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Horse-Related Injuries Among Agricultural Household Members: Regional Rural Injury Study II (RRIS-II)

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ABSTRACT: ***Purpose:*** *To determine the incidence, associated consequences, and potential risk factors for horse-related injuries among youth and adults residing in Midwestern agricultural households.* ***Methods:*** *Demographic, injury, and exposure data were collected for 1999 and 2001 among randomly selected agricultural households within a 5-state region. A causal model facilitated survey design, data analysis, and interpretation of results; directed acyclic graphs guided multivariate modeling.* ***Findings:*** *From 7,420 households (84% response of eligible), involving 32,601 persons, 5,045 total injury events were reported; 1,016 were animal-related injuries, of which 215 (21%) were horse-related (rate, 6.7 events per 1,000 persons per year). Seventy-seven percent (77%) required health care; comparing those under age 20 and those 20 and older, 49% and 54%, respectively, lost work time on their operation (28% and 26%, one week or more), as a result of injuries largely associated with horse riding activities (70% and 56%). Multivariate analysis for youths under age 20 indicated: increased risks in North and South Dakota, for >0 hours worked, and for having a history of prior agriculture-related injury; and decreased risks for males. For those 20 and older, increased risks were identified for a prior injury history and less than high school education.* ***Conclusions:*** *Horse-related injuries, primarily associated with riding activities, are a significant problem among agricultural communities, and greatly impact their operations.*

Agriculture ranks among the most hazardous occupations in the United States, with a fatality injury rate 8.5 times greater than for all other occupations combined (28.7 vs 3.4 per 100,000 workers).[1] Shared working and living environments associated with agriculture place all residents at risk, including children.[2,3]

Animals, especially horses, appear to account for large percentages of injuries on agricultural operations. Children and youth (<20 years), as well as adults (20+ years), utilize them both for recreation- and operation-related activities that place them at risk.[4–8] It is estimated that 102,904 people (36 per 100,000 population) per year are treated in US emergency departments for horse-related injuries as a result of falling off or being thrown from a horse.[9] Several case-based reports identified horses as a leading source of injury on US farms.[6–8] Yet, a major barrier to progress

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in prevention of such injuries has been a deficiency in knowledge about this problem.[2] Thus, the objectives of this study were to determine the annual incidence, associated consequences, and potential risk factors for horse-related injuries among children and youths <20 years and adults 20+ years of age who resided in agricultural households in a 5-state Midwest region.

Methods

Study Design and Population. This study utilized combined data from the Regional Rural Injury Study-II (RRIS-II), phase 1 (1999) and phase 2 (2001),[10,11] conducted in Minnesota, Wisconsin, North Dakota, South Dakota and Nebraska,[12] to address deficiencies in knowledge about the magnitude of the problem and associated risk factors among agricultural household members.

Phase 1 (1999 data) was designed to identify the incidence, consequences and potential risk factors for all types of injuries among all age groups. Phase 2 (2001 data), involving comparable data collection and results, was designed as a model for surveillance of agricultural injuries that enabled monitoring for changes in incidence, consequences, and risk factors from phase 1 to phase 2.[11] Approval for this study was obtained from the Institutional Review Board, Human Subjects Committee, University of Minnesota.

The US Department of Agriculture (USDA) National Agricultural Statistics Service (NASS) Master ListFrame of Farming Operations provided the roster of agricultural operations. For each study period (1999 and 2001), random samples of 3,200 agricultural operations were selected from each state (16,000, each year) and mailed letters regarding study information from the investigators and the USDA NASS in the respective states. Subsequently, telephone interviews were initiated to these operations. Eligibility criteria for the operations were: (1) actively farming/ranching and having a household associated with the operation that included household members <20 years of age as of January 1, 1999 or 2001; (2) producing at least $1,000 of agricultural goods in the year prior to each study period, or involvement in a Conservation Reserve Program (CRP). Participation involved willingness by eligible households to complete 2 additional telephone interviews at 6-month intervals in each study year.

Enrolled households received comprehensive packets with a letter describing the full-length interviews, along with informational cards (injury definitions; numerous examples of injury) used to enhance recall and facilitate data collection. Injury was defined as any event resulting in 1 or more of the following: restriction from normal activities for 4 or more hours; loss of consciousness, loss of awareness, or amnesia for any length of time; use of professional health care. An event was classified as a horse-related injury if a horse was identified as a source of injury associated with either agriculture- or non-agriculture-related activities. Agriculture-related injuries were those associated with work activity or standing or playing in areas where agricultural work occurred.

