



## Bystander injury evaluation of children from midwestern agricultural operations

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### ARTICLE INFO

Available online 25 January 2010

#### Keywords:

Child bystander  
Agricultural bystander  
Child injury

### ABSTRACT

**Background:** With more than a million youth living on agricultural operations, it is important for parents to understand the consequences of bystander injuries that children experience in these environments. We identified the childhood injuries for bystander status and compared the severity of these injuries to the working children in the Regional Rural Injury Study-II (RRIS-II). **Methods:** RRIS-II followed 16,546 children (~85% of eligible) from rural communities in the Midwest for two six-month recall periods in 1999 and 2001. Demographic, injury, and exposure data were collected through comprehensive computer-assisted telephone interviews. Child injuries were cataloged using narrative scenarios into four categories: (a) directly work-related; (b) indirectly work-related; (c) non-working accomplice; and (d) non-working attendant; the latter three all being bystander categories. Poisson regression modeling was used to calculate rates of bystander injuries. Frequencies were used for comparison of severity measures. **Results:** Among the 463 child injuries (aged <20 yrs), 102 were bystander injuries. Of the bystander-related injuries, 14 were identified as indirectly work-related (working bystanders), 27 as non-working accomplice (passengers/tag-alongs), and 60 as non-working attendant (playing on the operation). The overall rate of bystander injuries was 6.4 per 1,000 people, 95% CI (5.0, 8.1). Males, compared with females, had more than twice the injury rate (8.7; 95% CI 6.4–11.8, and 3.9; 95% CI 2.7–5.7, per 1,000 people, respectively). Bystanders in this population had more severe injuries with 4% having life-threatening circumstances; of these, 4% of the accomplices and 2% of the attendants subsequently died. **Conclusions:** Children who live or work on agricultural operations are vulnerable to many hazards. Therefore, this study examined child injuries and found a clear difference in the consequences of these injuries between working-related and bystander-related injuries. **Impact on Industry:** Unlike occupations such as construction and mining, where laws and organizations have been created for the protection of bystanders, agricultural bystanders have remained unprotected and have had to face the consequent injury and death outcomes. As public health professionals considering these risks, it is necessary that we work to develop more intervention studies and continue to propose suggestive guidelines for child safety in these environments so as to challenge family traditions and possibly spark public policies that will give further protection to this population.

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### 1. Introduction

Bystander is a term that all too often causes one to reflect on the daily news reports heard worldwide that speak to the unfortunate injury or death of youth caught in the crossfire of gang shootings and politically fuelled wars. However, bystanders also describe individuals in work-related settings. One of the first questions asked of public health professionals when dealing with bystanders is how to limit injury

based on circumstances those at risk cannot control (Burgess & Malek, 2005).

In agricultural settings, child bystanders are vulnerable to many of the same hazards as adults who live or work on agricultural operations; however, they are far less capable of understanding all of the potential hazards. Also, child agricultural workers receive fewer legal protections than other working children. U.S. labor law allows children in agriculture to work at younger ages, for longer hours, and under more hazardous conditions than children in other jobs. While the law allows children as young as 12 to work unlimited hours in agriculture, children in other occupations cannot work before the age of 14, and can only work three hours on a school day until age 16 (Human Rights Watch, 2002). This is due mostly to the fact that Child Labor Laws do not pertain to family operations and thus allow children in agriculture to be exposed to these many dangers (Child Labor Law, 2006).

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Although parents cannot child-proof an operation, it is important for them to understand the apparent risks of child bystanding and find ways to keep their children as safe as possible. Therefore, the study of bystander injuries has to become more salient in regard to children growing up in agricultural environments. Franklin, Mitchell, Driscoll, and Fragar (2001) sought to describe all non-work-related agricultural deaths in Australia and defined bystanders as persons who were fatally injured on an operation but not in connection with work activity or equipment. Mandryk and Harrison (1995) looked at work-related deaths of children and adolescents in Australia and identified bystanders as persons not engaged in work but who were fatally injured as a direct consequence of the work of another person. However, no studies have sought to study bystanding, based on all its possible mechanisms, for example, while: not working but accompanying a worker; not working but being present in the work environment; and working but being injured by a different work task. In order for prevention efforts to be best directed to protect young children from bystander injuries, it is imperative to characterize the rate and severity of these injuries and examine how they are not addressed by current prevention recommendations, which is the crux of this research effort.

