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QUANTITATIVE RESEARCH

Child drowning on farms in Canada and associated demographic and risk factors

Jason R. Randall[1] · Kathy Belton[1] · Colleen Drul[1] · Richard Franklin[2] · Don Voaklander[1]

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Abstract

Objectives This study aimed to examine the occurrence and characteristics of child drowning deaths on farms compared with other child injury deaths on farms.

Methods This study uses cross-sectional data from the Canadian Agricultural Injury Reporting Program for the years 1990 through 2012. Using χ^2 tests and regression, it compares the occurrence of demographics and potential risk factors between drowning deaths and all other injury deaths among children (< 19 years of age) on farms.

Results There were 44 drowning deaths and 306 non-drowning deaths identified. Drowning deaths were at younger age (mean age of 5.4 versus 8.8 years old), non-work-related (25% versus 79%), and less likely to occur during adult supervision (36.4% versus 53.5%).

Conclusions Drowning disproportionately affects the very young. Improving supervision of young children may prevent some farm drowning deaths, but installing effective barriers to water hazards is likely more effective.

Résumé

Objectifs Examiner la survenue et les caractéristiques des décès d'enfants par noyade sur les fermes comparativement aux autres décès d'enfants attribuables aux blessures sur les fermes.

Méthode L'étude fait appel aux données transversales de 1990 à 2012 du programme de Surveillance des blessures dans le secteur agricole au Canada. À l'aide de tests du X^2 et d'analyses de régression, elle compare l'existence de facteurs démographiques et de facteurs de risque potentiels entre les décès par noyade et les autres décès attribuables aux blessures chez les enfants (< 19 ans) survenus sur les fermes.

Résultats Quarante-quatre décès par noyade et 306 décès autres que par noyade ont été répertoriés. Les décès par noyade ont touché des enfants plus jeunes (âge moyen de 5,4 ans contre 8,8 ans), n'étaient pas liés au travail (25 % contre 79 %) et étaient moins susceptibles de se produire sous la surveillance d'un adulte (36,4 % contre 53,5 %).

Conclusions Les noyades touchent démesurément les très jeunes enfants. Une meilleure surveillance des jeunes enfants pourrait prévenir certains décès par noyade sur les fermes, mais l'installation de barrières contre les risques aquatiques est probablement plus efficace.

Keywords Drowning · Child · Infant · Adolescent · Farms · Agriculture

Mots-clés Noyade · enfant · nourrisson · adolescent · fermes · agriculture

Introduction

Agriculture accounts for a disproportionate number of work-related fatalities in Canada (Canadian Agricultural Injury Reporting 2016; Pickett et al. 1999). These fatalities account for 12% of all occupational fatalities in Canada (Sharpe and Hardt 2006). The fatality rate is estimated to be about 4 times the aggregate fatality rate for all occupations (Sharpe and Hardt 2006). Between 2003 and 2012, there were 843

✉ Jason R. Randall
jrandall@ualberta.ca

[1] Injury Prevention Centre, School of Public Health, University of Alberta, Edmonton, Alberta, Canada

[2] College of Public Health, Medical and Veterinary Sciences, James Cook University, Townsville, Australia

agriculture-related deaths in Canada (Canadian Agricultural Injury Reporting 2016). This corresponds to a fatality rate of 11.5 per 100,000 farm population (Canadian Agricultural Injury Reporting 2016).

Drowning is a leading cause of non-occupational deaths on farms (Adekoya 2003). Despite this, there is little research on the epidemiology of farm drowning deaths and how to prevent them. Research on American farms estimated a drowning rate for American youth at 2.2 cases per 100,000 youths between 1986 and 1997 (Adekoya 2003). This corresponds to an average of 32 farm drowning incidents each year. Recent Canadian data estimate that around 60 deaths from drowning occurred each year among those under the age of 20 between 2011 and 2015 (Drowning Prevention Research Centre Canada 2018). This corresponds to a rate of around 0.8 cases per 100,000 children. A report on agricultural deaths in Canada between 1990 and 2005 estimated that 15.2% of deaths among those 14 years and under were due to drowning (The Canadian Agricultural Injury Surveillance Program 2008). There does not appear to be any study reporting the characteristics of farm drowning deaths among Canadian children.

