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Characteristics of Fatal Agricultural Injuries by Production Type

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Abstract

Although agriculture is recognized as a hazardous industry, it is unclear how fatal agricultural injuries differ by production type. The purpose of this study was to characterize fatal occupational injuries in agriculture, comparing crop and animal production, and determine which risk factors are specifically associated with each production type. A cross-sectional study was conducted among crop and animal producers using data from the Census of Fatal Occupational Injuries in the Midwest region from 2005 to 2012. Rates of fatal injury by production type were estimated. The frequency of fatal injury in each production type was also reported by demographic and injury characteristics. Finally, a logistic regression was performed to determine whether age, gender, injury timing, or injury event/exposure type were associated with crop or animal production. A total of 1,858 fatal agriculture-related injuries were identified, with 1,341 in crop production and 517 in animal production. The estimated rate of fatal injury was higher in crop production than in animal production (15.9 vs. 10.8 per 100,000 workers). Fatal injuries among young and elderly agricultural workers were significantly associated with crop production compared to animal production. Animal assaults, falls, and exposure to harmful substances or environments were significantly associated with animal production. Fatal agricultural injury is more common in crop production. However, the characteristics and risk factors of fatal injuries differ by production type. Intervention strategies may be guided by considering the production-specific risk factors.

Keywords

Animal production; Crop production; Fatalities; Injury; Occupational

The agricultural industry has one of the highest fatality rates in the U.S. Numerous hazards threaten agricultural workers, including exposure to machinery, animals, chemicals, noise, and physical stress, which can be compounded by the fact that agricultural activities are often performed in rural environments with limited access to medical services.

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Although injury surveillance among agricultural workers has existed in the U.S. since the 1940s, the hazards associated with agriculture were brought to light in 1988 by the National Coalition for Agricultural Safety and Health (Merchant et al., 1988). Their recommendations prompted increased national recognition and support for efforts to improve surveillance, increase research funding for agricultural safety and health, and implement prevention strategies. Since 1992, the Bureau of Labor Statistics has collected data via the Census for Fatal Occupational Injuries (CFOI) to monitor the occurrence of work-related deaths in the U.S., including those among agricultural workers (BLS, 2012a).

The agriculture industry contains different types of producers, with hazards specific to their job tasks (McCurdy and Carroll, 2000; Stueland et al., 1993). Agricultural workers involved in crop production may have increased exposures to certain types of heavy equipment (e.g., combines) and chemicals (e.g., pesticides and fertilizers) used in planting and harvesting. In contrast, workers tending livestock face physical hazards from the animals as well as during activities required for animal upkeep (e.g., cleaning manure pits). Furthermore, agricultural workers producing different commodities are affected by numerous other factors, such as job location and seasonality, in unique ways. These differences in occupational exposures influence the risk, type, and severity of injuries experienced by agricultural workers in different production types.

While numerous studies have examined fatalities in the overall agricultural industry, few studies have reported risk factors specifically associated with crop and animal production. Studies that examined fatalities by production type have focused on specific age groups, such as youth (Castillo et al., 2000; Hard and Myers, 2006; Myers et al., 2009) or older workers (Castillo et al., 2000; Hard and Myers, 2006; Myers et al., 2009), and analyzed data now more than five years old. Those studies showed that fatal injury rates are higher for youth and elderly agricultural workers in crop production compared to animal production. Furthermore, although nearly half of agricultural fatalities occur in the Midwest (Hard et al., 2002), no studies have presented information specific to that region. Our study compares various factors related to fatalities, comparing animal and crop production for Midwestern agricultural workers, using the Census of Fatal Occupational Injuries (CFOI) from 2005–2012.