## 2. Methods

This study enabled identification of the rate of bystander injuries found in the combined efforts of Phase 1 (1999) and Phase 2 (2001) of the Regional Rural Injury Study- II (RRIS-II). RRIS-II was a population based prospective cohort study, in which comparable data were collected in both phases to identify the magnitude and scope of injuries for all members of the household from the five-state region, with a focus on childhood agricultural injuries and related risk factors. This research effort focused on the data for children (i.e., those less than 20 years of age) from both cohorts. Both study phases and the present study were approved by the University of Minnesota's Institutional Review, Human Subjects Committee.

### 2.1. Study Population

For both phases of RRIS-II, random samples of 3,200 agricultural operations were selected for each of the five states included in the study, providing a total of 16,000 selected operations each year (1999, 2001); these states were Minnesota (MN), Wisconsin (WI), North Dakota (ND), South Dakota (SD), and Nebraska (NE). To be eligible for participation, the agricultural operations had to: (a) have a household associated with the operation; (b) include children younger than 20 years of age (<20) in residence as of January 1, 1999 or 2001; (c) produce at least \$1,000 of agricultural goods in the year prior to each study, or be involved in a Conservation Reserve Program (CRP); and (d) be actively farming/ranching as of January 1, 1999 or 2001. Participation in the study also involved willingness by the eligible households to complete two additional telephone interviews at six-month intervals.

In 1999, 4,402 (27.5% of those randomly sampled) eligible operations were identified and 3,765 (85.5% of the eligible) participated in the complete study. For the second phase, in 2001, 4,408 eligible operations were identified with 3,655 (82.5% of the eligible) participating in the complete study. For each study year, over 16,000 household members participated with 16,538, in 1999 and 16,064 in 2001 (Gerberich et al., 2004).

### 2.2. Data Collection

Female heads of household were the preferred key informants for the collection of demographic information on the members of the household as well as the identification of any injury events incurred by persons associated with the agricultural operations and respective households. Permission to interview persons 12 to <18 years of age

was obtained from the parent at the time of the interview, as appropriate; those  $\geq 18$  years of age could respond for themselves, unless they preferred that one of their parents respond for them. For persons younger than 12, either the male or female head of household was the surrogate respondent for exposure information, unless the parent requested that the interviewer speak directly with the child. The male head of household was the preferred key respondent for information on the characteristics of the agricultural operation and the general operation exposures (e.g., acres in operation, primary enterprise, direct exposures to animals and machinery); these data were essential to the case-control study involving persons <20 years of age.

### 2.3. Contact Procedures

Identical contact procedures were used for both phases of the RRIS-II. Initial contact with the agricultural operations selected for the study was made after the first of January in each year (1999, 2001). This consisted of an introductory mailing that included letters from the United States Department of Agriculture National Agricultural Statistics Services (USDA NASS) offices, in each respective state, and from the study investigators who provided information on the project in more detail. This was followed by a brief screening telephone interview for each sampled operation that was administered by specially trained USDA NASS employees who were initially trained by and, then, monitored by research team members, in concert with their supervisors.

If the agricultural operation met all eligibility criteria, the household was asked to participate in the study. Operations that did not meet the criteria were excluded from the study. Details of the subsequent telephone interviews in which participants would be involved, as well as rights regarding participation and informed consent based on federal guidelines for protecting human subjects in research, were addressed in the initial mailing as well as during the screening interview. Eligible agricultural households that agreed to participate were then followed through the subsequent interviews where participants were questioned on characteristics of the household, as well as injuries incurred by all household members, and child injuries that occurred on the operation and the exposures that preceded them.

### 2.4. Data Collection Instruments

Data collection instruments were developed to be administered by a Computer Assisted Telephone Interview (CATI). The questions/content incorporated in the data collection instruments remained intact between the 1999 and 2001 efforts and the data were collected in the same manner for the current analysis.

Households that met eligibility criteria and agreed to participate were, then, mailed comprehensive packets of information regarding the study and the subsequent interviews to be conducted. These packets contained: (a) cover letters from the study investigators and the respective state NASS offices; and, (b) comprehensive booklets, including logs to maintain ongoing information pertinent to injury occurrences (according to the injury definition) between January 1 and June 30 in each study year, and telephone interview information for facilitating the interviews. Comparable mailings were implemented for the second six months of data collection (July 1 through December 31, each year). Full-length telephone interviews with the eligible and participating agricultural households began in July of each study year, and January of the following year, to collect data for the respective prior six-month periods. A six-month period was chosen to maximize quality of reporting while minimizing cost of follow-up, based on past experience and validation studies (Braun, Gerberich, & Sidney, 1994; Gerberich et al., 1990).

