Agricultural Work Activities Reported for Children and Youth on 498 North American Farms

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Abstract

Children are at high risk for agricultural injury, yet there is little documentation about the range of farm work that children perform or the ages at which children experience these work exposures. The purpose of this study was to identify the scope of agricultural jobs performed by farm children and to describe variations in work involvement within demographic subgroups. A descriptive analysis was conducted of baseline data collected by telephone interview during a multi–site randomized controlled trial. The study population consisted of 1,138 children from 498 North American farms. A total of 2,389 jobs were reported for the 1,138 children. The leading categories of work were animal care, crop management, and tractor with implement operation. Regional differences were observed, consistent with variations in commodities. Substantial proportions of children were assigned to farm work even in the youngest age group of 7–9 years. Males were differentially assigned to tractor with implement operations, while females were more often assigned to animal care. This study provides one of the first systematic accounts of farm work performed by North American children. This analysis of work exposures provides information from which known prevention priorities can be reinforced and new opportunities for prevention identified.

Keywords. **Agriculture, Farm, Occupational, Children.**

Although the farm environment poses a number of dangers to people in all age groups, there are notable hazards for children that are important sources of childhood mortality and morbidity (Cameron et al., 1992; Canadian Agricultural Injury Surveillance Program, 2000a, 2000b; Castillo et al., 1999; Centers for Disease Control, 1998; Mandryk and Harrison, 1995; Pickett et al., 1999, 2001; Rivara, 1997). Children also experience significant numbers of fatal and nonfatal farm injuries. An average of 104 children are killed on farms each year in the U.S. (Rivara, 1997) and an estimated 33,000 experience a non–fatal injury (USDA, 1999). In Canada, an average of 17 children are killed each year on farms

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(Pickett et al., 1999) and at least 500 are hospitalized (Canadian Agricultural Injury Surveillance Program, 2000b; Pickett et al., 2001).

In order to develop effective childhood injury prevention strategies, a clear understanding of the common occupational exposures involving farm children is required. Hawk et al. (1994) surveyed a random sample of 208 Iowa farm families and documented children's exposure to agricultural machinery (tractor, PTO, auger, and combine). The survey showed that children first experience these occupational exposures at an early age (0–4 years), that boys are assigned to mechanized work more often than are girls, and that some farm children begin to operate machinery by themselves when they are very young (5–9 years). Lee et al. (1997) surveyed 1,255 Wisconsin dairy farmers and found that farm fathers were very likely to allow their children younger than 14 years to drive a tractor, be a second rider on a tractor, and to be within five feet of the hind legs of a dairy cow. With these exceptions, there is little documentation in the medical and engineering literatures about the ranges of occupational hazards to which farm children are exposed and the ages when children commonly perform different farm jobs.

As part of our efforts to evaluate enhanced dissemination methods for the *North American Guidelines for Children's Agricultural Tasks* (NAGCAT) (Lee and Marlenga, 1999), we conducted a multi–site randomized controlled trial with a diverse sample of North American family farms representing different geographic regions, farm sizes, and commodities under production, each of which had children age 7–16 years working on the farm. In the baseline interviews for this randomized trial, parents were asked to provide up to two common jobs performed by each child between May and August. These data provided us with the opportunity to examine the jobs that children actually do on farms and how these vary within demographic subgroups. Tractor–related work by farm children was described in a previous manuscript (Marlenga et al., 2001) and the present analysis expands upon this by: (1) identifying the full range of agricultural jobs performed, and (2) describing how patterns of farm work involvement vary according to region, age, gender, and farm commodity.

Methods

The farms and children under study were from the U.S. and Canada. The sampling frame, eligibility criteria, and approach to subject recruitment are detailed elsewhere (Marlenga et al., 2001). In brief, farms were identified for the study by sampling farm registries in the two countries. In the U.S., a subset of farms that were selected from the USDA's master sampling frame for a 1998 national agricultural injury survey (USDA, 1999) were invited to participate. These farms were limited to those who had children age 7–16 years at the time of the survey (the age range covered by NAGCAT). In Ontario, Canada, farms were identified from the Central Farm Registrar maintained by Statistics Canada and the APC Farming Database, a commercially available mailing list. All farms were sent letters of invitation to participate.

Farm representatives who returned a signed letter indicating their willingness to participate and found to have children in the 7–16 year age range were enrolled in the study. Our goal was to recruit 276 farms in each of three regions (828 total) to allow 90% power to assess the primary outcome of the randomized controlled trial. Our actual recruitment was lower than expected, with a total of 498 farms volunteering to participate in the study. These farms were geographically situated as follows: Western

U.S. (11 states, 115 farms), Midwestern U.S. (12 states, 169 farms), and the province of Ontario, Canada (214 farms).