The interviews, facilitated by USDA interviewers, trained by the investigators, utilized specially designed Computer Assisted Telephone Interview (CATI) instruments.[13] These instruments enabled highly efficient interviewing, monitoring and data management, and provided data tapes compatible for analysis.[14,15]

Data were collected retrospectively at the end of each 6-month period of 1999 and 2001 to identify all injury events, relevant demographics, and some exposure information for all household members. Injury event data included: sources/vehicles of injury (branching enabled identification of the source/vehicle of injury, such as animals, and the specific type of animal involved—multiple sources could be coded); associated activities (coded from responses to an open-ended question about what the person was doing at the time of the injury); types of injury; anatomical locations; severity of injury (hospitalization, additional health care, duration of normal activity restriction, lost farming/ranching work time, other lost work time, presence/degree of restriction, persistent problems). Persistent problems included: pain; numbness/tingling; headache; paralysis; body part loss; weakness/fatigue; decreased motion range; impaired vision, speech, or hearing; dizziness; reduced ability to concentrate or do physical work; epilepsy; convulsions/seizures.

The female and male heads of household were the preferred respondents, respectively, for demographics, injury information and operation-related exposures.[11] Non-respondents were followed up to ascertain household eligibility for use in adjustment analyses.[16-18]

Analyses. Descriptive analyses[14,15] addressed occurrences of: (1) agriculture-related injuries on the respondent's own operation, or (2) another operation, and (3) injuries related to other activities, according to age group (<20 years; 20+ years). Annual injury rates per 1,000 persons at risk were generated for events and person-time from both reporting periods. A prior study, involving the same states, determined that all operations owned at least 1 horse.[19]

Data were then adjusted for within-household correlation using generalized estimating equations,[16] excluding levels for missing values and non-response. Confidence intervals (CIs) for event rate estimates were generated using Poisson regression (*proc genmod* in SAS).[14]

Potential selection bias was controlled by inversely weighting observed responses with probabilities of response,[17] estimated as a function of characteristics from the NASS Master ListFrame: operation state location, operation type, and operation revenue, by quintile. To account for unknown eligibility among non-respondents, probability of eligibility was estimated for these same characteristics.[18]

Multivariate analyses, specific to horse-related injury events and exposures associated with their own operation, involved logistic regression to estimate risk (odds ratios [ORs] and 95% Confidence Intervals [CIs]) for several factors/exposures of interest: state of residence; age group; gender; race; education; marital status; prior agricultural injuries; and work/chore hours (hours/week) involved on own operation. All responses were categorical, with the exception of age and work hours; these continuous variables were later categorized to demonstrate injury rate differences among groups.

Separate, theoretical causal models, were developed for children/youth and adults, based on previous research and expert knowledge. This enabled modeling of dependence of horse-related injury on each exposure of interest, while controlling for potential confounders. Selection of confounders for each exposure of interest/respective model was based on directed acyclic graphs (DAGs)[20–22] established from these models (Supplementary Figures 1 and 2, available online[13]). Each model indicated potential confounders controlled for, following reputable methods.[20–22] This enabled identification of parsimonious models, excluding covariates that should not be included lest they introduce bias.

Findings. Population data from both RRIS-II study phases were comparable[10,11] and, therefore, combined for the current study. A total of 7,420 households participated in the study (84% response of eligible), involving 32,601 persons. From a total of 5,045 injury events (all sources), 1,016 were animal-related injuries, of which 215 (21%) were identified as horse-related injuries (6.7 events per 1,000 persons per year). Injury rates for events associated with the respondent's operation, another operation, and other non-agriculture related activities were 5.0, 0.6 and 1.1 per 1,000 persons per year, respectively. (Supplementary Table, available on line[13]) Among the 215 injuries, primary diagnoses were fractures/dislocations (31%), sprains/strains (22%), and brain concussions (13%); at least 70% were associated with their own operation.

The highest and lowest total rates, by state per 1,000 persons per year, were found in South Dakota (9.4) and Wisconsin (3.3). Males and females, <20 versus 20+ years of age, showed opposite injury rate patterns (3.6 and 8.7, 7.9 and 6.8). Generally, injury rates increased with age to the 35-44 year age group (9.0), then decreased.

