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Exposure to agricultural hazards among children who visit farms

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Ethics board that approved the study: Behavioural Research Ethics Board, University of Saskatchewan

Abstract

Background: Children are commonly injured on farms, yet no studies provide evidence about exposures that leave rural children visiting farms at risk.
Objectives: The objectives of this study were to study (a) how frequently rural nonfarm children are exposed to farms, farm work and associated activities; and (b) the safety conditions and practices on farms being visited.
Methods: A cross-sectional survey was administered in Saskatchewan, Canada to rural parents during 2014. Participation included reports on 458 farms visited by rural children, and then 549 children from 312 families who had been exposed to a farm in the past year. Child-level indicators included age, sex, farm safety education and training, engagement in farm work and play activities and exposure to specific farm safety hazards. Farm-level indicators included self-perceived safety conditions, and child supervision practices.
Results: One-third of the children sampled (n=549) had been exposed to a farm in the past year. Safety conditions, practices and supervision varied by demographic subgroup. Farm safety education and agriculture training were most common in the oldest age group (13 to 17 years; 24.7% and 9.2%, respectively) of which 40.8% had worked on a farm previously, averaging 10 hours/week (interquartile range 3 to 20) during summer months. Mechanized and nonmechanized work was observed for children of both sexes and rose with age. Physical hazards were reported both proximally (≤100 yards) and distally (>300 yards) to farm homes.
Conclusions: Children who visit farms are potentially exposed to risk, and these risks increase with age as children take on formal work roles, leaving them vulnerable to farm injury.

Keywords: *Agriculture, Child, Epidemiology, Farm, Pediatric, Work.*

Injury is a leading cause of death and disability among farm children (1,2). Children residing on farms in Canada (3) and the USA (4) experience risks for injury that exceed population norms. This occurs due to exposure to mechanized and nonmechanized occupational hazards (5). In Canada, major causes of traumatic farm injury vary by severity, with fatalities to

children typically caused by machinery runovers, tractor and all-terrain vehicle rollovers, and drowning, and nonfatal trauma caused by machinery entanglements, runovers, blunt animal trauma and falls from heights (1,6). Farms are complex environments and represent both places of play and work for children, and this along with the types of farm work engaged in, the nature and adequacy of child supervision, and safety education and training experiences, play potential roles in the etiology of child farm injury (2,7–9). Less is known about the experiences of rural children who do not live on farms but who visit farms for play, work or other reasons. Such children may be susceptible to farm injury (7). Little evidence is available that summarizes the extent to which these children are exposed to farm-related hazards.

We had a unique opportunity to explore this issue as part of a Saskatchewan-borne cohort study (10,11). Our objectives were to: (a) examine how frequently rural nonfarm children are exposed to farm environments; (b) examine their exposures to different farm activities and situations and how they vary demographically and (c) profile parental perceptions of safety conditions and practices on farms visited by these children.

METHODS

Study population and procedures

We analyzed baseline data from the Saskatchewan Farm Injury Cohort Study (SFICS) Child Cohort (10,11). This cohort was designed to study determinants of health among children exposed to farms. Our sampling frame and data collection approach have been described (11). The target population included families with children attending rural schools in Saskatchewan. Our intention was to create a large and heterogeneous sample, with both farm and nonfarm rural children. The study base included families from 46 schools nested within 7 randomly selected school divisions. Questionnaires were distributed through schools for parents to complete. One questionnaire was completed for all children in the family.

Data collection occurred in the first four months of 2014. There were slightly different questionnaires for children who lived on farms and those who did not. The 'farm family version' included questions about the farm on which the child lived, while the 'rural family version' asked the same questions but about the farm the child had visited most often. The final sample included 2328 children from 1094 families, of which 1737 children (818 families) were nonfarm residents. The main foci of our analysis were reports about 458 farms that had been visited by a rural child, then separately reports on 549 rural children (312 families) who had visited or worked on a farm in the past year (Figure 1).

Study procedures and protocols were approved by the Behavioural Research Ethics Board at the University of Saskatchewan.

Measures

We collected information on farm activities, situations and physical hazards known to be associated with child farm injury risks (1,2,7–9).