Baseline data were collected by telephone from a farm parent. Variables assessed included the primary commodity produced on the farm, the working status of the farm (full–time, part–time, hobby), and geographic location. Characteristics of farm children assessed were the age and gender of each working child in the 7–16 year age range and whether they were resident children or children hired onto the farm to assist with farm work.

Farm parents were asked, "For each child, please name two farm jobs that the child does most often between May and August." Responses were collected using an open–ended format. Interviewers were instructed to probe, in a structured manner, for specific details about what the job entailed and how the work was done. Some parents could not limit their response to two jobs, stating that the child did three or four jobs with equal frequency. Thus, more than two jobs were reported for some children.

An organized list of farm work codes with an accompanying set of rules for their application was developed based in part on the list of 62 jobs available through the NAGCAT initiative (Lee and Marlenga, 1999). This list was augmented when job descriptions obtained in the interview did not fit within those 62 NAGCAT jobs, for example, "caring for small animals," "caring for animals while on horseback," and "handling of produce."

The 2,389 open–ended descriptions were coded into specific categories of farm work. Three people performed the coding independently, and disagreements were resolved by consensus. Following the coding, the specific categories of farm work were organized into the general divisions of animal care, crop management, tractor with implement operation, other equipment operations, farm maintenance, and other farm work (table 1).

Analysis

Descriptive analyses were used to characterize the study farms by commodity, self–reported working status of the farm operation, and North American region. The distribution of eligible children was described by residential status, age group, and gender. Distributions of the farm jobs assigned to children were described for the study population. Farm jobs were then summarized for each of the three study regions, by gender within each of the five age groups, and within the various commodity groups.

Analyses of regional differences in farm characteristics were based upon chi–square tests. Multiple logistic regression models were used to examine the potential associations of gender, age, commodity, and region with the performance of the general divisions of farm jobs by children working on the farm. Generalized estimating equations (Liang and Zeger, 1986) were used in the logistic models to allow for correlation among children from the same farm. These analyses, which are secondary analyses of a randomized trial, were conducted to assess general trends and are considered exploratory rather than confirmatory, as there are many inter–related factors that may be associated with agricultural work activities. Analyses were conducted using SAS statistical software (SAS, 1997).

Results

Table 1 provides a simple description of the specific jobs assigned to children. Leading types of farm work, described according to work division, involved animal care, crop management, and tractor with implement operation. In terms of more specific work descriptions, the most common farm jobs reported (based on the percentage of the 1,138 children involved) were: large animal care, small animal care, cleaning animal enclosures, haying activities, fieldwork involving tractors with trailed implements, picking rock, hand weeding, and riding lawnmower operation.

Table 1. Frequency of farm jobs among children.

Description	n	%
Animal care		
Animal care: large animals	353	31.0
Animal care: small animals	302	26.5
Animal care: cleaning corrals, pens, hutches, service alleys, stalls	182	16.0
Animal care: animal of indeterminate size	79	6.9
Animal care: use of farmstead equipment	73	6.4
Animal care: while on horseback	33	2.9
Animal care: high–risk activities (branding, vaccinating, etc.)	23	2.0
Animal care: pets	14	1.2
Crop management		
Haying: loading, unloading, stacking	148	13.0
Field preparation: picking rock	112	9.8
Hand weeding	97	8.5
Irrigation systems: installation, operation, maintenance	85	7.5
Gardening and greenhouse operations: all types	46	4.0
Hand–harvesting: vegetables, fruits, berries	33	2.9
Pruning: trees, vines	25	2.2
Produce handling: packing, sales	19	1.7
Tobacco handling: planting, harvesting	18	1.6
Chemical application: pesticides, fertilizers	15	1.3
Tractor with implement operation		
Fieldwork: trailed implements	139	12.2
Fieldwork: PTO–powered implements	75	6.6
Tractor operation: unspecified implements	61	5.4
Fieldwork: 3–point implements	47	4.1
Fieldwork: remote hydraulics	21	1.8
Tractor operation: front–end loader	9	0.8
Tractor operation: no attached implements	2	0.2
Other equipment operation		
Lawnmower operation: riding	102	9.0
Lawnmower operation: push	33	2.9
Fieldwork: truck	26	2.3
Fieldwork: all–terrain vehicle	14	1.2
Skidsteer operation	12	1.1
Fieldwork: self–propelled equipment	9	0.8
Farm maintenance		
General maintenance: no machinery involved	52	4.6
General maintenance: machinery	33	2.9
Fencing: building and maintenance	27	2.4
Other/unknown	70	6.2

