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A new approach to understanding pediatric farm injuries

Barbara A. Morrongiello[a,*], Barbara Marlenga[b], Richard Berg[c], James Linneman[c], William Pickett[d]

[a]*Psychology Department, University of Guelph, Guelph, Ont., Canada*
[b]*National Children's Center for Rural and Agricultural Health and Safety, Marshfield Clinic Research Foundation, Marshfield, WI, USA*
[c]*Department of Biostatistics and Bioinformatics, Marshfield Clinic Research Foundation, Marshfield, WI, USA*
[d]*Department of Emergency Medicine and Department of Community Health and Epidemiology, Queen's University, Kingston, Ont., Canada*

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Abstract

The objective of this study was to apply a new conceptual approach to the study of pediatric farm injuries. A large case series of pediatric farm injuries in North America was evaluated to assess *interactions* between risk factors for injury. Information about pediatric farm injuries to children in three age groups (<6 years, 6–12 years, 13+ years) was coded with respect to *children's behavior* (did unexpected child behavior contribute to injury?), *predictability of injury risk* (based on what the child had been doing, was the nature or occurrence of injury unexpected?), *environmental events* (did unexpected environmental events contribute to injury?), and *level of environmental risk* (low, high). The reliability of coding between independent raters was excellent ($\kappa = .83$) for the 330 cases providing complete data. Results revealed that, in high-risk environments, unexpected child behavior was coded more frequently when children under 6 years were injured than for older children, whereas in low-risk environments unexpected child behavior had less impact on injury risk and showed no such age variation. With increasing age, the predictability of injury increased in a high-risk context, suggesting that youth engage in increasingly hazardous activities as they develop. Consistent with this interpretation, unexpected environmental events increasingly contributed to injury in a high-risk context in the oldest age groups. The observed variations in risk factors suggest that interactions between behavioral and environmental factors are important to consider in studies of the etiology of pediatric farm injuries.

Keywords: Canada; US; Children; Farm injuries; Risk factors; Interactions

Introduction

The farm environment is a unique context for children because it is a work site that is also their home and place for play and recreation. Moreover, at the same time that children's exposure to environmental risks and hazards are high in this context, their caregivers' attention is often reduced as they try to balance attention to work with child supervision. Risk exposure for children is further elevated by virtue of their participation in chores, which begins as early as 5 years of age and often involves proximity to animals and machinery (Fisher, Hupcey, & Rhodes, 2001). Not surprisingly, therefore, injuries to children on farms are commonplace and tragic, with many resulting in death or permanent disability (Reed & Claunch,

*Corresponding author.
E-mail address: bmorrong@uoguelph.ca (B.A. Morrongiello).

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2000; Rivara, 1997). International statistics reveal that this safety issue is not limited to a single country but represents a global problem that affects children in many nations (Byard, Gilbert, Lipsett, & James, 1998; Cameron, Bishop, & Sibert, 1992; Marlenga et al., 2004). Prevention of such injuries has long been recognized as a major challenge for injury control (Pickett, Brison, & Hoey, 1995; Rivara, 1997). One factor that may be limiting our ability to make significant advances in injury control in this area is the conceptual approach to research that has prevailed.

To date, most research on pediatric farm injuries has involved descriptive studies that aim to elucidate the nature and scope of these injuries, and describe the circumstances surrounding the injury event (Reed & Claunch, 2000). Such research has revealed a variety of risk factors and has demonstrated that risk varies with developmental level. For example, although injuries to children on farms occur at all ages, there are two peak *risk* developmental periods evident in the literature. One peak occurs during the pre-school years (2–5 years) and the other during the teen years (12–16 years; DeMuri & Purschwitz, 2000; Pickett et al., 1995). Injuries to young children are most likely when the demands for work are elevated (i.e., harvest times) and parents are likely to be distracted from supervising by farm tasks. Behavioral attributes of young children (e.g., activity level, impulsivity, poor inhibitory control) that increase the likelihood they will interact with proximal injury hazards (e.g., animals, equipment) also can increase their risk for injury (Morrongiello, Corbett, McCourt, & Johnston, 2005a, 2005b; Morrongiello, Ondejko, & Littlejohn, 2004a; Schwebel, Speltz, Jones, & Bardina, 2002). Injuries to adolescents on farms often occur during work rather than recreation activities, with the majority of these related to operating machinery (Pickett et al., 1995; Zietlow & Swanson, 1999).