By educational status, the highest overall injury rate, primarily associated with their own operation, was for adults with less than a high school education (16.9). Lowest rates were among those of pre-marital status (by law, <16 years of age, 4.6) or married/living as married (7.7), while highest rates were among those never married (8.5) or separated/divorced/widowed (9.2). Total injury rates varied by the hours worked on their operation per week and increased with increasing hours of work (range, 0.1 for zero hours with a peak of 8.0 for >40-60 hours).

Respondents' history of prior, versus no prior, agricultural injury, was associated with a total injury rate 3.7 times greater (16.0 and 4.3, respectively). The rate was 4.5 times greater for injuries incurred only on their operation (see Supplementary Table).

Severity Measures Associated With Horse-Related Injury Events. Approximately, 77% of all injuries required some type of health care. For non-agriculture related injuries, much greater proportions of persons in both age groups (<20 and 20+ years) required health care (90%, and 100%, respectively; Fisher's exact test, $P = 0.043$). However, for all injury events only 6% and 10%, respectively, were hospitalized (Table 1).

In each age group, 85% had some *restriction of regular activities*. For all injuries, 38% and 39%, respectively, were restricted from one week to 3+ months; 20% and 19%, involved one month or more. For events on their own operation, 38% and 39%, respectively, were restricted one week or more—15% and 17% one month or more. For non-agricultural activities, 45% and 50% were restricted for one week or more—34% and 50%, one month or more (Fisher's exact test, $P = 0.61$).

Among participants aged <20 and 20+ years, 49% and 54%, respectively, *lost work time on their agricultural operation*, as a result of injuries; 28% and 26% lost one week or more. For injuries sustained on other operations or in other, non-agricultural activities, 0% and 23%, 28% and 50%, respectively, lost time. Persistent problems for total injuries were identified by 13% and 24% (<20 and 20^+ years of age, respectively,

Table 1. Severity Measures Associated With Horse-Related Injury Events: Regional Rural Injury Study–II

	Agricultural: Own Operation				Agricultural: Other Operation				Non Agricultural Operation Related				Total			
	<20 N = 53		20+ N = 109		<20 N = 7		20+ N = 13		<20 N = 29		20+ N = 4		<20 N = 89		20+ N = 126	
Severity Measures	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Where treatment was first sought																
None	13	24.5	29	26.6	3	42.9	1	7.7	3	10.3	0	0	19	21.3	30	23.8
Hospital emergency department	15	28.3	25	22.9	1	14.3	5	38.5	17	58.6	3	75.0	33	37.0	33	26.2
Doctor's office	17	32.1	34	31.2	2	28.6	4	30.8	5	17.2	1	25.0	24	27.0	39	30.9
Chiropractor's office	6	11.3	17	15.6	1	14.3	1	7.7	1	3.4	0	0	8	9.0	18	14.3
Hospital in-patient	2	3.8	12	11.0	0	0	1	7.7	3	10.3	0	0	5	5.6	13	10.3
Other health care facility/At scene of accident/Dentist's office	0	5.7	6	5.5	0	0	2	15.4	4	13.7	0	0	7	7.8	8	6.4
Hospitalized																
No	51	96.2	97	89.0	7	100.0	12	92.3	26	89.7	4	100.0	84	94.4	113	89.7
Yes	2	3.8	12	11.0	0	0	1	7.7	3	10.3	0	0	5	5.6	13	10.3
Amount of time regular activities restricted																
No restriction	8	15.1	14	12.8	1	14.3	5	38.5	4	13.8	0	0	13	14.6	19	15.1
>0 h<7 ds	25	47.2	53	48.6	5	71.4	3	23.1	12	41.4	2	50.0	42	47.2	58	46.0
7 ds<1 mo	12	22.6	23	21.1	1	14.3	2	15.4	3	10.3	0	0	16	18.0	25	19.8
1 mo< 3 mos	6	11.3	16	14.7	0	0	3	23.1	5	17.2	2	50.0	11	12.4	21	16.7
3 mos+	2	3.8	3	2.8	0	0	0	0	5	17.2	0	0	7	7.9	3	2.4
Work time lost on their operation																
No restriction	23	43.4	50	45.9	6	85.7	7	53.9	16	55.2	1	25.0	45	50.6	58	46.0
>0 hs<7 ds	15	28.3	30	27.5	1	14.3	3	23.1	5	17.2	1	25.0	21	23.6	34	27.0
7 ds<1 mo	8	15.1	16	14.7	0	0	1	7.7	3	10.3	0	0	11	12.4	17	13.5
1 mo-3 mos+	7	13.2	12	11.0	0	0	2	15.4	5	17.2	2	50.0	12	13.5	16	12.7
Missing/Unknown/Refused	0	0	1	0.9	0	0	0	0	0	0	0	0	0	0	1	0.8
Other work time lost																
No restriction	47	88.7	86	78.9	7	100.0	9	69.2	25	86.2	4	100.0	79	88.8	99	78.6
>0 hs<7 ds	5	9.4	16	14.7	0	0	2	15.4	1	3.5	0	0	6	6.7	18	14.3
7 ds-<1mo	1	1.9	2	1.8	0	0	0	0	0	0	0	0	1	1.1	2	1.6
1 mo-3 mos+	0	0	5	4.6	0	0	2	15.4	2	6.9	0	0	2	2.2	7	5.6
Missing/Unknown/Refused	0	0	0	0	0	0	0	0	1	3.5	0	0	1	1.1	0	0
Persistent problems																
No	47	88.7	83	76.2	6	85.7	10	76.9	24	82.8	3	75.0	77	86.5	96	76.2
Yes	6	11.3	26	23.9	1	14.3	3	23.1	5	17.2	1	25.0	12	13.5	30	23.8
Degree of current restriction																
None	51	96.2	102	93.6	7	100.0	12	92.3	27	93.1	3	75.0	85	95.5	117	92.9
A small amount	0	0	2	1.8	0	0	1	7.7	1	3.5	0	0	1	1.1	3	2.4
A moderate/large amount	2	3.8	5	4.6	0	0	0	0	1	3.5	1	25.0	3	3.4	6	4.8