Table 2 describes the 498 farms by region, primary commodity group, and working status of the operation. It also describes the 1,138 farm children (age 7–16 years) by region, residential status, age, and gender. The primary commodity groups represented varied by study region ($p < 0.001$) but were led by grain, dairy, and other livestock operations. Substantially larger proportions of farms in Ontario were dairy, hog, and poultry operations, while the Midwestern farms were more frequently grain producers, and the Western farms were more frequently other livestock, fruit, and other farm operations. There were significant regional differences in the working status of the farms ($p < 0.001$), with smaller proportions of Western farms reported to be full–time farming operations. The majority of children who worked on these farms were male and were residents on the farm property. The median acreage of the farm was 300 (range 2 to 30,000) acres.

The most common farm jobs performed by children are shown by region in table 3. The logistic regression analysis indicated that, when compared with the other two study regions, children on Midwestern farms were more likely to be assigned animal care ($p < 0.001$) and farm maintenance jobs ($p = 0.004$) and less likely to be assigned crop management jobs ($p = 0.007$). In addition, Ontario children were even less likely

Table 2. Description of study sample.

Factor	Ontario, Canada		Midwestern USA		Western USA		Total	
	n	%	n	%	n	%	n	%
Farms	214	100	169	100	115	100	498	100
Primary commodity group								
Dairy	74	34.6	39	23.1	6	5.2	119	23.9
Hogs	19	8.9	9	5.3	3	2.6	31	6.2
Other livestock	40	18.7	33	19.5	42	36.5	115	23.1
Poultry	9	4.2	1	0.6	0	0.0	10	2.0
Grain	31	14.5	74	43.8	16	13.9	121	24.3
Other field crops	20	9.3	4	2.4	15	13.0	39	7.8
Fruit	7	3.3	3	1.8	11	9.6	21	4.2
Vegetables	5	2.3	2	1.2	2	1.7	9	1.8
Other	9	4.2	4	2.4	20	17.4	33	6.6
Working status of farm								
Full–time	174	81.3	132	78.1	76	66.1	382	76.7
Part–time	40	18.7	26	15.4	27	23.5	93	18.7
Hobby	0	0.0	11	6.5	12	10.4	23	4.6
Farm children								
Total (7–16 years)	541	100	354	100	243	100	1138	100
Resident farm children	472	87.2	312	88.1	220	90.5	1004	88.2
Hired farm children	69	12.8	42	11.9	23	9.5	134	11.8
Age (years):								
7–9	127	23.5	68	19.2	39	16.0	234	20.6
10–11	105	19.4	77	21.8	40	16.5	222	19.5
12–13	110	20.3	86	24.3	51	21.0	247	21.7
14–15	130	24.0	84	23.7	78	32.1	292	25.7
16	69	12.8	39	11.0	35	14.4	143	12.6
Male	316	58.4	216	61.0	138	56.8	670	58.9
Female	225	41.6	138	39.0	105	43.2	468	41.1

Table 3. Common farm jobs performed by children age 7–16 years by North American study region.

	Ontario, Canada		Midwestern USA		Western USA		Total	
Farm job	n	%	n	%	n	%	n	%
Animal care	344	63.6	260	73.4	115	47.3	719	63.2
Crop management	240	44.4	133	37.6	134	55.1	507	44.6
Tractor with implement operation	124	22.9	94	26.6	54	22.2	272	23.9
Other equipment operation	96	17.7	36	10.2	39	16.0	171	15.0
Farm maintenance	11	2.0	74	20.9	23	9.5	108	9.5
Other tasks	34	6.3	14	4.0	22	9.1	70	6.2
Total children	541		354		243		1138	

to be asigned to farm maintenance work than were Western children ($p = 0.002$) but were more likely to be assigned to other equipment operation than were Midwestern children ($p = 0.007$).

The distribution of farm work is further described in table 4 by age group and gender. This shows that substantial proportions of children of both genders are assigned animal care and crop management activities, even at the youngest age group of 7–9 years. Tractor with implement operation was reported infrequently until the age of 12–13. The differential assignment of tractor work to males ($p < 0.001$) and animal care to females ($p = 0.001$) is also described. These differences were especially pronounced in older children.

Finally, the most common farm jobs reported for children varied substantially by commodity group (table 5). As might be expected, where the commodity group involved animal production (dairy, hogs, other livestock, poultry), the leading farm jobs reported involved animal care activities. Where the commodity involved crop production (grain, other field crops, fruit, vegetables), crop management was the leading farm job reported.