### 3. Theory/Calculation

#### 3.1. Bystander and Injury Definitions

Injurious events in this study were defined as any acute traumatic event that met one or more of the following criteria: restricted from normal activities for at least four hours; consequences that resulted in loss of consciousness, loss of awareness, or amnesia for any length of time; or required professional health care.

Narratives on child injury events were categorized into stages of work-relatedness. The narrative data were comprised of specific questions that were used to guide decisions on how the child was injured and if the injury was work-induced or bystander-related. Determinations were made to categorize each of the case narratives on whether or not the injury was directly work-related or bystander-related through one of three different mechanisms. This was accomplished by using questions such as: “What was the activity?,” “Where did the event occur?,” “What was the child doing at the time of the injury?,” “How did the accident happen?,” and “What type of activity was the child involved in when they got hurt?” along with demographics of the child and characteristics of the operation. Additionally, for any cases that revealed an indiscriminate work-relatedness status, they were grouped into another category as ambiguous cases.

Injuries were characterized as being directly experienced by working children and three other mechanisms by which children can be hurt as bystanders. Specific guidelines were established to clearly identify these four different categories of work-relatedness. Also, a fifth category, used for cases with conflicting or confusing mechanisms of injury, was included. A decision log was used as a guide in categorizing the cases by key words (e.g., operating) and circumstances (e.g., child was playing near working father). The guidelines for cataloging narrative scenarios according to the decision log were as follows:

- 1) **Directly Work-related** (injured by mechanism used for own task). For example, entangled in machinery while operating it; stepped on by cow while milking.
- 2) **Indirectly Work-related** (injured by outside source while doing own task). For example, child painting barn falls from ladder when it is hit by a mower; youth carrying buckets of water is run over by a tractor going in reverse.
- 3) **Non-working Accomplice** (injured while riding or tagging along with someone else who is working and aware of their presence). For example, extra rider on agricultural machinery falls off and is run over; child kicked by a horse as older sibling was feeding the horse.
- 4) **Non-working Attendant** (injured while playing or being present in/near the agricultural environment and the workers are unaware of their presence). For example, playing on old tractor tire and it falls on the child; driving a recreational vehicle too fast on the operation and it flips over onto child driver.
- 5) **Ambiguous** (child is injured in a manner that is indistinguishable among categories or a combination of the aforementioned categories and there is not enough evidence to be classified into groups 1–4). For example, child slipped, child stepped on nail.

The aforementioned definitions and examples were used as the basis for cataloging the narrative scenarios and, thus, required the development of six additional variables with yes/no responses (e.g., bystander, directly work-related, indirectly work-related, non-working accomplice, non-working attendant, and ambiguous). The decision log was used to make conclusions on the type of work-relatedness of the child injury case scenarios; the additional five variables, along with the new bystander variable, were initially determined by one rater for all 463 child injuries. Thereafter a substudy was completed to check the consistency of the decision log

by using an expert panel participating in the Occupational Injury Prevention Research Seminar. Members of the panel were given previously identified worker, bystander, and ambiguous cases in sets of four for each classification totaling 20 cases for examination. They also received the decision log of the five different bystander types to facilitate classification of each injury event into its specific work-relatedness type. The results from each panelist (rater) were compared and checked for consistency and differences. The goal was for the panel to discuss the reliability of the decision log and be able to use it to classify case scenarios agreeably. Their final ratings were combined to check for the sustainment of inter-rater reliability among the 10 different raters through use of the Fleiss' Kappa statistic. Fleiss' Kappa statistic for inter-rater reliability was calculated at 0.74, which indicated substantial agreement among the 10 raters (Fleiss, 1971).