Methods

Study Design and Population

The Bureau of Labor Statistics annually releases CFOI data that contain information on fatal occupational injuries occurring in the U.S. (BLS, 2012a). To be included in the CFOI, the decedent must have been employed at the time of the event, engaged in a legal work activity, or present at a site as a job requirement. Public and private sector non-institutionalized workers (i.e., wage and salary, self-employed, and volunteer) are included. The CFOI excludes deaths that occurred during a worker's normal commute to and from work and deaths related to occupational illnesses (e.g., lung disease or cancer). Various sources of information are used to verify work-related fatalities, including death certificates, workers' compensation reports, news media, other federal, state, and local government agency reports, and private sources. Our study years ranged from 2005 through 2012 and included the

twelve states in the CFOI Midwest region: Iowa, Illinois, Indiana, Kansas, Michigan, Minnesota, Missouri, North Dakota, Nebraska, Ohio, South Dakota, and Wisconsin. Access to the CFOI data was granted to the Great Plains Center for Agricultural Health for the purposes of agriculture injury surveillance over this time period.

Our sample included agricultural occupational fatalities (n = 1,858), which were identified using North American Industrial Classification System (NAICS) codes: 111 (crop production), 112 (animal production), 1151 (support activities for crop production), and 1152 (support activities for animal production). All occupation codes were included. Totals were calculated with restricted access to the CFOI research file.

Variables

Variables examined in our study included age, gender, location of incident, date and time of incident, nature of injury, body part affected, days survived after injury, location of injury event, worker activity, and event/exposure type. Nature of injury, body part affected, and event/exposure type were coded using the Occupational Injury and Illness Classification System division of major group codes (BLS, 2012b). Industry and geographic codes for states in the Midwestern region were used to obtain our study population.

Analysis

Data were obtained in a tab-delimited format and imported into SAS 9.3 for analysis (SAS Institute, Inc., Cary, N.C.). Annual fatality rates were calculated by agriculture production type by year using the number of fatalities as the numerator and the number of agricultural workers in the region, as obtained from the 2012 Occupational Injury Surveillance of Production Agriculture (OISPA) survey, as the denominator (NIOSH, 2014). The number of agricultural workers obtained from the OISPA survey included both household and hired workers. Frequency tables were used to describe the distribution of demographics and injury characteristics by type of production (animal vs. crop). Bivariate analyses were performed to determine whether age, gender, day of week, time, month, and cause of injury were crudely associated with agriculture production type. A logistic regression model was then fit to determine whether these variables were independently predictive of agriculture production type.

Results

Our sample was comprised of 1,858 agriculture-related occupational fatalities in twelve Midwestern states from 2005 through 2012. The majority of deaths (n = 1,341) occurred in crop production, while the remaining 517 deaths occurred in animal production. Of the 1,858 injuries, 1,650 injuries had complete covariate data and were used in the multi-variable analysis.

The average agricultural occupational fatality rate for the Midwestern states for this time period was 14.0 per 100,000 workers (table 1). The average agricultural occupational fatality rate in animal production was only 68% (rate ratio = 0.68) that of crop production (10.8 and 15.9 per 100,000 workers, respectively). The agricultural occupational fatality among crop producers was consistently higher, ranging from 1.2 to 2.1 times (rate ratio = 0.48 to 0.80)

the agricultural occupational fatality of animal producers. From 2005 to 2012, the highest annual occupational agricultural fatality rate occurred in 2005 (16.4 per 100,000 workers) and corresponded to the highest rate of crop production fatalities, which also occurred in 2005 (20.3 per 100,000 workers). The highest rate of animal production fatalities occurred in 2010 (11.5 per 100,000 workers).

Despite fluctuations in the injury rates from 2005 to 2012, both the overall and production-specific injury rates remained fairly constant (fig. 1). The largest drop in overall injuries occurred from 2005 to 2006 and corresponded to a decline in crop fatalities; however, trends in overall and crop-specific fatalities rose again and peaked in 2010. The rate of animal production fatalities exhibited slight declines in 2005 and 2011 but has been largely constant over this period.