Discussion

This study describes the range of agricultural work experienced by children on North American farms. Although the sampling frame did not encompass all of North America, the sample still comprised children from a large and geographically diverse group of farm families. These farms covered a range of production agriculture settings, and sufficient numbers of farm jobs were described to allow us to examine patterns within population subgroups of children.

Existing studies have described the magnitude of the farm injury problem within selected populations of children (Cameron et al., 1992; Canadian Agricultural Injury Surveillance Program, 2000a, 2000b; Castillo et al., 1999; Centers for Disease Control, 1998; Mandryk and Harrison, 1995; Pickett et al., 1999, 2001; Rivara, 1997). However, patterns of childhood injury are often interpreted in the absence of meaningful information about the amounts of occupational risk to which these children are exposed. Prevention priorities derived from descriptive injury data are undoubtedly reflective of important injury patterns, but they do not account for variations in work exposures between groups of farm children. In reality, there is actually little published evidence describing children's farm work exposures. When interpreted simulta-

neously with existing epidemiological evidence, such data may provide a clearer picture of priorities for prevention and the groups of children who may benefit from targeted intervention.

Common Farm Work Exposures and Children

The common work exposures experienced by farm children, in order of their reporting, include: animal care, haying activities, fieldwork involving tractors with trailed implements, picking rock, hand weeding, and riding lawnmower operation. Our findings are not directly comparable with published reports in the peer–reviewed literature. For example, Hawk et al. (1994) limited their study to tractors (with no description of type of machinery attached), PTOs, augers, and combines. Similar to our findings, the percentage of male children operating agricultural machinery was higher than that reported for females. However, their data were collected on all children age 18 years and younger, and different age groupings were used in their analysis (Hawk et al., 1994).

It is also difficult to compare our work exposure findings with the known patterns of childhood farm injury (Rivara, 1997; Pickett et al., 1999; Canadian Agricultural Injury Surveillance Program, 2000a). Available data sources used in the study and surveillance of farm injuries do not indicate whether or not children were working at the time of the injury. In this study, we did not simultaneously collect data on injury or injury risk, so it is difficult to conclude that the frequency of performing a job is associated with injury occurrence. Nonetheless, using our own judgment and experience in the absence of objective observations from existing data, we believe some farm jobs should clearly be highlighted as prevention priorities. First and foremost, animal care and tractor work assignments including those with trailed implements should be priority work exposures identified for injury prevention efforts. Other farm jobs that were reported as common (e.g., haying, picking rock, and hand weeding), while not responsible for large numbers of acute injuries, may be responsible for long–term musculoskeletal injuries.

The exposure data presented here provide evidence as to why farm animals and their handling should not be overlooked as leading potential causes of occupational injury. Almost two–thirds of the farm children studied were involved in animal care. These exposures were common for both genders, and they occur predominantly on animal production enterprises. Starting at a very early age, substantial numbers of North American farm children were handling, feeding, and working in the vicinity of animals of all sizes. While focused studies of animal–related injuries in adult workers exist (Casey et al., 1997; Boyle et al., 1997; Layde et al., 1996; Pratt et al., 1992), the importance of these injuries has not been emphasized for pediatric populations, despite the fact that several studies have identified animals as one of the leading sources of injury to children on farms (Cogbill et al., 1985; Gerberich et al., 2001; Myers and Hendricks, 2000; Stueland et al., 1991; Pickett et al., 2001). There is a clear need for useful injury prevention programs to be developed and evaluated in this area, as our data imply that early and continued involvement of farm children in animal care is the norm.

Exposures to tractor operations, while not rare, actually occurred less frequently among farm children than did other types of farm jobs. Yet tractors still account for the majority of deaths (Castillo et al., 1999; Mandryk and Harrison, 1995; Pickett et al., 1999) and major proportions of trauma experienced by farm children (Pickett et

Table 4. Common farm jobs performed by children age 7–16 years by age group and gender.

	Age group 7–9				Age group 10–11				Age group 12–13				Age group 14–15				Age group 16			
	M		F		M		F		M		F		M		F		M		F	
Farm job	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Animal care	94	70.7	77	76.2	85	69.1	72	72.7	89	62.7	78	74.3	88	49.4	70	61.4	47	50.0	19	38.8
Crop management	57	42.9	43	42.6	48	39.0	45	45.5	58	40.8	43	41.0	87	48.9	56	49.1	40	42.6	30	61.2
Tractor with implement operation	7	5.3	2	2.0	11	8.9	10	10.1	45	31.7	7	6.7	93	52.2	27	23.7	57	60.6	13	26.5
Other equipment operation	17	12.8	4	4.0	26	21.1	18	18.2	29	20.4	12	11.4	25	14.0	17	14.9	15	16.0	8	16.3
Farm maintenance	18	13.5	11	10.9	17	13.8	4	4.0	22	15.5	4	3.8	14	7.9	7	6.1	6	6.4	5	10.2
Other farm jobs	7	5.3	6	5.9	8	6.5	5	5.1	5	3.5	6	5.7	10	5.6	8	7.0	8	8.5	7	14.3
Total children	133		101		123		99		142		105		178		114		94		49	

Table 5. Common farm jobs performed by children age 7–16 years by commodity group.

