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Adult supervision and pediatric injuries in the agricultural worksite

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Abstract

Appropriate supervision is recommended as a strategy to prevent pediatric farm injuries, yet virtually nothing is known about the quality of adult supervision on farms. We therefore explored the nature of adult supervision among pediatric farm injury cases using three theoretically relevant dimensions of supervision: (1) attention, (2) proximity, and (3) continuity. We examined a retrospective case series of 334 pediatric farm injury cases from Canada and the United States that resulted in death or required hospitalization. Patterns of supervision were coded according to the three dimensions. Approximately two-thirds of the injured children (231/334; 69%) had an adult supervisor available (*attention*). The supervisor was in close *proximity* of the child in only about half the cases (169/334; 51%) and it was even less common for the supervision to be continuous (37%). Thus, many injuries occurred when children were inadequately supervised. However, approximately one-third of the injured children (112/334; 34%) had what in other circumstances would be considered *adequate* adult supervision at the time of their injury event, defined theoretically as having supervision available, proximal, and continuous. Yet, children on farms were injured even in the presence of *adequate* adult supervision. These findings, along with a growing body of literature examining pediatric farm injuries, suggest a need to develop a new definition of adequate adult supervision within the context of the agricultural work environment, or to consider restricting the access of children, especially the very young, to this hazardous worksite.

Keywords: Agriculture; Child; Parenting; Safety; Supervision; Wounds and injuries

1. Introduction

Agricultural injuries to children on farms have long been recognized as an important problem for public health. Farm children continue to experience high rates of premature mortality (Adekoya and Pratt, 2001; Brison et al., 2006; Castillo et al., 1999; Rivara, 1997), morbidity (CDC, 1998; Hendricks et al., 2005; Pickett et al., 2005), and disability (Reed and Claunch, 2000) due to injury. Each year more than 100 children in the United States die from agricultural injuries (Adekoya and Pratt, 2001) and nearly 23,000 children sustain agricultural injuries that require medical treatment or restrict their activity (Hendricks et al., 2005). Elevated risks observed in the United States are shared by populations of children internationally, for example among farm children in Canada (Brison et al., 2006), Australia (Mitchell et al., 2001), Finland (Rissanen and Taattola, 2003), and India (Tiwari et al., 2002). However, very little is understood about the etiology of these injury events beyond the mechanisms that lead to trauma. One prevention recommendation that is often cited is the need for parents to provide "more" or "better" supervision of children in the agricultural worksite (DeMuri and Purschwitz, 2000; Fisher et al., 2001; Hawk et al., 1991; Pickett et al., 1995; Salmi et al., 1989). Yet, there is virtually nothing known about the quality of adult supervision on the farm or the nature of supervision at the time of injury.

In the general pediatric injury literature, there has been increasing interest in studying supervisory behaviors by caregivers and relating these behaviors to child injury risk

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(Morrongiello, 2005). Although there is little agreement among professionals about what constitutes adequate supervision to prevent childhood injury (Peterson et al., 1993), prospective study designs have recently been used to track home injuries to children and to identify patterns of supervision associated with increased risk of children (Morrongiello and House, 2004; Morrongiello et al., 2004, 2006). Based on this research, three dimensions of supervisory behaviors have emerged as important: (1) attention to the child (watching, listening), (2) proximity of the supervisor (close proximity to the child allows for greater readiness to intervene), and (3) continuity of supervisory behaviors in time (extent of sustained attention and proximity to the child over time). Thus, based upon emerging theory, adequate supervision can be operationally defined as continuous (sustained) behaviors that index attention (watching and listening) and proximity (within arm's reach) to the child. This supervision framework posits that as attention, proximity, and continuity increase, the quality of supervision increases and the risk of injury presumably decreases (Morrongiello, 2005; Saluja et al., 2004).

Building on these findings, the purpose of this study was to explore the nature of adult supervision among pediatric farm injury cases using the supervision dimensions of attention, proximity, and continuity. Our specific objectives were to review existing cases of traumatic pediatric farm injury and (1) describe the patterns of supervision by age of the child, gender of the child, child activity, and location of the injury event, and (2) determine whether patterns of supervision observed in association with these injury events were consistent with the existing principles used to describe adequate adult supervision in the general pediatric injury literature.