The Canadian Agricultural Safety Association (CASA) is involved in developing farm safety programs and national strategies for farm safety, and serves as a common link for all provincial farm safety initiatives (Canadian Agricultural Injury Reporting 2016). CASA funds the Canadian Agricultural Injury Reporting Program (CAIR) which collects data on farm injuries that occur within the country, including fatal injuries (Canadian Agricultural Injury Reporting 2016). This study's objective was to examine the occurrence of agriculture-related drowning fatalities among children and youths under the age of 19 across Canada between 1990 and 2012 using the CAIR data. Drowning fatalities were compared against all other farm fatalities among children and youth to examine differences between these groups.

Materials and methods

Sample

This study uses data from the CAIR Program (Canadian Agricultural Injury Reporting 2016). This surveillance program tracks injuries and fatalities that occur on farms across Canada, and includes all individuals who either live or work on a farm that produces livestock, poultry, animal products, crops, greenhouse or nursery products, mushrooms, sod, honey, or maple syrup. CAIR identifies fatalities that occur on farms and records a large variety of variables, including demographic information (e.g., province, age, sex) and factors related to the fatality such as type of injury (e.g., drowning, machine-related) or whether the injury occurred during work activities (including chores for children). This information is extracted from coroner and medical examiner records. Farm injury records are identified from coroner and medical examiner databases using a comprehensive list of keywords. Data from this program were available for the period of 1990 through 2012.

A series of variables were used from these data to assess factors related to drowning deaths among children (< 19 years of age). Age, sex, and province of death were extracted. The location of the drowning is recorded in the data and specifies whether the child drowned in a dugout, lake/pond/slough, sewage lagoon or storage, or other water locations. These data also specify whether the drowning was work-related, whether the child was a relative of the farm owner/operator, and whether the drowning occurred under adult supervision.

Statistical analysis

Associations between demographics and other potential risk factors were examined and compared with those for non-drowning fatalities. The χ^2 test determined the significance of differences for categorical variables. Fisher's exact test was used if cell sizes were too small to use the χ^2 test. Ordinary least squares regression was used to test for differences in age for the following variables: drowning versus other fatalities, sex, and relatives versus non-relatives of the farm operator.

Results

Comparisons between child drowning fatalities and all other child fatalities on farms

The results of comparing child drowning deaths with all other child fatalities on farms can be found in Table 1. Drowning caused 44 of the 354 deaths that were recorded among children (< 19 years of age). Among the recorded deaths, 4 did not have enough detail to determine whether the cause of death was drowning and are therefore not included in further analyses. Therefore, 44 drowning fatalities are compared against 306 confirmed non-drowning fatalities. The mean age was 5.4 years old for drowning and 8.8 years old for other fatalities ($p < 0.001$). Drowning fatalities were less likely to occur with an adult nearby compared with other fatalities ($p = 0.0334$) and were considerably less likely to be work-related ($p < 0.0001$). There was no significant difference between these groups with regard to whether the death happened to a relative of the farm operator ($p = 0.075$), nor was there a significant difference in the gender of fatalities or province between the two groups.

Table 1 Factors related to death by drowning

		Drowning		Other fatalities		*P* value
Sample		44	%*	306	%*	
Age	Mean(SD)	5.4	4.0	8.8	5.6	< 0.0001
Sex	Male	39	88.6	249	81.4	0.238
Region	Alberta	16	36.4	73	23.9	0.4186
	Ontario	13	29.5	83	27.1	
	Saskatchewan	6	13.6	61	19.9	
	Other	9	20.5	89	29.1	
Location	Dugout	17	38.6	–	–	N/A
	Lake/pond/slough	8	18.2	–	–	
	Sewage lagoon or storage	8	18.2	–	–	
	Other	11	25.0	–	–	
Work-related		11	25.0	242	79.1	< 0.0001
Relative		28	63.6	233	76.1	0.075
Adult supervision		16	36.4	159	53.5	0.0334