Descriptive studies have proven useful to advance our understanding of developmental variation in pediatric injury risk on farms. However, identification of individual factors that affect injury (e.g., *activities* such as using equipment; *locations* such as young children near water sources or animals) may not provide sufficient understanding of risk processes to support the development of effective prevention strategies. For example, the unpredictable behavior of a 2-year old (e.g., spontaneously jumping on one foot) might pose less of a threat for injury to the child in a low-risk (hazard free) environment than the same behavior exhibited in a high-risk (hazard-rich) environment (e.g., standing near moving equipment that they might fall against or into). Thus, child behavior likely interacts with environmental factors to affect risk for injury. On farms, where hazards are plentiful, this may be especially true. Surprisingly, however, study of *interactions* between risk factors and the occurrence of injury is notably lacking in the literature on pediatric farm injuries.

Research on childhood injury in non-farm contexts has begun to examine these more complex *interaction models* of injury risk (Schwebel & Barton, 2005), as well as how factors interact in the prevention of injury (Morrongiello, 2005). For example, in a prospective study of mothers' home-safety practices, Morrongiello and her colleagues found that mothers evaluate both child attributes (e.g., age personality) and the child's location (e.g., bathroom versus playroom) in deciding how best to manage risks for injury (Morrongiello et al., 2004a, 2004b). In contexts the parent rates as low in risk (i.e., few potential hazards), parents teach safety rules that children are expected to follow in order to ensure the child's safety. In contrast, in high-risk contexts with many hazards, parents supervise more closely or implement environmental changes to decrease children's access to hazards. Thus, parents consider *child* × *situational* interactions in planning for injury prevention. Similarly, children's risk for injury can arise from interactions among child attributes and situational factors. For example, children with difficult temperaments (i.e., impulsive, aggressive, undercontrolled) who are typically at increased risk for injury (Bijur, Golding, Haslum, & Kurzon, 1988; Matheny, 1986; Schwebel & Plumert, 1999) show uncharacteristic cautiousness in certain social environments (Schwebel & Bounds, 2003; Schwebel, Brezausek, Ramey, & Ramey, 2004). Thus, research on children's risk for injury has begun to consider the importance of assessing interactions between risk factors, moving from focusing on single risk factors to assessing the dynamic interplay of multiple risk factors.

The aim of the present study was to explore the application of this conceptual approach for the purpose of better understanding children's risk of injuries in farm contexts. Using an existing registry of traumatic injury events, this exploratory study was conducted to assess the hypothesis that child and environmental factors would interact to affect injury risk, and vary with developmental level.

Method

Study design

A primary review was conducted of two retrospective case series of pediatric agricultural injuries that had been previously assembled for studies of the efficacy of work guidelines (North American Guidelines for Children's Agricultural Tasks, NAGCAT; Marlenga et al., 2004) and child labor laws for injury prevention (Marlenga, Berg, Linneman, Brison, & Pickett, 2007). The case series represented fatal and hospitalized injuries from Canada, as well as fatal work-related injuries from the United States. The ethics committees of Marshfield Clinic Research Foundation and Queen's University each approved the original study protocol.

Definitions

For the purpose of this study, pediatric farm injuries were defined as any injuries to children (younger than 18 years) that (1) occurred during activities related to agricultural production and/or (2) involved any operational hazard or activity associated with the agricultural worksite; play activities resulting in injury because of interaction with proximal agricultural hazards also were included.

Data sources

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 and death certificates were reviewed on-site at each provincial coroner's or medical examiner's office. The Canadian fatality case series was supplemented with 15 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 (US Department of Health and Human Services, 2003).

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 admitted to hospital for the years 1989–2002. The hospitals identified cases using both inpatient and Emergency Department-based registries. Medical records were reviewed on-site after ethics review at each institution.

Data coding and reliability

There were 374 injury cases available for coding. Following elimination of cases for which there was insufficient information to code each of the four characteristics outlined below ($N = 44$) there were 330 cases with complete data.