$\chi^2 = 3.5$, $P = 0.060$) with variations by age group. Perception of current activity restriction (small to large amount), was reported by 4% and 7%, respectively, and varied by category (Table 1).

Activities Associated With Injury Events. The primary activity associated with the total injuries, for both age groups, was riding animals (70%; 56%), resulting in falls. (Table 2). This accounted for important proportions of injuries incurred on their own operations (60%; 58%), other operations (71%; 31%), and in non-agricultural activities (86%; 100%) that were primarily recreational, including rodeo-related.

Multivariate Analyses: Models for Children/Youth and Adults. By state of residence, children were at increased risk of injury in North Dakota (OR 6.7; 95% CI 2.0-22.9) and South Dakota (OR 5.9; CI 1.8-20.0) versus Minnesota (Table 3). Decreased risks were identified for males (OR 0.4; CI 0.2-0.7) versus females,

Table 2. Activities Associated With Horse-Related Injury Events, Regional Rural Injury Study – II

	Agricultural: Own Operation				Agricultural: Other Operation				Non Agricultural Operation Related				Total			
	<20 N = 53		20+ N = 109		<20 N = 7		20+ N = 13		<20 N = 29		20+ N = 4		<20 N = 89		20+ N = 126	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Activities Associated with Injury Events																
Feeding	6	11.3	9	8.3	1	14.3	1	7.7	0	0	0	0	7	7.9	10	7.9
Herding/Moving	3	5.7	15	13.8	1	14.3	4	30.8	0	0	0	0	4	4.5	19	15.1
Riding animals	32	60.4	63	57.8	5	71.4	4	30.8	25	86.2	4	100	62	69.7	71	56.3
Working with animals, NEC	7	13.2	9	8.3	0	0	3	23.1	2	6.9	0	0	9	10.1	12	9.5
Other (specify)*	5	9.4	10	9.2	0	0	1	7.7	2	6.9	0	0	7	7.9	11	8.7
Unknown	0	0	3	2.8	0	0	0	0	0	0	0	0	0	0	3	2.4

*Breeding; trimming hooves/shoeing; opening/closing door/gate; passenger/in tractor/vehicle; bystander; driver of tractor/vehicle; play (general); fencing/fixing fence; treatment; chasing animals; checking on/looking for animals

and for children whose head of household age was <35 years versus >55 years of age (OR 0.1; CI 0.0-0.8).