Demographic and Injury Characteristics of Agriculture-Related Occupational Fatalities

The proportion of agriculture-related fatalities increased with age; the highest proportion (nearly 42%) occurred among those age 65 and older, and over three-quarters occurred among those age 45 and older (table 2). The majority (94%) of fatalities occurred among males. Injuries were nearly three times as frequent during the work week (Monday through Friday) compared to the weekend and were more common during the workday (6:00 a.m. to 5:59 p.m.). Agriculture-related fatalities were most frequent in the growing (34.9%) and harvest seasons (32%), which take place during summer and fall months.

Multiple trauma, involving multiple injury diagnoses, caused 28.8% of deaths among fatally injured farmers, and 29.9% had injuries to multiple body parts. Internal organ or blood vessel injuries (25.5%) and intracranial injuries (16.1%) were the second and third leading causes of death (table 3). For fatal injuries in animal production, the injuries most frequently occurred to the trunk (28.2%), multiple body parts (25.7%), and head (21.5%), while crop production injuries were most common to multiple body parts (31.5%), the trunk (28.9%), and body systems (20.1%). The majority of injured agricultural workers died less than 24 hours after the time of injury (85.6%).

The majority (79.8%) of fatal agriculture-related injuries occurred on the farm (table 4). Nearly half of all injuries were due to transportation-related events (49.1%), although such events appeared to be proportionally less common among animal production workers (39.7%) compared to crop production workers (52.8%). Contact with objects and equipment was the second leading cause of injury in both production types, accounting for nearly one-third of all agriculture-related fatalities.

Table 5 provides a more detailed list of the leading event/exposure types in each category. Transportation-related subtypes are common in both production types, including motor vehicle incidents on and off the roadway as well as pedestrian incidents; non-roadway motor vehicle incidents are the leading event/exposure type for both animal (22.4%) and crop production (33.2%). Machinery-related injuries, including being struck by/against or caught/compressed by objects or equipment, are also common events in both production types. Animal-related incidents are the fourth leading cause of agriculture-related occupational fatalities in animal production (12.2%) but are not among the highest event types in crop

production. Being caught in collapsing materials appears to be more common in crop production (9.2%) but also accounts for 2.7% of animal production injuries. The proportion of falls to a lower level appears similar in both animal (5.8%) and crop (4.3%) production, while falls on the same level appear more common in animal production (2.9%). Several other event types are among the top ten in each category, but each contributes less than 5% to the total fatalities per group.

Association of Selected Variables with Agriculture Production Type

Both the crude and adjusted analyses showed that the age extremes were associated with crop production fatalities (table 6). Compared to adults age 25 to 44, children below the age of 16 had half the odds (adjusted OR = 0.40, 95% CI = 0.19–0.84) of having an animal production death as opposed to a crop production death. Similarly, agriculture-related deaths had significantly lower odds of being animal related for adults age 45–64 (adjusted OR = 0.61, 95% CI = 0.44–0.85) and for those age 65+ (adjusted OR = 0.42, 95% CI = 0.30–0.59).

Among injury event/exposure types, animal-related injuries were the most strongly associated with production type (table 6); animal-related events had 14 times the odds of occurring in animal production as opposed to crop production (adjusted OR = 14.19, 95% CI = 7.62–26.41). Additionally, fatalities resulting from falls (adjusted OR = 2.51, 95% CI = 1.59–3.97) and exposures to harmful substances or environments (adjusted OR = 1.75, 95% CI = 1.03–2.97) both had approximately 2-fold greater odds of occurring in animal production as opposed to crop production. Violence by persons/self-inflicted injury and contact with objects/equipment were not associated with a particular production type.

In the crude analysis, deaths during the growing season (June to August) were significantly associated with crop production; however, this effect was no longer significant in the adjusted analysis (table 6). Neither sex, day of occurrence, or time of occurrence were significantly associated with production type in the crude or adjusted analyses.