Based on a review of all available narrative information, each injury case was coded according to four dimensions (see details below; the coding scheme is available from the first author): (1) unexpected child behaviors, (2) predictability of injury risk based on the child's ongoing activity, (3) unexpected environmental events, and (4) level of environmental risk based on child's location. Two independent coders classified each case and reliability across the four categories was excellent ($M = 90\%$ agreement, $\kappa = .83$), with disagreement resolved by a third independent scorer or by discussion.

Unexpected child behaviors

Based on narrative descriptions of what was occurring before the injury, the behavior of the child that led to injury was evaluated relative to what the child was doing before this. Child behavior was coded into one of two categories: (1) *Same or Related* behavior: what the child had been doing remained unchanged when the injury occurred (e.g., they had been standing on the tractor and fell off the tractor from this standing position; they had been working on the fence and suddenly fell on the fence; they had been jumping on the haystack and were still doing so at the time they fell off and got injured) or was related and logically followed from what they had been doing (e.g., child was playing with a ball and then chased this ball behind a moving tractor), or (2) *Different* if the child was doing one activity (e.g., collecting rocks in the field) and then unexpectedly changed to do something different that immediately led to injury (e.g., tried to climb on the back of the tractor going by).

Predictability of injury risk

The aim here was to determine if coders could reliably distinguish activities that posed some inherently elevated risk for injury from other activities that did not do so. Toward this aim, coders considered what the child had been doing beforehand and judged whether or not the occurrence or nature of the injury that resulted might have been expected considering what the child had been doing. Specifically, for each case, coders reviewed what the child was doing before they did whatever led to the injury and assigned each injury to one of the two categories: (1) would not have expected this injury to occur based on what the child had been doing (e.g., child was playing on the lawn and a car-related explosion occurred on the road sending a projectile that hurt the child) or (2) might have expected this injury to occur given what the child was doing (e.g., swinging from a rope in the barn and child fell; riding on the fender of a car and fell off). Based on prior identification of factors associated with acute farm injury events (Pickett et al., 1995; Rivara, 1997), if the child was on equipment, machinery, or near animals the case was coded as 'predictable' injury risk (i.e., category 2 above).

Unexpected environmental events

Based on descriptions of the circumstance of injury each event was coded according to whether or not there was mention of some unexpected environmental event that directly contributed to the occurrence of the injury (e.g., barn collapsed, animal kicked, tractor wheel hit a hole that was covered by grass and tipped over). Unexpected events were coded as such only if the person reporting on the injury specifically mentioned this as a contributor to the injury event when asked to explain how the injury occurred.

Level of environmental risk

Based on the child's location, environmental risk was coded as either: (1) low, i.e., no obvious hazards were mentioned; e.g., playing in the front yard, walking to the house on the lawn or (2) high, i.e., obvious hazards were mentioned, including: being on or near machinery, equipment, or animals, or playing/working at a height, such as in the loft or on the roof. For children under 13 years of age, being near a large water source, e.g., skating on a semi-frozen pond or playing near a lagoon was also coded as high risk due to the potential for drowning. In coding for level of risk, unless the specific environmental hazards indicated above were mentioned, a low-risk environment was assumed.

Data analysis

Descriptive statistics were used to characterize the number and percentage of injuries occurring in each age group under low and high levels of environmental risk as a function of child behavior (same/related, different), whether the injury was unexpected based on the child's prior activity (yes, no), and the occurrence of unexpected environmental events that contributed to injury occurrence (yes, no). Based on inspection of the data and because of our interest in interactions among these risk factors, select sub-sets (cells) of data were analyzed, rather than analyzing all possible sub-sets (cells) of data. Chi-square analyses were used when comparing proportions. Log-linear analysis was used to test higher-order models of interactions between variables. We note that some of the analyses reported involve expected frequencies less than 5, however, Howell (2002) notes that there is no need for concern as long as all cells have expected frequencies greater than 1 and no more than 20% of cells have expected frequencies less than 5, which was true in our case. Also, low expected frequencies invariably contribute more to lowered power than to spurious significant effects (Howell, 2002). Hence, low expected frequencies would have limited our capacity to find effects, leading to a conservative evaluation of interaction effects. Effects were deemed statistically significant at the 5% level ($p < .05$). It should be noted that gender was not considered in our analyses because there were too few females to assess for sex differences. Thus, findings based on the entire sample of males and females are reported herein ($N = 330$), although the same pattern of significant effects was obtained when females were excluded and the data from only males were considered ($n = 267$).