Farms visited (farm level): Parents were asked to describe the farm or ranch their children visited most often. These included the commodities produced ('*grain crops*', '*cattle [beef]*', '*cattle [dairy]*', '*swine*', '*poultry*', '*vegetables/fruit*', '*other animals*', '*don't know*'); and perceptions of safety conditions and practices on the farm ('*excellent*', '*good*', '*fair*', '*poor*'). We documented the presence of a designated fenced play area. We asked about supervision practices on the farm, and recorded the person that supervised the child who most recently visited a farm ('*owner of the farm*', '*you or your spouse [their parents]*', '*another adult (i.e., grandmother, worker)*', '*a sibling*', '*they were not supervised*', '*don't know*').

Safety hazards (farm level): We profiled the presence of specific farm injury hazards: '*indoor [barn] intensive livestock operation [building]*', '*outdoor feedlot or corrals*', '*grain bins*', '*sewage pond or manure lagoon*', '*bale stack or bales*', '*water source (e.g., dugout, slough)*', '*machine shop*' and '*machinery storage*'. We documented the presence or absence of hazards, as well as their proximity to the farm house: '*yes, <100 yards*', '*yes, 100-300 yards*', '*yes, >300 yards*', '*no*' and '*don't know*'.

Child characteristics (individual level): Children were described by biological sex, and age group, categorized by stage of development ('*0–6 years*', '*7–12 years*', '*13–17 years*'). Specific farm-related exposures included whether the child had '*attended daycare, child care or nursery school in the past year*', and (if yes) '*was this daycare, child care or nursery school located on a farm?*'. We also asked whether the child had '*completed any farm safety education? (e.g., farm safety day camp)*'; and '*completed any agriculture courses or training? (e.g., 4H)*'.

Farm activities and work (individual level): We documented whether each child had '*ever worked on a farm or ranch?*' and '*how many hours per week*' the child spent '*doing farm work*' for each season during the past year. For the previous year, we asked how often the child spent at least 1 hour taking part in the following: '*haying/moving/ playing with hay bales*', '*feeding livestock*', '*cleaning or playing in barns*', '*cleaning grain bins*', '*cleaning or playing in pens/corals*'. Response options were reclassified as never, occasionally ('*less than once a month*' or '*at least once a month*') or frequently ('*at least once a week*' or '*every day*'). Parents also reported whether the child operated specific types of machinery ('*tractors*', '*combines*', '*grain augers*') during the last year, by season.

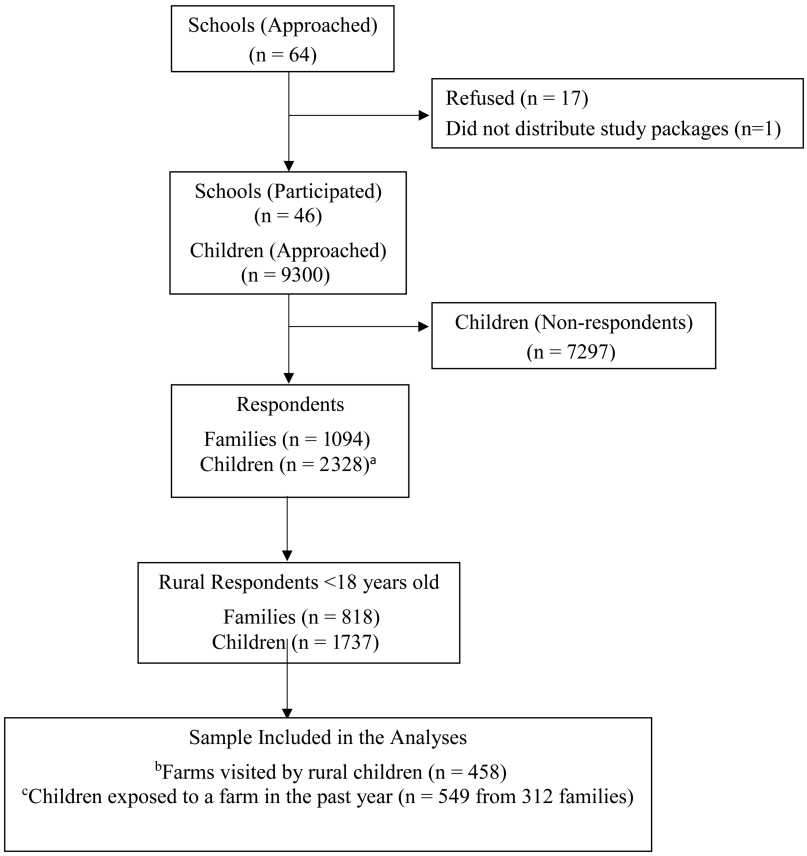

Figure 1. Participant flow chart. [a] 325 of the 2328 children respondents were pre-Kindergarten siblings who were not directly approached through schools and therefore are not included in the n=9300 children (approached). [b]458 Families provided information about the farm or ranch their children visited most often. [c]Children who visited and/or worked on a farm or ranch in the past year.