2. Methods

2.1. Study design

A review of two retrospective case series of pediatric agricultural injuries that had been previously assembled for a study on the efficacy of the child labor laws for injury prevention was conducted (Marlenga et al., 2007). The case series represented fatal and hospitalized injuries from Canada, as well as fatal work-related injuries from the United States. We were deliberate in examining a range of serious traumatic injuries across two main contexts: (1) when children were working on the farm, and (2) when children were in the production environment but not working.

2.2. Definitions

For the purpose of this study, pediatric farm injuries were defined as any injuries to children (younger than 18 years) that (1) occurred when they were actively engaged in farm work and/or (2) occurred when they were not engaged in farm work but were injured by a known farm worksite hazard. Injury cases with incomplete information on adult supervision were excluded (197/531, 37%). A comparison of excluded and included cases indicated that our case series was similar by gender, resident status, relationship to owner, and injury mechanism, but included a higher proportion of younger children (51% versus 24% age 6 years and younger).

2.3. Data sources

2.3.1. Fatal injuries

All fatal pediatric agricultural injuries for the calendar years 1990–2001 were identified by personnel at each of the 10 provincial coroners' and medical examiners' offices in Canada, using all available registries (e.g., vital statistics, ministry of labor, coroner's registry, farm safety associations). Written investigation reports (e.g., coroner's reports, police reports, site investigations by government inspectors) and death certificates were reviewed on-site at each provincial coroner's office. The Canadian fatality case series was supplemented with 13 occupational fatality case reports from the United States that were investigated by the National Institute for Occupational Safety and Health, Fatal Assessment and Control Evaluation program for the years 1992–2000 (USDHHS, 2003). All available information on supervision was recorded in a narrative fashion.

2.3.2. Hospitalized injuries

Research agreements were established with five regional pediatric hospitals (three in Ontario, two in Alberta) and one general hospital (Alberta) in Canada to permit access to individual medical records for pediatric agricultural injuries for the years 1989–2002. The hospitals identified cases using both inpatient and emergency department-based registries. Medical records (including emergency responder reports, emergency room records, nurses' notes, and discharge summaries) were reviewed on-site after ethics review at each institution. All available information on supervision was recorded in a narrative fashion.

2.4. Instrument

A standardized instrument and study glossary for coding supervision were developed incorporating the theoretical dimensions of (1) attention, (2) proximity, and (3) continuity (Morrongiello, 2005). For this study, we operationally defined *attention* to mean that an adult was available to supervise the child. *Proximity* was operationalized to mean that the adult supervisor was within arm's reach of the child (e.g., in the tractor cab with the adult) or near the child (e.g., in the vicinity of the adult who is operating equipment). There were no formal measures of distance taken, rather, proximity was judged based on the narrative information provided about the circumstances of the injury (e.g., location of child relative to others). C*ontinuity* was assumed to exist unless there was documented evidence in the record that there was a break in the continuity of adult supervision (e.g., parent reported "only taking their eyes off the child for a minute") prior to injury.

The six-item supervision instrument was pilot tested and refined by two study investigators through independent coding of three samples of 20–30 cases each, in an iterative fashion. At each step in the process, all discrepancies were identified and the

instrument and study glossary were refined to improve clarity and consistency.

2.5. Data collection

The original case series of pediatric farm injuries was already assembled from a previous study (Marlenga et al., 2007) and was available electronically. In order to ensure consistency in coding and adherence to coding standards established in the glossary, two investigators coded each case. Where there was perfect agreement, this coding was accepted. When there were disagreements, consensus was reached through discussion between the coders in order to improve the accuracy and consistency of coding across all injury cases. Investigator agreement was reached for all 334 cases prior to analysis. Data quality checks were established to ensure that data were collected and entered accurately.