After appropriate identification was made of the circumstances leading to the injuries for all of the cases, the goal was to examine the characteristics and outcomes of the injuries sustained. Injury event rates were calculated for bystander and non-bystander injuries, using the RRIS-II population of children under age 20 as the denominator. Confidence intervals were estimated using a Poisson model, while the rates were adjusted for within-household correlation using Generalized Estimating Equations (GEEs; Liang & Zeger, 1986) and weighted for non-response (Horvitz & Thompson, 1952; Mongin, 2001). It was further hypothesized that bystander injuries were distinct from those sustained while the child was actively engaged in agricultural work tasks. Sources of injuries were also compared between bystander-related injury events and non-bystander-related events to determine if any specific sources are more commonly associated with bystander injuries. It is believed that by clearly identifying the sources of injury for each injury event, within the classification of bystander exposure, this would assist in ultimately recommending possible prevention efforts.

Next, a comparison on the severity of injury events between the workers and the bystanders was completed. Each case was considered through four specific measures, those being: *types of healthcare sources used* (e.g., hospital emergency department); *work time lost from their own operation* (e.g., 14 days to < 1 month); *parent's view of the seriousness of the injury* (e.g., life threatening); and *length of restricted activity* (e.g., 4 hr to < 1 day). Differences in the proportions of those injured in each of these categories between worker and bystander injuries were examined using Pearson's chi-square tests. The categories were evaluated independently for all severity measures of interest. Through examination of the severity of the injury events within the variable categories (work-related or bystander), prevention techniques can possibly be more refined to clearly target the specific sources of these critical injuries that affect all types of child bystanders and workers in agriculture.

After comparing worker-related injuries to bystander injuries, an evaluation of the Five Priorities for Primary Prevention of Non-Working Related Childhood Injuries was adapted to determine whether common methods for preventing pediatric injuries would be effective for bystander injuries (Pickett et al., 2005). The exposure log was linked with the injury log to identify direct exposures with its specific injury outcome. Once the exposure was linked to each injury event, the guidelines of the five priorities were examined to determine the number of bystander injuries that could have potentially been prevented, had those suggestions been observed. While NAGCAT does not provide guidelines for prevention of agricultural injuries with respect to non-working children and children who are working but who are injured as bystanders, a comparison of these injury events and their respective exposures to the five priorities will assist in determining if these prevention measures may be helpful. It is anticipated that this analysis will underscore the complexity of and the need for injury prevention measures (e.g., safety guidelines) to be developed for non-working, working, and bystander children on agricultural operations.

## 4. Results

A total of 7,420 farm/ranch operations (approximately 85% of those eligible) participated in the study that included 16,546 children under the age of 20 years in this cohort. There were a total of 463 injury events experienced by these children. Of these, 102 were classified as bystanders and are the focus of the analysis in the current study.

### 4.1. Work-relatedness Categorization

Of the bystander-related injuries, 14 were identified as indirectly work-related (working bystanders), 27 non-working accomplices (passengers/tag-alongs), and 60 non-working attendants (playing on the operation). There were 330 directly work-related cases and 31 ambiguous cases that had inadequate information for classification.

Bystanders and workers differed by demographic characteristics as well. The majority of worker injuries were between the ages of 10 to 19 years, while there were no injuries found for the oldest age group of 15 to 19 year olds in the indirectly work-related group. Accomplice and attendant injuries were found among all age groups with approximately 40% of injuries in both groups found among those five years old and younger. Nearly 70% of injuries in all categories were found among males. The majority of the children did not experience a prior injury, as can be seen in Table 1.

### 4.2. Bystander Injury Rates

The overall annual rate of bystander injuries was 6.4/1000 (95% CI = 5.0, 8.1). Males, compared with females, had more than twice the rate (8.7/1000; 95% CI = 6.4, 11.8 and 3.9/1000; 95% CI = 2.7, 5.7). Children less than five years of age had the highest rate of injuries (12.7/1000; 95% CI = 8.6, 18.8). Bystanders who worked between 1 and 20 hours per week had a rate of 7.4/1000 (95% CI = 5.5, 10.0), and those with prior injuries had a rate of 16.9/1000 (95% CI = 9.0, 31.6). A summary of these rates can be found in Table 2.