Results

Child behavior × level of environmental risk

Table 1 shows the percentage of injuries in each age group for which the action of the child that immediately led to injury was the *same/related* versus *different* relative to what s/he had been doing

Table 1
Number (%) of injuries to children at a given age (in years) for which the action of the child that immediately led to injury was the same or related (S/R) versus completely different (D) compared to what s/he was doing previously, as a function of level of environmental risk (low and high)

Age	N	% Male	Level of environmental risk			
			Low		High	
			S/R	D	S/R	D
<6	139	78	6 (4)	10 (7)	93 (67)	30 (22)
6–12	111	82	3 (3)	2 (2)	96 (86)	10 (9)
13+	80	84	3 (4)	0 (0)	73 (91)	4 (5)

beforehand. These data are shown as a function of level of environmental risk (low, high).

Children in all three age groups experienced more injuries in the high-risk than low-risk context. However, interactive effects involving child behavior, level of environmental risk, and child age were also indicated by the data. For example, the importance of child behavior varied with age, with 29% (40/139) of those under 6 years doing something unexpected as compared with 11% (12/111) of children 6–11 and 5% (4/80) of children 13 years and older ($\chi^2 = 25.90$, df = 2, $p < .001$). In a high-risk context only 14% (44/306) of injuries occurred when the child did something unexpected, as compared with 50% (12/24) of injuries in a low-risk context ($\chi^2 = 16.64$, df = 1, $p < .001$). For the youngest children, 22% of injuries occurred in a high-risk context when the child did something unexpected that resulted in him/her interacting with a nearby injury hazard, whereas only 7% of injuries were related to unexpected child behavior in a low-risk context ($\chi^2 = 10.00$, df = 1, $p < .01$). Differences between the number of injuries related to unexpected child behavior in low- versus high-risk contexts were not significant for the two older age groups ($p > .05$). Thus, level of environmental risk interacted with child behavior to differentially impact on injury and this was most notable for the youngest age group.

There also was evidence of an interaction between age and child behavior in high-risk contexts. With increasing age, there was a steady decline in the percentage of injuries that resulted from the child doing something unexpected (22%, 9%, 5% for ages <6, 6–12, 13+, respectively) in the high-risk context ($\chi^2 = 25.27$, df = 2, $p < .01$). Thus, particularly for young children who are likely to behave in unexpected ways due to their developmental level, being in a hazard-rich environment is likely to increase risk for injury.

In sum, the pattern of findings provides support for the notion that child behavior interacts with level of environmental risk to differentially influence children's risk for injury on farms, and these effects vary with children's developmental level.

Predictability of injury risk × level of environmental risk

Table 2 shows the percentage of injuries in each age group that was coded as predictable or not, based on the nature of the child's activity. Again, these data are shown as a function of level of environmental risk.

These data also indicate that predictability of injury based on the child's activity interacts with level of environmental risk to differentially influence injury risk and this varies with developmental level. In high-risk contexts, as the age of children increased, more of the injuries were judged to be predictable based on the nature of the child's activity: for children under 6 years of age there were 59% of such injuries compared with 80% of such injuries in the 6–12 year group and 91% of such injuries in the 13+ group ($\chi^2 = 25.00$, df = 2, $p < .001$). This finding probably reflects age-related increases in children's participation in chores and farm work. Nonetheless, even in the youngest age group, 59% of injuries were judged as expected based on the child's activities, many of which were play activities that clearly posed risk of serious injury in this high-risk context (e.g., swinging from ropes at heights in a barn; jumping from haystack to haystack; touching farm animals). This supports the notion that child activity interacts with level of

Table 2
Number (%) of injuries to children at a given age (in years) that were judged to be predictable (yes) or not predictable (no) based on what the child had been doing before the injury, as a function of level of environmental risk (low and high)