*Due to missing values, the percentages and overall *n* values may not perfectly agree

Comparisons within drowning fatality group

Among drowning fatalities, the mean age was 3.0 years for females and 5.7 years for males ($p < 0.0001$). The mean age of relatives of farmers was 3.9 years compared with a mean age of 7.9 years for others ($p = 0.010$). There were no significant differences between sex and whether the child was a relative, whether an adult was near, or whether the death was work-related. Among those who had died from drowning, 32% had "wandered away from supervision," 45% drowned in the presence of other children, and 16% had drowned after falling through thin ice.

Discussion

This study described the occurrence of farm drownings among children in Canada between the years of 1990 and 2012. It identified 44 cases of drowning deaths in this period. Compared with other farm fatalities, drowning deaths had younger victims, were less likely to be work-related, and were less likely to happen while under adult supervision. This study also found that, for those with adults present at the time of the event (36.4%), the majority of children "wandered away from supervision" and 45% died in the presence of other children.

Drowning is a cause of death that disproportionately affects the very young (aged < 10 years; Bugeja and Franklin 2005; Clemens et al. 2016). Young children do not have sufficient knowledge of the danger that water poses, or the skills to save themselves from dangerous water (Davey et al. 2019). Australian research showed that prevention measures reduced the occurrence of drowning among youth significantly between the 1990s and the early 2000s (Bugeja and Franklin 2005). The measures employed to achieve this included installing fencing around swimming pools and spas to separate children from these areas when unsupervised, as well as increasing public awareness around caregiver supervision (Bugeja and Franklin 2005; Davey et al. 2019). However, the researchers noted that the prevention effort did not sufficiently address drowning on agricultural property.

Data from Australia have shown that rural water sources are now the most common locations for drowning, replacing private swimming pools and spas (Bugeja and Franklin 2005). Australian research also indicated that a lack of proper supervision was a major factor in the drowning death of young children (Bugeja and Franklin 2005). The majority of farm dugout drownings they identified occurred while the caregiver was inside the house. Other drownings occurred while the caregiver was engaged in maintenance, working, or domestic chores. An interesting finding from this study was that 11 of the 16 identified farm dugout drownings occurred with a barrier present. This underlines the importance of installing effective barriers around water hazards. Alternatively, where effective barriers around water hazards are not cost-effective due to the size of the water area or the necessity of allowing animals access to it, farm operators could restrict younger children to "safe play areas" with effective barriers to keep them in place.

Prevention should rely not only on supervising adults actively preventing children from going near dangerous water areas but also on the creation of barriers that prevent children from getting to the water. Relying on supervision alone is insufficient, since so many deaths occur while parents are present. Farm work taxes the attention of adults, and even small lapses in attention can be enough time for a child to

drown. Relying on other children for supervision is also insufficient since they may not recognize the danger of water on a farm. If a child falls into the water, an older sibling may not possess the knowledge, skills, or strength to rescue them. Furthermore, such attempts may also result in the second child drowning. Therefore, farms should be designed such that children are prevented from going close to water. This is especially true for very young children, who are at particularly high risk of drowning.

Strengths and limitations

There are several limitations to this study. One is that there is some missing information from the reporting data, including 4 cases where cause of death information was insufficient to determine whether or not drowning occurred. There also were 9 total cases where supervision was not specified sufficiently, and all of these occurred among non-drowning fatalities. Another limitation is that the relatively small number of drownings each year did not allow sufficient power to test for a trend over time. The strengths of this study include the nationwide, comprehensive sample of farm fatalities that should provide an accurate accounting of the occurrence of farm drowning deaths among children and a comparison with children who died on farms from other causes.

Conclusion

Child drowning deaths on farms in Canada are preventable deaths. Research on drowning prevention in other areas has highlighted the importance of ensuring that barriers to water are in place and effective at preventing children from entering these areas. Guidelines for agriculture workers with children may prove useful for ensuring that proper precautions are in place on Canadian farms.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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