### 4.3. Severity of Injury Comparison

Parents rated seriousness of the injury as minor/moderate for 87% of the workers and for 76% of the bystanders. Approximately 95% of workers and bystanders were not admitted to the hospital but, rather, were treated at the scene of the incident or as outpatients at other venues. More workers than bystanders visited the doctor's office, but only 29% of workers visited the emergency room where 47% of bystanders did. Length of restricted activity was equal between workers and bystanders after being injured for 14 days to one month, but thereafter bystanders required more time from restricted activity than did workers. Nonetheless, bystanders in this population had more severe injuries with 4% of them having life threatening circumstances; of these, 4% of the accomplices and 2% of the

**Table 1**  
Characteristics of Working and Bystanding Children from RRIS-II.

Characteristics	Worker	Bystanders	Indirectly	Accomplice	Attendant	Ambiguous	Total
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	
Age							
< 5	7 (2)	36 (35)	1 (7)	10 (37)	24 (40)	5 (16)	48
5 - 9	50 (15)	28 (27)	5 (36)	7 (26)	16 (27)	7 (23)	85
10 - 14	159 (48)	35 (34)	8 (57)	9 (33)	18 (30)	12 (39)	206
15 - 19	114 (35)	3 (3)	0 (0)	1 (4)	2 (3)	7 (23)	124
Gender							
Males	228 (69)	71 (70)	11 (79)	19 (70)	40 (67)	20 (65)	318
Females	102 (31)	31 (9)	3 (21)	8 (30)	20 (33)	11 (35)	144
State							
MN	43 (13)	16 (16)	0 (0)	4 (15)	11 (18)	6 (19)	65
NE	76 (23)	27 (26)	3 (21)	4 (15)	20 (33)	6 (19)	109
ND	63 (19)	18 (18)	4 (29)	6 (22)	8 (13)	8 (26)	89
SD	82 (25)	19 (19)	4 (29)	8 (30)	7 (12)	10 (32)	111
WI	66 (20)	22 (22)	3 (21)	5 (19)	14 (23)	1 (3)	89
Household Child Total							
One	55 (17)	8 (8)	2 (14)	2 (7)	4 (7)	4 (13)	67
Two	126 (38)	24 (24)	3 (21)	6 (22)	15 (27)	9 (29)	159
Three	85 (26)	36 (35)	2 (14)	9 (33)	24 (40)	10 (32)	130
Four	39 (12)	19 (19)	3 (21)	4 (12)	12 (20)	6 (19)	64
Five to Ten	25 (8)	15 (15)	4 (29)	6 (22)	5 (8)	2 (6)	42
Sources of Injuries							
Tractor	17 (5)	11 (11)	0 (0)	7 (26)	4 (7)	5 (16)	33
Motor Vehicle	28 (8)	18 (18)	2 (14)	7 (26)	9 (15)	6 (19)	52
Large Machinery/Equipment	32 (10)	15 (15)	3 (21)	5 (19)	7 (12)	3 (10)	50
Small Equipment/Hand Tools	40 (12)	10 (10)	5 (36)	4 (15)	1 (2)	0 (0)	50
Livestock or Animals	114 (35)	16 (16)	2 (14)	2 (7)	11 (18)	6 (19)	136
Storage Structures	14 (4)	6 (6)	0 (0)	0 (0)	6 (10)	1 (3)	21
Chemicals/Drugs/Medications	5 (2)	6 (6)	0 (0)	3 (11)	4 (7)	0 (0)	11
Falls/Surfaces	15 (5)	5 (5)	0 (0)	0 (0)	5 (8)	5 (16)	25
Sports/Recreation	0 (0)	3 (3)	1 (7)	0 (0)	2 (3)	0 (0)	3
Yardwork/Gardening	2 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2
Physical Object	38 (12)	12 (12)	1 (7)	0 (0)	11 (18)	2 (6)	52
General Activity	25 (8)	0 (0)	0 (0)	0 (0)	0 (0)	1 (3)	26
Prior Injury							
No	236 (72)	78 (76)	9 (64)	22 (81)	46 (77)	22 (71)	336
Yes	94 (28)	24 (24)	5 (36)	5 (19)	14 (23)	9 (29)	127
Total Child Injuries	330	102	14	27	60	31	463