2.6. Data analysis

Descriptive summaries were used to characterize the injury cases and the patterns of supervision. Data were categorized by the characteristics of the injured child, their activity and location, and by injury outcome. Chi-square tests were used for statistical comparisons across categories when important differences were suspected. The test results were summarized simply with the observed significance level (p-value) without adjustment for multiple comparisons.

3. Results

3.1. Full case series

There were 334 injured children in the full case series (Table 1) and more than half were 6 years or younger (172/334, 51%). The majority of injured children were male (264/334, 79%), lived on the farm (260/334, 78%), and were the children of the farm owner/operator (254/334, 76%). Most (228/334, 68%) were not involved in farm work at the time of injury. The majority of fatal injuries (119/175, 68%) involved tractors and/or farm machinery (mechanized).

3.2. Attention (availability of an adult supervisor)

An adult supervisor was available for the majority of pediatric farm injury cases (Table 2). However, for nearly one-third of the injured children (103/334, 31%), there was no adult supervisor available at the time of injury. Even 20% (34/172) of the children 6 years and younger were unsupervised at the time of injury.

Table 1
Characteristics of children who sustained a serious agricultural injury

	Fatal injuries ($N=175$)		Hospitalized injuries ($N=159$)		Total ($N=334$)	
	N	%	N	%	N	%
Age in years						
≤6	90	51.4	82	51.6	172	51.5
7–12	38	21.7	48	30.2	86	25.7
13–17	47	26.9	29	18.2	76	22.8
Gender						
Male	141	80.6	123	77.4	264	79.0
Female	34	19.4	36	22.6	70	21.0
Child lives on farm?						
Yes	126	72.0	134	84.3	260	77.8
No	32	18.3	23	14.5	55	16.5
Unknown	17	9.7	2	1.3	19	5.7
Relationship to owner						
Child of owner	121	69.1	133	83.6	254	76.0
Other relative of owner	15	8.6	10	6.3	25	7.5
Child/relative of hired employee	4	2.3	1	0.6	5	1.5
Visitors to farm	10	5.7	7	4.4	17	5.1
Other/unknown	25	14.3	8	5.0	33	9.9
Child engaged in farm work						
Yes	53	30.3	47	29.6	100	29.9
No	121	69.1	107	67.3	228	68.3
Unknown	1	0.6	5	3.1	6	1.8
Adult supervisor available						
Yes	128	73.1	103	64.8	231	69.2
No	47	26.9	56	35.2	103	30.8
Injury mechanism						
Mechanized	119	68.0	78	49.1	197	59.0
Non-mechanized	56	32.0	81	50.9	137	41.0

Table 2
Description of patterns of child supervision observed for farm injury events based on four standard criteria for adequate child supervision

	Cases	Description of adult supervision (% of cases)							
		Attention[a]		Proximal[b]		Continuous[c]		Adequate[d]	
	N	*N*	%	*N*	%	*N*	%	*N*	%
All cases	334	231	69.2	169	50.6	123	36.8	112	33.5
Injury outcome									
Fatal injury	175	128	73.1	93	53.1	49	28.0	44	25.1
Hospitalized injury	159	103	64.8	76	47.8	74	46.5	68	42.8
Age in years									
≤6	172	138	80.2	104	60.5	65	37.8	62	36.0
7–12	86	56	65.1	38	44.2	33	38.4	27	31.4
13–17	76	37	48.7	27	35.5	25	32.9	23	30.3
Gender									
Male	264	179	67.8	132	50.0	95	36.0	87	33.0
Female	70	52	74.3	37	52.9	28	40.0	25	35.7
Child activity									
Engaged in farm work	100	61	61.0	42	42.0	38	38.0	33	33.0
Not engaged in farm work	228	165	72.4	123	53.9	82	36.0	76	33.3
Unknown	6	5	83.3	4	66.7	3	50.0	3	50.0
Farm location (top three)									
Farm yard	88	59	67.0	43	48.9	24	27.3	23	26.1
Barn (inside)	62	39	62.9	17	27.4	15	24.2	12	19.4
Crop field, orchard	55	46	83.6	42	76.4	31	56.4	30	54.5

[a] Adult supervisor was available.
[b] Supervisor within arm's reach or near to the child.
[c] No evidence of a break in continuity of supervision.
[d] Criteria [a,b,c] met.

