailable for two provinces, Newfoundland and Nova Scotia.

*p<0.05.

increasingly participate in all aspects of agricultural production, there is a need to collect, interpret, and disseminate information on agricultural injury that is relevant for both sexes. Cultural and social determinants of gender distinctions in recurrent patterns of injury should be considered in future aetiological and qualitative research. A further recommendation is that farm injury prevention programmes stress gender sensitivity using education, regulation, or engineering approaches.

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REFERENCES

- 1 Notkola VJ, Husman KR, Kaukkanen VJ. Mortality among male farmers in Finland. *Scand J Work Environ Health* 1987;13:124–8.
- 2 McCurdy SA, Carroll DJ. Agricultural injury. *Am J Ind Med* 2000;38:463–80.
- 3 Smith P. Beyond 'add women and stir' in Canadian rural society. In: Hay DA, Basram GS, eds. *Rural sociology in Canada*. Toronto: Oxford University Press, 1992:155–70.
- 4 Statistics Canada. *Agricultural profile of Canada*. Ottawa: Statistics Canada, 1997.
- 5 Reed DB, Westneat SC, Browning SR, et al. The hidden work of the farm homemaker. *J Agricultural Safety and Health* 1999;5:317–27.
- 6 Nordstrom DL, Layde PM, Olson PM, et al. Incidence of farm-work-related acute injury in a defined population. *Am J Ind Med* 1995;28:551–64.
- 7 Brison RJ, Pickett W. Non-fatal farm injuries on 117 Eastern Ontario beef and dairy farms: a one-year study. *Am J Ind Med* 1992;21:623–36.
- 8 Hartling L, Pickett W, Brison RJ. The Canadian agricultural injury surveillance program: a new injury control initiative. *Chronic Diseases in Canada* 1998;19:108–11.
- 9 Canadian Agricultural Injury Surveillance Program. *Report on fatal farm injuries in Canada, 1990–1996*. Saskatoon: Canadian Coalition for Agricultural and Rural Safety and Health, 1998.
- 10 Canadian Agricultural Injury Surveillance Program. *Hospitalized farm injuries in Canada: 1990–96*. Saskatoon: Canadian Coalition for Agricultural and Rural Safety and Health, 1999.
- 11 World Health Organisation. *Manual of the International Classification of Diseases, Injuries, and Causes of Death (9th revision)*. Geneva: Switzerland, 1977.
- 12 Gunderson P, Gerberich S, Gibson R, et al. Injury surveillance in agriculture. *Am J Ind Med* 1990;18:169–78.
- 13 National Safety Council. *Farm accident survey report*. Chicago, IL: NSC, 1982.
- 14 Myers JR, Hard DL. Work-related fatalities in the agricultural production and services sectors, 1980–1989. *Am J Ind Med* 1995;27:51–63.
- 15 Eherston JR, Myers JR, Jensen RC, et al. Agricultural machine-related deaths. *Am J Public Health* 1991;81:766–8.
- 16 Rivara FP. Fatal and non-fatal farm injuries to children and adolescents in the United States, 1990–3. *Inj Prev* 1997;3:190–4.
- 17 Young SK. Agriculture related injuries in the parkland region of Manitoba. *Can Fam Physician* 1995;41:1141–4, 1148–51.
- 18 Wolfenden K, McKenzie A, Sanson-Fisher RW. Identifying hazards and risk opportunities in child farm injury. *Aust J Public Health* 1992;16:122–8.

- 19 **Grisso JA**, Kelsey JL, Strom BL, et al. Risk factors for falls as a cause of hip fracture in women. *N Engl J Med* 1991;**324**:1326–31.
- 20 **Friede A**, Reid JA, Ory HW. CDC Wonder: a comprehensive on-line public health information system of the Centers for Disease Control and Prevention. *Am J Public Health* 1993;**83**:1289–94.
- 21 **Grisso JA**, Wishner AR, Schwarz DF, et al. A population-based study of injuries in inner-city women. *Am J Epidemiol* 1991;**134**:59–68.
- 22 **Murphy DJ**, Seltzer BL, Yesalis CE. Comparison of two methodologies to measure agricultural occupational fatalities. *Am J Public Health* 1990;**83**:736–8.
- 23 **Voaklander DC**, Hartling L, Pickett W, et al. Work related mortality among older farmers in Canada. *Canadian Family Physician* 1999;**45**:2903–10.
- 24 **Cordes DH**, Foster D. Farming: a hazardous occupation. *Occupational Medicine: State of the Art Reviews* 1991;**6**:327–34.
- 25 **Pickett W**, Brison RJ, Niezgoda H, et al. Nonfatal farm injuries in Ontario: a population-based survey. *Accid Anal Prev* 1995;**27**:425–33.

ECHO



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Psychological and psychosocial factors and musculoskeletal pain

Studies of musculoskeletal pain among workers have usually been cross sectional, have involved established work forces (so that workers with symptoms may have left), have included workers in a single occupation, and have concentrated on pain at a single anatomical site. Researchers in Manchester have performed a prospective study of pain at four different sites (low back, shoulder, wrist/forearm, and knee) involving newly employed workers in a variety of occupations.

The 1081 subjects had been employed in their present work for a mean of eight months and were trainees in 12 occupational groups (fire fighters, police, army (officers, infantry, or clerks), students (dental, nursing, podiatry, or forestry), supermarket workers, postal workers, and ship building apprentices). Questionnaire data were obtained at baseline on workplace psychosocial factors and on personal psychological distress. Follow up data at 12 months were obtained for 829 subjects (77%). One month pain prevalences were 26% (low back), 18% (shoulder), 6% (forearm), and 12% (knee). The prevalence of low back pain varied from 15% (army officers) to 57% (podiatrists). Army infantry had high rates of low back pain (33%), shoulder pain (33%), and knee pain (29%). Pain in at least one anatomical site was reported by 344 subjects (41%) of whom 127 reported pain in more than one site. Job dissatisfaction and unsatisfactory working conditions (stressful, monotonous, or uninstructional work) increased pain prevalence at all anatomical sites and psychological distress (General Health Questionnaire score >0) doubled the prevalence of pain at all sites.

Psychological distress and poor working conditions increase the likelihood of musculoskeletal pains.

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