Statistical analyses

We estimated the proportion of rural children exposed to a farm environment in the previous year. We examined characteristics of the farms that these children visited and the presence of safety hazards near the farm house. At the child level, we described the farm-related exposures and then farm activities these children engaged in, stratified by age group and sex, and by whether they had visited a farm in the past year or not (for work, play or other purposes). Rao-Scott chi-square tests adjusting for clustering by family were used in child group comparisons. All analyses were conducted using SAS Version 9.4 (SAS Institute, Cary, NC, 2013) and were descriptive.

RESULTS

The study sample is described in Figure 1. A total of 1737 children less than 18 years of age from 818 families were identified as being rural dwelling, nonfarm residents. Approximately one-third of these children (n=549 children from 312 families) reported exposure to a farm or ranch in the past year.

Parents described the farm visited most often by their children (n=458 farms). These farms mainly produced grain (61.5%), beef cattle (45.1%) or other animals (18.2%). Parents rated the safety conditions and practices of the farm as 'excellent' 43.7% of the time, 'good' 46.4% and 'fair/poor' 9.9%. A designated fenced play area was reported present on 19.5% of farms. Child supervision during their most recent visit was conducted by the farm owner(s) (42.9%), the responding parent or their spouse (39.8%), or another adult (8.6%). In less common cases where the child was reported as being unsupervised (6.2%), 21% (n=6) were 7 to 12 years old, and 79% (n=23) were 13 to 17 years old.

Table 1 demonstrates the presence of potential safety hazards on farms that were visited. Many hazards were in close proximity (<100 yards) to the farm home including: machinery in storage, machine shops, grain bins, outdoor feedlot or corrals, and indoor livestock operations. Alternatively, a number of these hazards were distant (>300 yards), possibly indicating a different risk profile. Potential hazards that were further from the home included the above and exposures to water sources, bale stacks and bales.

A description of the rural children exposed to farms and their work exposures appears in Table 2. This table includes all rural children (n=1737), but our focus is on children exposed to a farm in the past year (n=549). Formal daycare was reported uncommonly even in the youngest age group (7.1%). Farm safety education was reported more frequently in the two older age

Table 1. Presence of safety hazards near the homes of farms most often visited by rural children (n=458)

Hazard	Reported Hazard Present		Distance of Hazard From the Home (if Reported Present)		
			<100 yards	100–300 yards	>300 yards
	n	(%)	Row%	Row%	Row%
Machinery storage	335	(73.1)	35.2	39.1	25.7
Machine shop	318	(69.4)	48.1	32.7	19.2
Grain bins	308	(67.2)	26.7	36.2	37.1
Balestack or bales	262	(57.2)	18.7	30.9	50.4
Outdoor feedlot or corrals	260	(56.8)	23.5	44.6	31.9
Water source (e.g., dugout, slough)	250	(54.6)	16.0	28.8	55.2
Indoor intensive livestock operation	168	(36.7)	29.8	47.6	22.6
Sewage pond or manure lagoon	136	(29.7)	17.7	31.6	50.7

Table 2. Description of rural children: total sample then subgroup who were exposed to a farm or ranch in the last year

	Ages 0–6		Ages 7–12		Ages 13–17	
	Total sample (n=510)	Exposed to farm/ranch (n=156)	Total sample (n=753)	Exposed to farm/ranch (n=240)	Total sample (n=474)	Exposed to farm/ranch (n=153)
Attended daycare, child care or nursery school located on a farm - *%*	2.8	7.1	0.9	2.5	n/a	n/a
Completed any farm safety education—*%*	3.0	5.2	19.6	27.2	18.4	24.7
Completed any agriculture courses or training—*%*	1.0	1.3	4.3	6.7	5.5	9.2
Visited a farm in the past year—*%*	30.2	98.7	30.2	94.6	24.4	86.3
Ever worked on a farm or ranch—*%*	3.8	9.0	8.6	21.3	15.9	40.8
Worked on a farm in the past year—*%*	1.8	5.8	4.8	15.0	11.0	34.0
Average hours/week worked on the farm in the past year—*Median (IQR)*		(n=9)		(n=36)		(n=52)
Spring		2 (1–2)		1 (0–5)		4 (0–7)
Summer		1 (1–2)		2 (1–7.5)		10 (3–20)
Fall		2 (1–2)		1 (0–5.5)		4 (0–14)
Winter		0 (0–1)		0 (0–1.5)		0.25 (0–4)
Number of children involved in mechanized work—*count*						
Tractor operation		2		9		31
Combine operation		0		1		5
Auger operation		0		0		5