Discussion

This study aimed to describe the differences between fatal injuries in animal vs. crop production in the Midwestern region. Our results showed that both the frequency and estimated rate of fatal injury is larger for crop production (table 1), which has been shown nationally using prior years of CFOI data (Hard et al., 2002; Myers et al., 2009). Our study showed that fatal injuries occur approximately 1.5 times more often in crop production than in animal production. Additionally, despite some fluctuation in rates over time, the difference between fatal injury rates in animal and crop production has been largely stable over the eight years of our Midwestern sample, as it has been in the past nationally (Hard et al., 2002).

In contrast to the higher fatality rates among crop producers, previous work has shown that nonfatal injury incidence is not necessarily higher among crop producers. Some studies have found that rates are comparable between the two groups, while others have found that nonfatal injury rates are actually higher in animal production, e.g., 5.9 vs. 3.5 injuries per

100 (Myers et al., 2009). If the proportions of fatal injury were equal in crop and animal production, one would expect the rates of fatal injury to follow the same patterns as the rates of nonfatal injury. Instead, the higher rates of fatal injury in crop production indicate that a greater proportion of injuries in crop production prove fatal when compared to animal production.

Our results also indicate that the odds of a fatal injury occurring in animal vs. crop production differ by age (table 6). The most pronounced differences were seen at the age extremes, among those age <16 and 65+. In each of these age categories, fatalities had twice the odds of occurring in crop production. Previous studies have shown that the fatal injury rate may be more than twice as high for youth (under 20) working in crop production compared to those working in animal production (Hard and Myers, 2006). Similarly, the fatal injury rate among agricultural workers age 55 and older may be more than three times as high in crop production (Myers et al., 2009). Although both youth and elderly workers have previously been defined as at-risk populations in agriculture, these results suggest that this may be particularly true among those involved in crop production in the Midwest.

Several injury event types were significantly associated with animal production. As-saults by animals were most strongly associated with animal production, causing 12.2% of deaths in animal production but only a minority of deaths in crop production. While this is a logical finding, the high number of deaths from animals suggests the need for increased programs in safe animal handling. Falls were the second leading cause of injury in both animal and crop production fatalities but had 2.5 times the odds of occurring in animal production. We considered that this increase in fall risk may be due to animals, but animals were not listed as the primary or secondary source of injury for any fall fatalities (data not shown). Falls on the same level accounted for a higher proportion of animal production falls compared to crop production falls, suggesting that slipperiness, clutter, or surface instability may be a greater hazard in animal production. Fatalities due to exposure to harmful substances or environments were also found to have 1.7 times the odds of occurring in animal production, but this result was only marginally significant. Common exposures in animal production include gases from animal waste or silage, while electrocutions were notable in crop production. Overall, exposure to harmful substances or environments only accounted for 6.6% and 4.0% of injury fatalities in animal and crop production, respectively.

Despite these associations between injury event types and production type, the most frequent cause of agricultural occupational fatalities in both animal and crop production was transportation. In particular, we found that non-roadway incidents were the leading cause of death in both groups. Previous analyses of CFOI data indicated that tractors, particularly overturn events, are the leading cause of agricultural occupational fatality (Hard et al., 2002). Although studies have found that the rates of tractor-related fatalities may be declining, possibly due to increased adoption of rollover protective structures, the rate of tractor overturn deaths remains high, particularly in crop production (Myers and Hendricks, 2010). Other types of transportation-related injuries, including falls/ejections, run-over events, and collisions, also contribute to agricultural fatalities (Hard and Myers, 2006; Pickett et al., 1999). Transportation-related injuries should continue to be a priority area for injury prevention efforts aimed at reducing agricultural fatalities.

Strengths and Limitations

This study used population-based surveillance data to identify differences in the rates and characteristics of agriculture-related occupational injury fatalities by production type. While previous studies have focused primarily on specific demographics or injury types, our analysis of a broad occupational sample helps fill a gap in the literature. Furthermore, our focus on the Midwest has allowed us to provide geographically specific information to agricultural safety and health workers in our region.