3.3. Proximity

Roughly one-half of the time (169/334, 51%), the adult supervisor was proximal to the child at the time of injury (Table 2), and this percentage was higher for children 6 years or younger (104/172, 60%, $p < 0.001$). By farm location, the supervisor was proximal to the child most often for injury events that occurred in the crop field (42/55, 76%, $p < 0.001$). Approximately one-half of these crop field injuries involved children as extra riders on farm tractors (data not shown). The supervisor was less often proximal to the child if the injury occurred in the barn (17/62, 27%, $p < 0.001$).

3.4. Continuity

Despite our conservative interpretation of *continuity*, continuous adult supervision was present in only 37% (123/334) of the full case series (Table 2). This finding was consistent regardless of the child's age, gender, activity, or location on the farm, with the exception of the crop field, where supervision was continuous in 56% (31/55, $p < 0.001$) of the cases. Similar to the findings for *proximity*, approximately half of these crop field injuries involved children who were extra riders on tractors (data not shown). Distribution by injury outcome suggests that there was a tendency for more breaks in the continuity of supervision in fatality cases.

3.5. Adequacy of adult supervision

For the full case series, one-third of the children had what would typically be defined as *adequate* adult supervision at the time of their injury event (supervision available, proximal, and continuous) and this was consistent across age, gender, and child activity (Table 2). However, supervision was less likely to be *adequate* for fatal injury cases compared to hospitalized injury cases. By farm location, only 19% (12/62) of children injured in the barn had *adequate* supervision, while 55% (30/55, $p < 0.001$) of children injured in the crop field had *adequate* supervision, again reflecting the preponderance of extra rider injuries.

3.6. Possible compromises to adequate adult supervision

Table 3 further describes the supervision circumstances among the 231 cases where an adult supervisor was available. In the overwhelming majority of cases (193/231, 84%), the adult supervisor was simultaneously engaged in farm work while supervising the injured child (48% of the cases with *adequate* supervision, data not shown) and working supervisors were common across injury outcome, age, gender, child activity, and location on the farm. In 26% (59/231) of cases, the adult supervisor was simultaneously supervising multiple children, and this appears to be an important factor in the occurrence of fatal injuries. Interestingly, in 16% (37/231) of cases, there

Table 3
Description of possible compromises to the quality of child supervision among 231 cases where adult supervisor was available

	Cases	Supervisor engaged in farm work		Supervising multiple children		Multiple supervisors	
	N	*N*	%	*N*	%	*N*	%
All cases	231	193	83.5	59	25.5	37	16.0
Injury outcome							
Fatal injury	128	113	88.3	50	39.1	24	18.8
Hospitalized injury	103	80	77.7	9	8.7	13	12.6
Age in years							
≤6	138	118	85.5	38	27.5	25	18.1
7–12	56	44	78.6	17	30.4	6	10.7
13–17	37	31	83.8	4	10.8	6	16.2
Gender							
Male	179	154	86.0	48	26.8	26	14.5
Female	52	39	75.0	11	21.2	11	21.2
Child activity							
Engaged in farm work	61	57	93.4	8	13.1	7	11.5
Not engaged in farm work	165	132	80.0	49	29.7	28	17.0
Unknown	5	4	80.0	2	40.0	2	40.0
Farm location (top three)							
Farm yard	59	50	84.7	25	42.4	11	18.6
Barn (inside)	39	23	59.0	7	17.9	6	15.4
Crop field, orchard	46	45	97.8	12	26.1	9	19.6

were multiple adult supervisors available at the time of injury to the child. However, this often reflected their working together on chores and clearly did not result in greater supervision and protection of the child.