Age	N	% Male	Level of environmental risk			
			Low		High	
			Yes	No	Yes	No
<6	139	78	1 (1)	15 (11)	82 (59)	41 (29)
6–12	111	82	0 (0)	5 (5)	89 (80)	17 (15)
13+	80	84	2 (3)	1 (1)	73 (91)	4 (5)

Table 3
Number (%) of injuries to children at a given age (in years) for which there was an unpredictable (yes) environmental event, as a function of level of environmental risk

Age	*N*	% Male	Level of environmental risk			
			Low		High	
			Yes	No	Yes	No
<6	139	78	2 (1)	14 (10)	40 (29)	83 (60)
6–12	111	82	1 (1)	4 (4)	37 (33)	69 (62)
13+	80	84	2 (3)	1 (1)	36 (45)	41 (51)

environmental risk to differentially influence children's risks for injury, and these effects vary with developmental level.

Unexpected environmental events × level of environmental risk

Table 3 shows the percentage of injuries to children in each age group for which an unexpected environmental event contributed to the injury event. These data are shown both for low and high conditions of environmental risk.

Being in the vicinity of hazards (i.e., animals, machinery, equipment, heights) was associated with more injuries due to unexpected environmental events than was true for a low-risk environment (113/306 or 37% and 5/24 or 21%, respectively). However, relations between unexpected environmental events and injury vary between age groups in high-risk contexts (see Table 3), $\chi^2 = 14.30$, df = 2, $p < .01$. For the two youngest age groups, unexpected environmental events were reported for about 30% of injuries. In contrast, for the oldest age group, 45% of injuries in high-risk contexts were associated with unexpected environmental events. Thus, at all age groups the unpredictability of environmental events when in the vicinity of hazards (high-risk context) contributes to injury risk, however, this pattern becomes more evident with increasing age.

Discussion

Prior research has provided a wealth of information about single risk factors that can affect children's risk for injury on farms, including developmental level, child behavioral attributes, and scope of caregiver supervision (DeMuri & Purschwitz, 2000; Morrongiello et al., 2005b, 2004b; Pickett et al., 1995; Schwebel et al., 2002; Zietlow & Swanson, 1999). The conceptualization of risk that we advocate for, however, focuses attention on questions of how risk factors *interact*, and what the implications of these interactions are for injury control. Study findings confirm that children at all ages are at increased risk for injury on farms when the level of environmental risk is high (e.g., near equipment, animals, working or playing at heights, etc.). However, the results also indicate that interactions among risk factors help to explain *how* this occurs, and the process *varies* depending on the developmental level.

For children under 6 years of age, the unpredictability of their behavior fosters interactions with hazards, particularly in high-risk settings. Closer supervision is not likely to be sufficient to prevent such natural tendencies of young children to spontaneously change their behavior without warning. In fact, proximity to a supervising adult actually has been suggested to contribute to child-injury events on farms when the supervisor is engaged in a hazardous activity (Morrongiello et al., under review). Similarly, retrospective reviews of child-pedestrian injury reports reveal that supervisor presence did not guarantee protection (i.e., 36% of these injuries occurred when a supervisor was present and the child presumably did something unexpected that resulted in being hit by a vehicle; Wills et al., 1997). Thus, because of the nature of how young children typically behave, the best strategy to moderate their risk for injury on farms is to keep them out of high-hazard environments altogether. Supervision is not likely to reduce risk for injury in high-risk farm contexts for these young children.

For children 6 years and older, the nature of the tasks and chores is changing and exposure to high hazard situations seems to increase across this age range due to these changes in tasks and activities (Marlenga, Pickett, & Berg, 2001). Thus, injury risk for older children arises more from the nature of the task per se (e.g., increased exposure to moving equipment) than unexpected aspects of the child's behavior. This explains why unexpected *environmental* events contribute to injury in older children (see Table 3). Moreover, this finding also explains why increased training in doing farm chores is not likely to address this injury-risk issue for older children. Simply put, no amount of training can prevent unexpected environmental events from happening and causing injury. Thus, just as for

younger children, reducing injury risk at these older ages necessitates reducing exposure to high-hazard situations. However, in this case the issue is not so much removing the child from the situation per se but changing the nature of the activities of older children on farms. Hence, across this broad developmental age range the concern must be with reducing risk exposure, however, the means by which one does so needs to vary with developmental level. For younger children this means keeping them out of the actual situation, whereas for older children this necessitates eliminating their participation in chores and activities that increase risk exposure.