Based on valid response totals (up to 3.1% missing data)

groups (7 to 12 years: 27.2%; 13 to 17 years: 24.7%). Among the older children, a considerable proportion who visited a farm in the past year had worked on a farm previously (7 to 12 years: 21.3%; 13 to 17 years: 40.8%). During the summer months, these 13 to 17 year olds worked a median of 10 hours/week (interquartile range 3 to 20). In the younger age groups, there was consistent reporting of farm work in all but the winter season. Children in all age groups were reported to have operated tractors, with older children reported to have operated combines and augers. The number of children involved in these mechanized tasks increased with age. To illustrate, 9 out of 240 (3.8%) children 7 to 12 years of age had operated a tractor and 1 out of 240 (0.4%) had operated a combine. Of children aged 13 to 17 years, 31 out of 152 (20.5%) had operated a tractor (27

while performing work), five (3.3%) a combine and five (3.3%) a grain auger.

In Table 3, common farm activities and tasks are explored by sex. In the youngest age groups boys were more often exposed than girls. In the oldest age group, this pattern became much clearer, consistent with boys becoming more involved in work tasks.

DISCUSSION

This study focused on the experiences of a group of children who are often overlooked yet are vulnerable for injury. These are children who do not live on farms but visit them for play, work or other purposes. Through this analysis we demonstrate that, beginning at a young age, there are substantial numbers of nonfarm children who are potentially exposed to activities and situations involving occupational hazard. Hazardous exposures were reported more frequently as children get older, coincident with these children becoming involved in farm work. The nature and extent of such exposures, to our knowledge, have not previously been documented.

Observed demographic patterns were suggestive of developmental and gender-based trends. Developmentally, although a small amount of work was documented among very young children (ages 0 to 6), the majority of these children were presumably taken to farms for play and nonwork purposes. Yet there was clear potential for these young children to be exposed to significant hazards. For children engaged in outdoor play, only one in five farms had a designated area to keep them physically separated from worksite hazards. Adults involved in supervision varied, and although we did not have information about the quality (i.e., proximity, continuity and attention) (8) of supervision, it is difficult to achieve optimal levels of child supervision in farm settings without removal of the child from the worksite (3,8,12). A suboptimal (less than 'excellent') rating of safety conditions and practices was provided 56% of the time, and the potential for inaccuracy in this assessment is obvious. Past study has shown the potential consequences of such exposures in terms of mortality and disabling injury (3), and there appears to be a substantial amount of trust placed in farm operators to keep these children safe.

The range of exposures expanded in the older age groups to include farm work. Indeed, there was a remarkable number of exposed children and apparent sizable use of rural youth for farm labour. Such roles often emerged in the absence of reported safety education and training, and some in direct contravention of child labour laws (13). Social desirability biases would likely lead to under-estimation of such violations. In addition to engagement in significant work hours, we documented use of tractors and other specialized machines, and other farm work exposures in children below the age at which they would have developmental abilities in terms of reach, strength, and vision to conduct this work safely (14–16). Starting in the youngest age groups, boys were exposed to more and different activities and work tasks than girls, consistent with the excess injuries reported for male farm children (1–4).

A unique aspect of this analysis was our documentation of the proximity of selected farm hazards to farm homes. Even if not working, if children are permitted access to the farm worksite, they appear to have ready access to stored machinery, machine shops, animal operations, bale stacks and large bales and water and other liquid hazards. These were reported to be within 100 yards of the farm residence, an easy walking distance for most children. Proximity of the home to the worksite remains an important risk for paediatric farm injury in all age groups, but especially for young children whose behaviour can be curiosity driven and unpredictable (12). Conversely, substantial proportions of parents reported some of the same safety hazards at a distance (>300 years) from the residence. Distal hazards may be associated with a reduced opportunity for adequate supervision, and distance from immediate help. This is more likely to affect older children who do not typically require constant supervision.