Compared with 0 hours work per week on one's own operation, risk increased greatly for children with increasing ranges of hours worked. However, this finding was limited by sample size. A history of prior, versus no prior, agricultural injury (OR 4.6; CI 2.4-8.6) was also important for children. Increased risk was also identified for non-Caucasian versus Caucasian respondents (OR 4.7; CI 1.1-20.6).

Among adults, increased risks were identified for education completion of less than high school (OR 3.1; CI 1.2-8.1) compared with college or post-graduate education. Increased risks were also identified for respondents with prior, versus no prior, injury history (OR 3.8; CI 2.4-6.2) and for non-Caucasian versus Caucasian respondents (OR 3.5; CI 1.1-11.2).

Discussion

This study provides new information on the magnitude and consequences of, and potential risk factors for horse-related injuries in a large Midwest population. Due to major differences in types and methods of prior studies, key findings cannot be compared. However, such injuries have been reported from descriptive case studies.[6,7,23-27]

In the current study, very small percentages of those injured required hospitalization. This highlights limitations of hospital surveillance data that may include the more severe and life threatening injuries, but represent a small proportion of the problem. However, a very large proportion of the injured required some form of health care. Moreover, the impact of horse-related injuries on agricultural households was evident. For both age groups, <20 and 20+ years of age, 85% had some restriction, and nearly 40% involved restriction from 1 week to 3+ months. Restrictions of this magnitude can affect the productivity of the operation, resulting in heavy financial impacts. Notably, the severity of these injuries, similar for both age groups and both agriculture- and non-agriculture-related injuries, including recreational injuries, resulted in a major burden on these operations.

The primary activity associated with injuries, for those aged <20 and 20+, was riding animals that resulted in falls. Previous studies have also reported the problem of riding activities.[5,7,25-26,28,29] However, methods and populations were not comparable to the current study.

Multivariate analyses identified some novel patterns of risks. Children were at increased risk of horse-related injury in North and South Dakota, where beef cattle ranches are more prevalent, compared with Minnesota; however, this was not true for adults. Similarly, the greater risk for young females was not seen in adults. Most studies of agricultural injury have reported males as being at higher risk than females; but, those results were not specific to horse-related injuries.[30-32] Others[5,7,33] also reported higher injury rates for females than males. It is likely that exposure time, especially for riding activities, was much greater for females than males in this population; if exposure time could be controlled for, rates would be expected to be more comparable.

Among children, injury risk increased with increasing ranges of hours worked; however, the

Table 3. Multivariate Analyses: Models Specific to Adults and Children–Personal Risk of Any Horse-Related Injury Among Agricultural Household Members: RRIS—II

Variable		Children/Youth (<20 Year Age Group) Number at Risk	Events	OR: Personal Risk	95% CI	Adults (20+ Year Age Group) Number at Risk	Events	OR: Personal Risk	95% CI
State of Residence*									
Minnesota		3179	3	1	- -	3071	20	1	- -
Nebraska		3414	5	1.4	(0.3, 6.0)	3257	26	1.3	(0.7, 2.3)
North Dakota		3036	18	6.7	(2.0, 22.9)	2985	18	0.9	(0.5, 1.8)
South Dakota		3691	19	5.9	(1.8, 20.0)	3582	32	1.4	(0.8, 2.4)
Wisconsin		2773	5	2.1	(0.5, 8.7)	2662	8	0.4	(0.2, 1.0)
Gender§									
Male		8393	15	0.4	(0.2, 0.7)	7952	56	1.1	(0.7, 1.6)
Female		7700	35	1	- -	7605	48	1	- -
Age group (years)‡									
Children	Adults								
0-4	20-25	2261	1	0.37	(0.04, 3.5)	1204	5	0.5	(0.2, 1.3)
5-9	25-35	3554	9	0.93	(0.4, 2.1)	2091	12	0.7	(0.4, 1.2)
10-14	35-45	4895	22	1.45	(0.8, 2.9)	6949	55	1	- -
15-19	45-55	5385	18	1	- -	4505	27	0.7	(0.5, 1.2)
	55-65					658	4	0.8	(0.3, 2.1)
	65+					150	1	1.1	(0.2, 7.6)
Hours worked on one's own operation/week¶									
0		4414	1	0.05	(0.01, 0.4)				
>0-20		9501	35	1	–	5452	37	1.6	(0.5, 5.1)
>20-40		1580	10	2.58	(1.2, 5.6)	2864	23	1.8	(0.6, 5.5)
>40-60		228	1	2.49	(0.3, 20.7)	2449	19	1.7	(0.6, 5.1)
>60-80		55	1	7.49	(1.0, 57.7)	2254	17	1.6	(0.5, 4.8)
>80						834	4	1	- -
Prior injury†									
No		14384	34	1	- -	10683	41	1	- -
Yes		1565	16	4.6	(2.4, 8.6)	4830	63	3.8	(2.4, 6.2)
Race									
White		15858	47	1	- -	15402	101	1	- -
Non-White		214	3	4.7	(1.1, 20.6)	130	3	3.5	(1.1, 11.2)
Head of household age group									
25-34		1463	1	0.1	(0.0, 0.8)				
35-44		8392	24	0.4	(0.2, 1.2)				
45-54		5371	19	0.5	(0.2, 1.4)				
55+		845	6	1	–				
Educational status** (Head of household's education for children)									
Less than high school graduate						467	7	3.1	(1.2, 8.1)
High school/equivalent		3882	7	0.5	(0.2, 1.3)	5783	37	1.1	(0.6, 1.9)
Technical/some college		6380	17	0.7	(0.3, 1.3)	5689	39	1.2	(0.7, 2.1)
College/post graduate		5689	26	1	- -	3592	21	1	- -
Marital status¥									
Married/living as married						13939	94	1	- -
Never married						1263	7	1.2	(0.3, 5.5)
Separated/divorced/						244	2	1.2	(0.3, 4.8)
Widowed						80	1	3.2	(0.3, 31.2)