Limitations and future research

The present study illustrates how a focus on interactions among risk factors can broaden our understanding of injury events in ways that are important for intervention planning. Moreover, not only did interactions between risk factors emerge, but also the patterns of these interactions often varied with developmental level of the child. Despite these advancements in our knowledge, however, there are a few limitations that merit consideration. First, this sample included only children who had experienced an injury. Thus, we do not know to what extent the identified risk factors routinely occur but do not result in injury to children on farms. A better understanding of such risk-exposure issues is necessary and merits attention in future research. Second, in the real world there is a continuum of risk, and our coding of risk as dichotomous does not capture this continuum. In future research, it would be useful to evaluate the merits of conceptualizing and coding risk as a continuous variable. Third, because of the low frequency of injuries to females, we were unable to examine interactions involving gender. This is an important issue, however, that merits attention in future research. Fourth, only 24 injuries occurred in low-risk environments, which limits our ability to make inferences specific to low-risk environments. Although the overall sample size of 330 injuries provided statistical power adequate to detect significant interactions with the level of environmental risk, in future work it may prove useful to refine the delineation of risk and perhaps further partition the environment based on several levels of risk. Finally, because these case studies were gathered for different purposes, there was limited information about some aspects of the injury context that might have been useful to know about in conceptualizing about risk. For example, more detailed information about whether peers or siblings were present at the time of injury might have helped in determining if social context impacts on risk, and if this varies with developmental status of the child. Thus, a number of important issues remain to be addressed in future research.

Conclusions

Most studies of injuries to children on farms have been descriptive in nature, with the aim being to elucidate the nature and scope of these injuries or identify risk factors. Results from this study, however, suggest that a greater understanding of risk processes can be obtained by considering how factors interact to effect injury and by assessing risk within a developmental context. Children at all ages may be at elevated risk for injury on farms, particularly in high-risk situations. However, the best solution to reduce this risk seems to vary with developmental stage due to age-related differences in interactions among risk factors. For children under 6 years of age, keeping them out of hazard-rich contexts is essential. In contrast, at increasingly older ages, risk arises more from the nature of their tasks and activities, which makes them more vulnerable to unpredictable environmental events leading to injury. Although one may argue that increased supervision and/or training in farm chores will be sufficient to address these risk issues, respectively, these preliminary findings suggest otherwise.

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Coroner, Province of Quebec; and Dr. Barry McLellan, Chief Coroner of Forensic Services, and June Lindsell, Office of the Chief Coroner of Ontario.

References

Bijur, P., Golding, J., Haslum, M., & Kurzon, M. (1988). Behavioral predictors of injury in school-age children. *American Journal of Diseases of Children*, *142*, 1307–1312.

Byard, R., Gilbert, J., Lipsett, J., & James, R. (1998). Farm and tractor related fatalities in children in South Australia. *Journal of Pediatric Children's Health*, *34*, 139–141.

Cameron, D., Bishop, C., & Sibert, J. (1992). Farm accidents in children. *British Medical Journal*, *305*, 23–25.

DeMuri, G. P., & Purschwitz, M. A. (2000). Farm injuries in children: A review. *Wisconsin Medical Journal*, *99*, 51–55.

Fisher, K., Hupcey, J., & Rhodes, D. (2001). Childhood farm injuries in old-order Amish families. *Journal of Pediatric Nursing*, *16*, 97–101.

Howell, D. C. (2002). *Statistical methods for psychology* (6th ed.). Pacific Grove, CA: Duxbury.

Marlenga, B., Berg, R. L., Linneman, J., Brison, R., & Pickett, W. (2007). Changing the child labor laws for agriculture: Impact on injury. *American Journal of Public Health*, *92*, 276–282.