Limitations of the study include the inaccuracies of self-reports and social desirability biases that may be especially pronounced when it comes to the care of children. Second, while we provide basic documentation on the presence of safety hazards and work tasks that commonly lead to child injury, more in-depth exposure assessments, both quantitative and qualitative, are warranted. Third, due to our sampling strategy (children and families sampled from schools), the experiences of children less than 6 years of age would be under-represented. Further, the youngest of these children may not be representative as they must have had a school-aged sibling to enter the study. Finally, there was significant nonresponse, which could impact the overall samples representativeness of rural nonfarm children. Strengths of this study include its novelty in focusing on a robust sample of children for which there is little information. Our analysis demonstrates that many nonresident children visit farms and potentially have significant exposures to hazards, both play and work-related. Provision of this information addresses an important gap in the paediatric health and safety literatures.

Farm owners and parents have a shared responsibility for protecting children who visit farms. Safety specialists, paediatricians and agricultural producers have identified best practices to ensure such protection (17). Recommendations include the need for: (a) previsit discussions between farm owners and parents about safety and health risks on the farm; (b) shared decision-making about developmentally appropriate access to the farm worksite (18) and areas of the farm that remain off-limits; (c) naming the adult responsible for child supervision with agreement on proximity, attentiveness and continuity of that supervision (8,12); (d) physical barriers around areas

Table 3. Among rural children who visited and/or worked on a farm in the past year how often did they spend ≥1 h taking part in the activity

	Ages 0–6			Ages 7–12			Ages 13–17		
	Boys (n=72)	Girls (n=82)	P[c]	Boys (n=112)	Girls (n=128)	P[c]	Boys (n=64)	Girls (n=88)	P[c]
	%	%		%	%		%	%	
Haying/moving/playing with hay bales									
Occasionally[a]	29.6	18.3	*0.09*	33.6	27.2	*0.32*	27.4	27.6	*0.98*
Frequently[b]	8.5	2.4	*0.12*	3.6	5.6	*0.46*	11.3	10.3	*0.84*
Feeding livestock									
Occasionally[a]	31.9	24.4	*0.33*	30.6	32.0	*0.83*	33.9	28.4	*0.47*
Frequently[b]	6.9	1.2	*0.04*	5.4	2.3	*0.22*	11.3	12.5	*0.80*
Cleaning or playing in barns									
Occasionally[a]	20.6	32.1	*0.14*	34.2	26.2	*0.20*	32.8	23.5	*0.21*
Frequently[b]	5.9	1.2	*0.06*	2.7	3.2	*0.83*	6.6	8.2	*0.68*
Cleaning grain bins									
Occasionally[a]	4.2	4.9	*0.87*	7.3	1.6	*0.04*	24.6	11.6	*0.04*
Frequently[b]	0.0	0.0	/	0.0	0.0	/	4.9	1.2	*0.17*
Cleaning or playing in pens/corrals									
Occasionally[a]	21.7	14.6	*0.30*	27.3	30.5	*0.62*	31.2	22.1	*0.22*
Frequently[b]	5.8	1.2	*0.04*	3.6	1.6	*0.31*	4.9	9.3	*0.28*

Based on valid response totals (up to 5.7% missing data).

[a]Occasionally defined as 'at least once a month' or 'less than once a month' (excluding 'never')

[b]Frequently defined as 'at least once a week' or 'everyday'

[c]Rao-Scott chi-square for activity participation by gender, adjusted for clustering by family

that are off-limits including consideration of designated, fenced play areas (18). For children who are to be engaged in work, best practices would extend to compliance with: (e) applicable child labour laws (9), and (f) developmentally appropriate work guidelines (18). The duty to share in these responsibilities and associated recommendations also falls to paediatricians and other clinicians who work with rural communities, and have an important and critical function for the protection of child visitors to farms.

CONCLUSION

We studied visiting children's exposures to farm activities, situations and physical hazards that leave them vulnerable to injury. Our findings demonstrate that even very young children visiting farms are potentially exposed to risks, and these exposures increase with age as children take on formal work roles on the farm. Farm owners and parents share the responsibility of keeping such children safe from the physical hazards present in most farm worksites.

Conflict of Interest

WP reports grants from Canadian Institutes of Health Research during the conduct of the study. No other conflicts of interest declared by any of the authors.

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