**Table 2**  
Injury Rates of Bystanders from RRIS-II.

Exposed	Number Exposed	Number of Injury Events	Injury events per 1,000 people	95% CI
All Children	16542	102	6.4	(5.0, 8.1)
Gender				
Males	8615	71	8.7	(6.4, 11.8)
Females	7927	31	3.9	(2.7, 5.7)
Age Groups				
< 5	2301	29	12.7	(8.6, 18.8)
5 - 9	3634	26	7.4	(5.0, 10.9)
10 -14	5056	40	8.4	(5.7, 12.3)
15 - 19	5551	7	1.4	(0.6, 2.9)
State				
MN	3319	16	4.8	(2.9, 8.0)
NE	3444	27	8.5	(4.9, 14.8)
ND	3146	18	5.7	(3.6, 9.1)
SD	3734	19	4.9	(3.1, 7.8)
WI	2899	22	8.1	(5.0, 13.2)
Hours Worked (weekly average)				
0	4448	24	5.3	(3.5, 7.9)
1-20	9568	67	7.4	(5.5, 10.0)
21-40	1606	10	5.6	(2.7, 11.6)
41-60	233	0	0	---
61-80	61	1	14	(1.8, 106.1)
>80	625	0	0	---
Race				
White	16296	100	6.3	(5.0, 8.1)
Non-white	222	1	4.7	(0.6, 33.9)
Prior Injury				
No	14935	78	5.3	(4.2, 6.7)
Yes	1605	24	16.9	(9.0, 31.6)

attendants subsequently died. Table 3 displays the full results of these severity comparisons.

#### 4.4. Bystander Injury Prevention

The exposures of the non-working portion of the 102 bystander injuries were matched to the suggestions of the five priorities for primary prevention as proposed by the National Children's Center for Rural and Agricultural Health and Safety in 2005 (Pickett et al., 2005). As RRIS-II data were adapted to match bystander injuries and their sources, it was apparent that no bystander injuries were due to children being around bodies of water. Animal-related trauma accounted for 16% of the injuries, while 33% of the injuries were associated with machine-related events. This analysis showed that the installation of passive physical barriers around the operation and identifying child care alternatives could have potentially prevented the majority of the bystander injuries in this study. However, identification of the specific details of all safety measures that were in use on the operation was not possible with these data. The five priorities for prevention are displayed in Table 4 with the potential preventable exposure pattern that was examined with RRIS-II data.

## 5. Discussion

This study identified the mechanism of bystander injuries and compared the frequency and severity of them to injuries of working children. More than 20% of the 463 identified child injuries in RRIS-II were due to bystander exposures. Bystander injuries were equal or more severe than working injuries. Proposed prevention practices did not address the majority of the bystander injuries. Prior analysis of RRIS-II data revealed that bystander injuries were identified in the zero working-hour group, especially in the younger age categories (Gerberich et al., 2004). Also, it was noted that other bystander injuries may be present in non-zero working-hour groups; but it was not possible to determine them directly through the interview responses (Gerberich et al., 2003). Therefore, this study sought to

identify all of the bystander injuries in the working and non-working children on the operations included in RRIS-II.

Because the agricultural workplace allows the exposure of non-working children to hazards, it is imperative to evaluate the injuries of bystander children, as well as workers. Bystanders incurred the same kinds of injuries and required the same kinds of treatment; however, they experienced more severe consequences. Despite the fact that both bystanders and working children were injured, only the bystander children of preschool age experienced the consequence of death in this study population, which was consistent with other studies (Brison et al., 2006). One death was very consistent with the passenger scenario, in which the child bounces off the seat and is run over by the tractor. However, the circumstances surrounding the other death was ambiguous; but, it was determined that the child was at play in the environment and, thus, identified as a non-working attendant bystander. This study also revealed how preteen and young teenager injuries made up the majority of the worker and working bystander injuries as similar results were found with Lilley, Feyer, Langley, and Wren (2004).

Sources of injuries were examined with RRIS-II data and while worker injuries were associated with all exposures, other than recreation, attendant injuries sources were found in all the same places. Indirectly work-related injuries tended to come from heavy equipment on the operation, while accomplice injuries were more frequently due to mobile equipment as they interacted as passengers (Franklin et al., 2001). Pickett et al. (2005) examined sources of injuries with potential strategies for the prevention of pediatric injuries in this environment. RRIS-II data were compared with these strategies and found that installing passive physical barriers was the way to potentially prevent most of the bystander injuries despite not having any drowning-related injuries in this dataset.