Marlenga, B., Brison, R. J., Berg, R., Linneman, J., Zentner, J., & Pickett, W. (2004). Evaluation of the North American guidelines for children's agricultural tasks using a case series of injuries. *Injury Prevention*, *10*, 350–357.

Marlenga, B., Pickett, W., & Berg, R. L. (2001). Agricultural work activities reported for children and youth on 498 North American farms. *Journal of Agricultural Safety and Health*, *7*, 241–252.

Matheny, A. P., Jr. (1986). Injuries among toddlers: Contributions from child, mother, and family. *Journal of Pediatric Psychology*, *11*, 163–176.

Morrongiello, B. A. (2005). The role of supervision in child-injury risk: Assumptions, issues, findings, and future directions. *Journal of Pediatric Psychology*, *30*, 536–552.

Morrongiello, B. A., Corbett, M., McCourt, M., & Johnston, N. (2005a). Understanding unintentional injury-risk in young children: I. The nature and scope of caregiver supervision of children at home. *Journal of Pediatric Psychology*, *31*, 529–539.

Morrongiello, B. A., Corbett, M., McCourt, M., & Johnston, N. (2005b). Unintentional injuries in young children: II. The contribution of caregiver supervision, child attributes, and parent attributes. *Journal of Pediatric Psychology*, *31*, 540–551.

Morrongiello, B. A., Ondejko, L., & Littlejohn, A. (2004a). Understanding toddlers' in-home injuries: I. Context, correlates, and determinants. *Journal of Pediatric Psychology*, *29*, 415–431.

Morrongiello, B. A., Ondejko, L., & Littlejohn, A. (2004b). Understanding toddlers' in-home injuries: II. Examining parental strategies, and their efficacy, for managing child injury risk. *Journal of Pediatric Psychology*, *29*, 433–446.

Morrongiello, B. A., Pickett, W., Berg, R. L., Linneman, J., Brison, R., & Marlenga, B. (under review). Adult supervision and pediatric injuries in the agricultural worksite: What constitutes adequate supervision?

Pickett, W., Brison, R., & Hoey, J. (1995). Fatal and hospitalized agricultural machinery injuries to children in Ontario, Canada. *Injury Prevention*, *1*, 97–102.

Reed, D. L., & Claunch, D. T. (2000). Nonfatal farm injury incidence and disability to children. *American Journal of Preventive Medicine*, *18*, 70–79.

Rivara, F. P. (1997). Fatal and non-fatal farm injuries to children and adolescents in the United States, 1990–1993. *Injury Prevention*, *3*, 190–194.

Schwebel, D. C., & Barton, B. (2005). Contributions of multiple risk factors to child injury. *Journal of Pediatric Psychology*, *30*, 553–561.

Schwebel, D. C., & Bounds, M. L. (2003). The role of parents and temperament on children's estimation of physical ability: Links to unintentional injury prevention. *Journal of Pediatric Psychology*, *28*, 505–516.

Schwebel, D. C., Brezausek, C. M., Ramey, S. L., & Ramey, C. T. (2004). Interactions between child behavior patterns and parenting: Implications for children's unintentional injury risk. *Journal of Pediatric Psychology*, *29*, 93–104.

Schwebel, D., & Plumert, J. M. (1999). Longitudinal and concurrent relations between temperament, ability estimation, and accident proneness. *Child Development*, *70*, 700–712.

Schwebel, D. C., Speltz, M., Jones, K., & Bardina, P. (2002). Unintentional injury in boys with and without early onset of disruptive behavior. *Journal of Pediatric Psychology*, *27*, 727–737.

US Department of Health and Human Services. (2003). NIOSH Face Program. DHHS (NIOSH) Publication No. 2003-146. Available at: 〈http://www.cdc.gov/niosh/docs/2003-146/pdfs/2003-146.pdf〉. Accessed January 13, 2006.

Wills, K. E., Christoffel, K. K., Lavigne, J. V., Tanz, R. R., Schofer, J. L., Donovan, M., et al. (1997). Patterns and correlates of supervision in child pedestrian injury. The Kids 'N' Cars Research Team. *Journal of Pediatric Psychology*, *22*, 89–104.

Zietlow, S., & Swanson, J. (1999). Childhood farm injuries. *American Surgery*, *65*, 693–698.