4. Discussion

Drawing on recent research in the general pediatric injury literature, this study examined three aspects of supervision (attention, proximity, continuity) in order to assess the nature of adult supervision at the time of pediatric farm injury occurrence and determine if emerging conceptualizations of *adequate* adult supervision apply to the farm context (Morrongiello, 2005). Our findings showed that among cases of injured children, the quality of adult supervision was frequently compromised. Yet, even in the presence of what would typically be defined as *adequate* adult supervision (supervision available, proximal, and continuous), children exposed to the agricultural worksite were still seriously injured or killed.

4.1. Attention (availability of an adult supervisor)

Although we did not code actual *attention* to the child per se, availability of an adult supervisor provides for the opportunity of attention to the child. In two previous studies of pediatric farm injuries, investigators also coded whether or not a supervisor was present at the time of injury. Their results revealed that children were often in the vicinity of potential supervisors when injured (Pryor et al., 2002; Sebille et al., 1997). Thus, it was poor quality of supervision and not the absence of a supervisor that posed risk for injury. Our findings replicate and extend these results. We found that 69% of the injured children were in the presence of a potential adult supervisor at the time of injury. Moreover, having more than one adult supervisor available did not necessarily protect children from injury. Across the age groups, approximately 10–20% of injuries occurred when there were multiple potential supervisors present. Further, in the vast majority of injury cases, the potential supervisor was engaged in farm work at the time the child was injured. In fact, Pryor et al. (2002) found that children were significantly more likely to experience an injury when supervised by a caregiver engaged in farm work than when supervised by a caregiver at home. This pattern of findings suggests that adult supervisors cannot simultaneously be involved in farm work and provide the level of *attention* that is needed to protect children in a hazardous work environment. These findings are consistent with those obtained in studies relating caregiver supervision to children's home injuries and risk taking during play (Morrongiello and House, 2004; Morrongiello et al., 2004, 2006). Hence, across a broad range of contexts, evidence indicates that decreases in caregiver *attention* elevate young children's risk of injury.

4.2. Proximity

The most striking finding surrounding the *proximity* dimension of supervision was the paradoxical nature of this dimension. In approximately 50% of the injury cases, the adult supervisor was too far away from the child to intervene to prevent the injury, and this supports the importance of *proximity* as a key dimension in defining *adequate* supervision. However, in the other 50% of the injury cases (Table 2, all cases), the adult supervisors' *proximity* to the child may have contributed to the injury event via exposure to hazardous situations, such as the child being an extra rider on a tractor. The fact that

supervisors were engaged in farm work could explain why, despite the supervisor's *proximity* to the child, the supervisor was unable to intervene to protect the child from injury. Thus, while research shows that *proximity* to an adult supervisor is protective in non-farm contexts (Morrongiello and House, 2004; Morrongiello et al., 2004, 2006), our findings suggest that this may not be true in the agricultural worksite, particularly if the supervisor is engaged in farming activities.

4.3. Continuity

Our measure of *continuity* was admittedly atypical in that we assumed *continuity* and coded for discontinuity only when there was clear evidence for this based on the narrative in the case record. Nonetheless, in nearly two-thirds of the cases there was an obvious break in the *continuity* of adult supervision before the child was injured. This finding highlights the difficulty of providing continuous supervision in the agricultural worksite and the negative consequences that result from failing to do so. Research relating caregiver supervision to young children's home injuries also confirms that discontinuities in supervision are associated with more frequent injuries (Morrongiello et al., 2004, 2006). Thus, regardless of context, children are at elevated risk of injury when caregivers are not providing continuous supervision.

4.4. Adequacy of adult supervision

The present analysis clearly demonstrates that the quality of supervision was inadequate in a substantial number of pediatric farm injury cases. Compromises to *adequate* supervision included a range of circumstances from the absence of an adult supervisor to distractions that resulted in breaks in *continuity* of supervision.

Perhaps even more revealing was the number of pediatric farm injuries and fatalities that occurred in the presence of what would typically be defined as *adequate* adult supervision (supervision available, proximal, and continuous) based on prior research examining children's home injuries. Thus, in order to completely protect children from injury in the agricultural worksite, we may need different standards for defining *adequate* supervision *or* we may need to restrict children's access to this hazardous work environment (Brison et al., 2006; Morrongiello et al., 2007; Pickett et al., 2003). Further research is needed to identify typical patterns of adult supervision on farms and how these patterns impact injury risks. However, there is considerable evidence herein to suggest that restricting children's access to work environments on farms may be essential to prevent serious injury.