	Commodity group																	
	Dairy		Hogs		Other livestock		Poultry		Grain		Other field crops		Fruit		Vegetables		Other	
Farm job	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Animal care	269	86.5	59	79.7	175	74.5	25	75.8	125	49.6	33	39.8	5	9.3	7	26.9	21	30.0
Crop management	83	26.7	23	31.1	88	37.4	11	33.3	133	52.8	61	73.5	48	88.9	16	61.5	44	62.9
Tractor with implement operation	73	23.5	17	23.0	57	24.3	3	9.1	71	28.2	24	28.9	6	11.1	10	38.5	11	15.7
Other equipment operation	26	8.4	15	20.3	37	15.7	6	18.2	48	19.0	14	16.9	8	14.8	11	42.3	6	8.6
Farm maintenance	13	4.2	5	6.8	33	14.0	1	3.0	46	18.3	0	0.0	1	1.9	2	7.7	7	10.0
Other farm jobs	8	2.6	6	8.1	14	6.0	0	0.0	11	4.4	12	14.5	7	13.0	0	0.0	12	17.1
Total children	311		74		235		33		252		83		54		26		70	

al., 2001; Rivara, 1997). This excess is partly explained by the large numbers of deaths and injuries experienced by children as bystanders to an occupational environment (Canadian Agricultural Injury Surveillance Program, 2000a; Pickett et al., 1999). It is also partially attributable to the unforgiving physical forces exerted upon victims when the tractor malfunctions or the operator makes an error in judgment. This implies that childhood injuries associated with tractor operation must remain a prevention priority. Limits must be put on farm children to prevent them from being in the vicinity of operating tractors, and children who are not developmentally capable of operating tractors must be prohibited from doing so.

Finally, the analysis points to the need for consideration of regional and commodity–specific differences in farm work to best understand patterns of farm injury and target the delivery of farm safety programs. Although the common childhood work exposures reported were universally important, the relative frequency of their reporting varied by region and commodity group. This type of information clearly helps to identify specific prevention priorities. Depending upon the population mix, it also shows that priorities developed from national data may not always be applicable to specific regions and/or commodity groups.

Strengths and Limitations

This descriptive analysis provides new information about childhood farm work practices that was previously unavailable, but it also has several limitations. The use of voluntary participants recruited initially for a randomized controlled trial limits the external validity of the observed findings. The work descriptions on which the analysis was based, while reasonably detailed, sometimes did not provide full detail about the degree of hazard imposed on the child and the exact circumstances and duration of work exposures. The inventory of farm jobs was not exhaustive, was based upon self–reports, and was undoubtedly affected by the time of recall of work exposures, which may be differential by site (interviews were conducted between April and December depending on study site).

Implications for Prevention

The present analysis has implications for the study and prevention of childhood farm injuries. Although less conventional than traditional injury surveillance, a descriptive analysis of potential hazards is a viable means by which known prevention priorities can be reinforced and new opportunities for prevention identified. Our data indicate common work exposures among farm children, and these should provide a focus for safety professionals who work in the agricultural sector and for evaluative researchers who wish to recommend best practices for the prevention of children's farm injuries. Injury prevention professionals also require knowledge of the farm practices in their area when choosing injury prevention strategies. The analyses also identify regional and commodity–specific differences in work practices (e.g., working with irrigation systems in the Western U.S.) and the extent to which mechanical and animal–related work is differentially assigned to boys and girls of different ages.

Future research on childhood farm injuries and farm work exposures should focus on filling in the gaps mentioned previously. Childhood farm injury surveillance efforts should be expanded to include data collection on whether or not the child was

working at the time of injury and more specific details on the job the child was doing at the time of injury. Additional research is also needed to confirm whether the work exposures presented here are representative of those experienced by the full spectrum of North American children who work on farms. This would ideally provide a comprehensive inventory of farm jobs that children do at different ages, along with information on the duration (hours spent) and level of risk associated with these jobs. With this knowledge, safety professionals will be able to rely on objective observation (rather than judgment and experience) to establish evidence–based injury prevention priorities for children who work on farms.

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