Even though RRIS-II data were very useful in examining and surveying childhood agricultural injuries in this population, they were limited for delineating specific details of the bystander injuries. Information biases may be present in this study as results are limited by the accuracy of the respondent's reports of injury. While the six-month reporting period was expected to have reduced the potential for recall bias, this could still remain an issue (Gerberich et al., 1991, 2001). The severity of the injury also influences recall. This means that the more life-threatening the injury, the more likely one will remember the event (Lyman, McGwin, Enochs, & Roseman, 1999; Stallones, Beseler, & Chen, 2006). Response bias could be a potential issue as parents may be uncomfortable revealing the complete details of their child's injuries since they occurred while being under their supervision. This study may also be limited in generalizability. Workers on the agricultural operations in this five-state region are not necessarily representative of those in other regions within or outside the United States.

Selection bias due to non-response is also a potential concern. The impact of potential selection bias was controlled by inversely weighting observed responses with probabilities of response (Horvitz & Thompson, 1952), estimated as a function of characteristics available from the NASS Master List Frame. To account for unknown eligibility among non-respondents, probability was estimated for these same characteristics (Mongin, 2001).

## 6. Conclusion

With more than a million youth living on agricultural operations, it is important for parents to understand the apparent consequences of child bystander. These types of injuries are less frequently acknowledged and are not given high priority for current prevention initiatives. In order to best direct prevention efforts to protect young children from bystander injuries, it is imperative to specifically identify the mechanism by which these injuries occur. Since children are vulnerable to many of the same hazards as adults, but are far less

**Table 3**  
Severity Measures Associated with Bystander Injuries in RRIS-II.

Severity Measures	Worker	Bystander	Indirectly	Accomplice	Attendant	Ambiguous	Total
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
<b>Seriousness of the Injury</b>							
Minor	147 (45)	33 (32)	6 (43)	11 (41)	15 (25)	14 (45)	194 (42)
Moderate	137 (42)	45 (44)	4 (29)	11 (41)	30 (50)	15 (48)	197 (43)
Serious	33 (10)	14 (14)	3 (21)	4 (15)	7 (12)	2 (7)	49 (11)
Severe	11 (3)	6 (6)	1 (7)	0 (0)	5 (8)	0 (0)	17 (4)
Life Threatening	2 (1)	2 (2)	0 (0)	0 (0)	2 (3)	0 (0)	4 (0.9)
Death	0 (0)	2 (2)	0 (0)	1 (4)	1 (2)	0 (0)	2 (0.4)
<b>Types of Healthcare Resources</b>							
None	62 (19)	20 (20)	2 (14)	6 (22)	12 (20)	8 (26)	90 (19)
Doctor's Office	119 (36)	25 (25)	5 (36)	5 (19)	15 (25)	9 (29)	153 (33)
Hospital ER	94 (29)	48 (47)	6 (43)	14 (52)	28 (47)	12 (39)	154 (33)
Hospital Inpatient	3 (1)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	4 (1)
Dentist's Office	6 (2)	2 (2)	0 (0)	0 (0)	2 (3)	0 (0)	8 (2)
Chiropractor's Office	25 (8)	2 (2)	0 (0)	1 (4)	1 (2)	1 (3)	28 (6)
At Scene of Accident	12 (4)	2 (2)	0 (0)	1 (4)	1 (2)	0 (0)	14 (3)
Other Healthcare Resource	9 (3)	2 (2)	1 (7)	0 (0)	1 (2)	1 (3)	12 (3)
<b>Time Spent Under Professional Care</b>							
0 days	1 (0.3)	1 (1)	0 (0)	0 (0)	1 (2)	0 (0)	3 (0.6)
1 days	10 (3)	2 (2)	0 (0)	1 (4)	1 (2)	0 (0)	14 (3)
2 days	2 (0.6)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (0.4)
3 days	1 (0.3)	1 (1)	0 (0)	1 (4)	0 (0)	1 (3)	4 (0.9)
10 days	1 (0.3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.2)
14 days	1 (0.3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.2)
60 days	1 (0.3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.2)
N/A	313 (95)	97 (95)	14 (100)	25 (93)	58 (97)	30 (97)	26 (6)
<b>Time Restricted From Activities</b>							
No restriction	43 (13)	10 (10)	4 (29)	1 (4)	5 (8)	2 (7)	53 (12)
0 hrs < 4 hrs	23 (7)	5 (5)	0 (0)	3 (11)	2 (3)	5 (16)	33 (7)
4 hrs < 1 day	54 (16)	16 (16)	2 (14)	2 (7)	11 (18)	6 (19)	76 (16)
1 day < 7 days	119 (36)	34 (33)	4 (29)	12 (44)	18 (30)	9 (29)	162 (35)
7 days < 14 days	40 (12)	9 (9)	1 (7)	4 (15)	4 (7)	1 (3)	50 (11)
14 days < 1 month	25 (8)	8 (8)	0 (0)	2 (7)	6 (10)	2 (7)	35 (8)
1 month < 3 months	20 (6)	15 (15)	2 (14)	2 (7)	11 (18)	4 (13)	39 (8)
3 months +	7 (2)	3 (3)	1 (7)	0 (0)	2 (3)	2 (7)	12 (3)
N/A Deceased	0 (0)	2 (2)	0 (0)	1 (4)	1 (2)	0 (0)	2 (0.4)
<b>Total</b>	<b>330</b>	<b>102</b>	<b>14</b>	<b>27</b>	<b>60</b>	<b>31</b>	<b>463</b>