*Adjusted for age and gender.
§Adjusted for age and state.
‡Adjusted for gender and state (and head of household age for children).
¶Children: Adjusted for child's age, head of household age, gender, head of household education, prior agricultural injury. Adults: Adjusted for age, gender, marital status, education, prior injury.
†Children: Adjusted for age, state, gender, head of household education. Adults: Adjusted for age, gender, state, marital status, education.
**Children: Adjusted for head of household age, state. Adults: Adjusted for age, gender and state.
¥Adjusted for age, gender, state, education.

estimates were limited. Previous studies of agricultural injury, in general, have also shown such findings.[2,10-11] In the current study, an increased risk of horse-related injury was identified for respondents with a prior history of agricultural injury. While such risks have been identified in agriculture, generally, horse-related injuries had not previously been examined.[13,34]

The potential for recall bias, inherent in any study, could have resulted in the misclassification of subjects on exposure and/or outcome but was decreased by utilizing two 6-month recall periods, rather than longer periods. This approach was based on 2 major relevant validation efforts.[35-37] Recall bias was also minimized by providing participants with packets for recording injury information throughout the study period.[10,11] Another potential bias was misclassification of the injury source. Allowing an injury to be coded for more than 1 source minimized this bias. While non-response is also a potential issue, an 86% response rate obtained among those eligible, provided the advantage of obtaining data for the vast majority of events. Moreover, specific techniques, previously identified, enabled adjustment for potential selection bias[17] and unknown eligibility,[18] and controlled for potential confounding factors.[20-22]

From a previous similar study, in the same region,[19] it was determined that all operations had at least one horse, thus, providing the potential for related injuries. Because this was not specifically identified for all operations in the current studies,[10,11] the results presented may be very conservative.

Future studies could build on this study through data collection of additional environmental information, eg, weather conditions, surface hazards and barriers, use of protective clothing (eg, headgear), and time spent in horse-related activities.[38,39] Within the current study design, this was not possible for every injury source/vehicle.

Despite potential limitations, this analytical study provided new data on the magnitude and consequences of horse-related injuries in a large population, including the severity, impact on the agricultural operation, and potential risk factors for these injuries. Clearly, such injuries represent a significant problem among agricultural operations. Identification of potential risk factors for these injuries serves not only as a basis for further research but, also, as a foundation for intervention efforts.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Figure S1. Horse-Related Injuries to Children: Regional Rural Injury Study II (RRIS-II): Causal Model for Multivariate Analyses.
Figure S2. Horse-Related Injuries to Adults: Regional Rural Injury Study II (RRIS-II): Causal Model for Multivariate Analyses.
Table S1. Horse-Related Injury Event Rates per 1,000 Persons/Year among Agricultural Household Members: Regional Rural Injury Study – II.

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