This study contains several limitations that warrant mention. First, since we used an occupational data base, one limitation of our study is incomplete case identification based on inclusion in the CFOI data, which depends on an ability to identify work-relatedness. Injuries in certain populations, such as children living on the farm or undocumented workers, may be less likely to be identified or classified as work-related, despite their contribution to agricultural activities. The frequencies reported in this study likely underestimate the true number of agriculture-related occupational fatalities. Second, rates were calculated using the number of household and part-time workers according to the 2012 OISPA survey. This denominator does not include volunteer workers on the farm and may underestimate the actual number of agricultural workers in the Midwest, leading to an inflation of our calculated fatality rates. Furthermore, since only the 2012 OISPA estimates were available, we could not capture annual shifts in farming employment. Although the relative magnitudes of these rates may be more robust against error, an imprecise denominator may also introduce bias into our estimation of the rate ratios.

Conclusion

The characteristics of fatal agricultural injuries differ by production type. Several causes of fatal injury, most significantly animal assaults, were significantly associated with animal production and represent opportunities for tailored injury prevention strategies. Additionally, this study also found that fatalities among younger and older workers were associated with crop production, suggesting that continued work is needed to reduce injury among vulnerable workers in crop production. Interventions that aim to reduce agricultural injury may be improved by considering the risk factors associated with specific production types.

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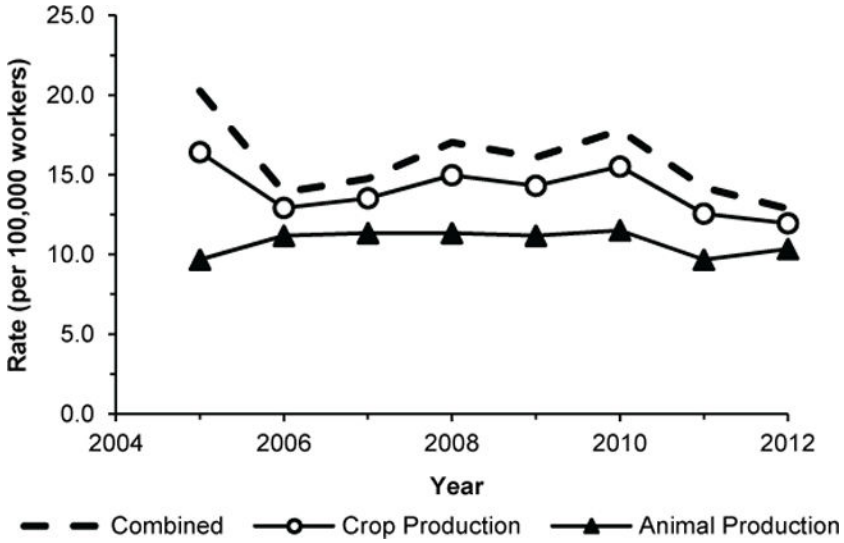

Figure 1.
Rates of fatal occupational injury in Midwest region by production type.

Table 1

Rates of occupational fatality by production type in twelve Midwestern[a] states.

			Agriculture Production Type				
	Total[b]		Animal[b]		Crop[b]		
Year	N	Rate[c]	N	Rate[c]	N	Rate[c]	Rate Ratio[d]
2005	272	16.4	58	9.7	214	20.3	0.48
2006	214	12.9	67	11.2	147	13.9	0.80
2007	224	13.5	68	11.3	156	14.8	0.77
2008	248	15.0	68	11.3	180	17.0	0.67
2009	237	14.3	67	11.2	170	16.1	0.69
2010	257	15.5	69	11.5	188	17.8	0.65
2011	208	12.6	58	9.7	150	14.2	0.68
2012	198	12.0	62	10.3	136	12.9	0.80
Total rate	1858	14.0	517	10.8	1342	15.9	0.68

[a] Midwest = Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.

[b] Frequencies were calculated with restricted access to the CFOI research file.

[c] Rates are reported per 100,000 farm workers.