5. Strengths and limitations

To our knowledge, this study is the first to explore the nature of adult supervision in the agricultural worksite and it fills a critical gap in the literature. Further, we used a theoretical model of supervision that has shown utility in the general pediatric injury literature. Nonetheless, several potential limitations should be considered in interpreting the findings and planning for future research on this topic.

First, we evaluated adult supervision in cases of injury, not supervision on farms in general, so we are in fact looking at cases where adult supervision failed. Thus, our findings cannot speak to the more general issue of whether and under what conditions supervision impacts to serve as a protective function regarding children's risk of injury on farms. We need studies to establish baseline levels of supervision (e.g., what patterns of supervision are *routinely* provided by adults on farms) so that one can then differentiate those patterns that are associated with increased risk for child injury from those that are not.

Second, our data were based upon records collected for other purposes and the lack of detail surrounding the description of adult supervision at the time of the pediatric injury event constrained our ability to apply more rigorous indices of supervisory behaviors. We wanted to be conservative in our approach so there would be no tendency to deem supervision inadequate as a result of the limitations inherent in our data. Thus, our approach was to only code "violations" to the dimensions of supervision when they appeared explicitly in the narrative, giving the "benefit of the doubt" in our coding of both *attention* and *continuity*. This undoubtedly led to some bias in our results, and the conservative natures of any biases are recognized as a limitation. Thus, we can only discuss availability of a potential adult supervisor but do not know whether or not the supervisor was actually attending to the child. Similarly, based on the fact that discontinuity or breaks in adult supervision before the child was injured were noted in the case information, we assumed that failure to note this in the record indicated *continuity* of adult supervision at the time the child was injured. Furthermore, the magnitude of the observed differences in supervision by factors such as age or gender may have been influenced by differences in data sources, since the available detail varied somewhat by data source.

Third, our findings are heavily based upon Canadian pediatric injury records because these data were not available in the United States. Thus, inferences from our results to supervision patterns in the United States are less direct than would be possible if more data from the United States were available. However, leading causes of traumatic injury in this case series are very similar across countries. In addition, although regional differences exist, the leading types of crops and livestock produced on farms are also similar (NASS, 2002; Statistics Canada, 2001). Thus, our findings are likely generalizable to the United States pediatric farm population.

Finally, the research to date that has provided a foundation for developing a definition of *adequate* adult supervision (attention, proximity, continuity) has focused exclusively on children under 6 years of age (Morrongiello and House, 2004; Morrongiello et al., 2004, 2006). Thus, our application of this definition of *adequate* adult supervision to children 6 years and older has been previously untested. Moreover, the current findings suggest that it is also essential that one consider the context in which this supervision is provided to evaluate whether supervisory patterns serve a risk or protective function for childhood injury. Clearly, the present results suggest that what constitutes *adequate* supervision in a non-farm context (Morrongiello et al., 2004) does

not necessarily serve the same function in an agricultural context.

6. Conclusion

Inadequate adult supervision was common among our case series of pediatric farm injuries. Nonetheless, even in the presence of what traditionally would be defined as *adequate* adult supervision according to accepted theoretical criteria (attention, proximity, continuity), children exposed to the agricultural worksite still were seriously injured or killed. Consistent with prior research on children's injuries in non-farm contexts, we found that discontinuities in supervision and inattentiveness were associated with injuries to children on farms. However, in contrast to research in non-farm contexts, the present study results reveal that *proximity* to a parent who was involved in farm work was associated with increased, rather than decreased risk of injury. These findings along with a growing body of literature examining pediatric farm injuries suggest that in order to prevent serious injuries in this setting we may need to develop new standards for defining *adequate* adult supervision in the agricultural worksite, or we may need to consider restricting the access of children, especially the very young, to this hazardous worksite.

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