capable of understanding all of the potential hazards, it is necessary to examine RRIS-II for parental factors that may be associated with children's likelihood of bystandering in high-risk work environments.

RRIS-II was not specifically designed to measure bystander injuries among children; however, these data allowed initial investigation of these issues. However, given the increased odds when there were several children in the household, it is possible that parents tended to

relax their emphasis on safety in terms of attention and proximity, despite the fact that it has been documented that children on agricultural operations have been injured in the presence of potential and adequate supervision (Morrongiello et al., 2008; Pryor, Caruth, & McCoy, 2002; Williams et al., 2010). Identification of bystander scenarios, examination of bystander determinants, and evaluation of the consequences of these injuries can lead to more realistic

**Table 4**  
Evaluation of Prevention Techniques with RRIS-II Bystander Injuries.\*

Five Priorities for the Primary Prevention of Pediatric Non-working Agricultural Injuries			
	Preventable Bystander Exposures of Interest	Potential Injuries	Exposed Bystanders n (%)
<b>1</b>	<b>Prohibiting access to the farm worksite:</b>		
	a. Toddlers while adults are engaged in ag work	Runovers, drownings	23 (22)
	b. Passengers ("extra riders") on farm vehicles	Passenger runovers	14 (14)
<b>2</b>	<b>Installing passive physical barriers:</b>		
	a. Fencing for water/drowning hazards	Drowning, asphyxia	0 (0)
	b. Fall protection in haylofts	Falls from heights	5 (5)
	c. Fencing of animal enclosures	Animal trauma	16 (16)
	d. Barriers around machinery and vehicle compounds	Bystander runovers, machinery entanglements	33 (32)
	e. Fencing to promote safe play areas	All injuries	16 (16)
<b>3</b>	<b>Instituting safe storage practices:</b>		
	a. Large objects in worksite	Crush injuries	15 (15)
	b. Tools and sharps	Lacerations	10 (10)
<b>4</b>	<b>Identifying child care alternatives:</b>		
	a. All play activities on farms	All injuries	11 (11)
	b. Daycare options	All injuries	29 (28)
<b>5</b>	<b>Developing guidelines for common recreational activities:</b>		
	a. All-terrain vehicle use	Recreational vehicle crashes	6 (6)
	b. Horse related and riding activities	Animal trauma	3 (3)

\*Adapted from Pickett, W. et al. (2005). Pediatric farm injuries involving non-working children injured by a farm work hazard: Five priorities for primary prevention. *Injury Prevention*, 11, 6–11.

intervention efforts. Therefore, it is important to protect children from bystander injuries on agricultural operations as they can be too young to realize the dangers of the work environment and are all too often the members of the household that suffer the severest of the consequences.

## Acknowledgments

Support was provided, in part, by the: National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention (CDC), Department of Health and Human Services (R01 CCR514375; R01-OH04270); Midwest Center for Occupational Health and Safety, Occupational Injury Prevention Research Training Program (NIOSH T42 OH008434); and the Regional Injury Prevention Research Center, Division of Environmental Health Sciences, School of Public Health, University of Minnesota. The lead researcher was supported in part by the Center for Disease Control and Prevention (CDC), Training Program Grant # 5T01 CD000189-05. The contents of this effort are solely the responsibility of the authors and do not necessarily represent the official view of the CDC or other associated entities.

The investigators are also grateful for the collaboration and assistance from the United States Department of Agriculture, Agricultural Statistics Service offices in the five participating states, and for the time and information volunteered by the participating farm and ranch families.

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