[d] Rate ratio = $\text{Rate}_{\text{animal}}/\text{Rate}_{\text{crop}}$.

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Table 2

Demographics of agriculture-related occupational fatalities in twelve Midwestern[a] states.

			Agricultural Production Type			
	Total[b]		Animal[b]		Crop[b]	
Characteristics	**N**	**(%)**	**N**	**(%)**	**N**	**(%)**
Total	1858		517		1341	
Age						
<16	55	(3.0)	11	(2.1)	44	(3.3)
16–24	104	(5.6)	38	(7.4)	66	(4.9)
25–44	260	(14.0)	97	(18.8)	163	(12.2)
45–64	673	(36.2)	193	(37.3)	480	(35.8)
65+	766	(41.2)	178	(34.4)	588	(43.8)
Gender						
Male	1755	(94.5)	483	(93.4)	1272	(94.9)
Female	103	(5.5)	34	(6.6)	69	(5.1)
Day of occurrence						
Weekday	1363	(73.4)	370	(71.6)	993	(74.1)
Weekend	495	(26.6)	147	(28.4)	348	(26.0)
Time of occurrence						
Workday (6:00 a.m. to 5:59 p.m.)	1321	(71.1)	344	(66.5)	977	(72.9)
Non-workday	329	(17.7)	95	(18.4)	234	(17.5)
Not reported	208	(11.2)	78	(15.1)	130	(9.7)
Month of occurrence						
Winter (January to March)	291	(15.7)	100	(19.3)	191	(14.2)
Planting season (April to May)	325	(17.5)	97	(18.8)	228	(17.0)
Growing season (June to August)	648	(34.9)	167	(32.3)	481	(35.9)
Harvest season (September to December)	594	(32.0)	153	(29.6)	441	(32.9)

[a]Midwest = Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.

[b] Frequencies were calculated with restricted access to the CFOI research file.

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Table 3

Injury event characteristics of agriculture-related occupational fatalities by age in twelve Midwestern[a] states.

			Agriculture Production Type			
	Total[b]		Animal[b]		Crop[b]	
Characteristics	**N**	**(%)**	**N**	**(%)**	**N**	**(%)**
Total	1858		517		1341	
Nature of injury						
Multiple injuries	536	(28.8)	131	(25.3)	405	(30.2)
Internal organ/blood vessel	473	(25.5)	125	(24.2)	348	(26.0)
Intracranial injuries	300	(16.1)	102	(19.7)	198	(14.8)
Asphyxiation	287	(15.4)	70	(13.5)	217	(16.2)
Bone/nerve/spinal cord injuries	54	(2.9)	20	(3.9)	34	(2.5)
Open wounds	50	(2.7)	17	(3.3)	33	(2.5)
Burns/environmental effects	39	(2.1)	8	(1.6)	31	(2.3)
Other injuries/unknown	119	(6.4)	44	(8.5)	75	(5.6)
Body part injured						
Multiple body parts	555	(29.9)	133	(25.7)	422	(31.5)
Trunk	534	(28.7)	146	(28.2)	388	(28.9)
Body systems[c]	372	(20.0)	102	(19.7)	270	(20.1)
Head	319	(17.2)	111	(21.5)	208	(15.5)
Neck (including throat)	44	(2.4)	13	(2.5)	31	(2.3)
Extremities/other	34	(1.8)	12	(2.3)	22	(1.6)
Number of days worker lived after injury						
0	1591	(85.6)	409	(79.1)	1182	(88.1)
1	97	(5.2)	42	(8.1)	55	(4.1)
2	33	(1.8)	14	(2.7)	19	(1.4)
3–7	43	(2.3)	15	(2.9)	28	(2.1)
8–14	33	(1.8)	12	(2.3)	21	(1.6)
15+	61	(3.3)	25	(4.8)	36	(2.7)

[a] Midwest = Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.

[b] Frequencies were calculated with restricted access to the CFOI research file.

[c] Injuries are classified as body systems when the functioning of an entire body system has been affected without specific injury to any other part of the body.

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Table 4

Place of occurrence, activity, and cause of injury at time of injury for agriculture-related occupational fatalities by production type in twelve Midwestern[a] states.

			Agriculture Production Type			
	Total[b]		Animal[b]		Crop[b]	
Characteristics	**N**	**(%)**	**N**	**(%)**	**N**	**(%)**
Total	1858		517		1341	
Location of injury event						
Farm	1482	(79.8)	427	(82.6)	1055	(78.7)
Home	23	(1.2)	_[d]	_[d]	_[d]	_[d]
Non-farm[c]	353	(19.1)	87	(16.9)	266	(19.9)
Activity at time of fatal injury						
Construct/repair/clean	326	(17.5)	73	(14.1)	253	(18.9)
Materials handling operations	125	(6.7)	40	(7.7)	85	(6.3)
Other activities[e]	271	(14.6)	140	(27.1)	131	(9.8)
Tools/machinery	178	(9.6)	42	(8.1)	136	(10.1)
Vehicle/transportation operations	958	(51.6)	222	(42.9)	736	(54.9)
Event/exposure type						
Animal-related	77	(4.1)	63	(12.2)	14	(1.0)
Violence by persons/self-inflicted injury	45	(2.4)	16	(3.1)	29	(2.2)
Contact w/objects/equipment	586	(31.5)	147	(28.4)	439	(32.7)
Falls	108	(5.8)	45	(8.7)	63	(4.7)
Harmful substances/environmental exposures	87	(4.7)	34	(6.6)	53	(4.0)
Transportation-related	913	(49.1)	205	(39.7)	708	(52.8)
Other	42	(2.3)	7	(1.4)	35	(2.6)

[a] Midwest = Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.

[b] Frequencies were calculated with restricted access to the CFOI research file.

[c] Includes home, industrial place/premise, public building, street/highway, and other places.

[d]No data or data that do not meet Bureau of Labor Statistics publication criteria.

[e]Includes protective service activities, not reporting, physical activities, and other activities.

Table 5

Ten leading detailed event/exposure types by production type for agriculture-related occupational fatalities in twelve Midwestern[a] states. Percentages are given as the percent total by production type.

Event or Exposure Type	Percentage[b]
Animal[c]	
Non-roadway motor vehicle incident	22.4%
Caught in/compressed by object or equipment	12.8%
Struck by/against object or equipment	12.6%
Animal-related incident	12.2%
Roadway/highway motor vehicle incidents	12.2%
Falls to lower level	5.8%
Exposure to harmful (caustic, noxious, or allergenic) substance	3.7%
Pedestrian vehicular incidents	3.3%
Falls on same level	2.9%
Struck, caught, or crushed in collapsing structure, equipment, or material	2.7%
Crop[c]	
Non-roadway motor vehicle incident	33.2%
Struck by/against object or equipment	17.9%
Roadway/highway motor vehicle incidents	12.8%
Caught in/compressed by object or equipment	9.2%
Struck, caught, or crushed in collapsing structure, equipment, or material	5.5%
Falls to lower level	4.3%
Pedestrian vehicular incidents	3.5%
Electrocution	1.8%
Aircraft incidents	1.7%
Self-inflicted injury	1.4%

[a] Midwest = Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.

[b] Percentages do not sum to 100%.

[c] Percentages were calculated with restricted access to the CFOI research file.

Table 6

Association for selected risk factors with animal production fatalities compared to crop production occupational fatalities in twelve Midwestern[a] states.

Characteristics	Crude OR[b]	95% CI	Adjusted OR[b]	95% CI
Age				
<16	0.45	(0.22–0.91)	0.40	(0.19–0.84)
16–24	0.96	(0.58–1.58)	0.88	(0.53–1.48)
25–44	ref	–	ref	–
45–64	0.67	(0.49–0.92)	0.61	(0.44–0.85)
65+	0.47	(0.34–0.65)	0.42	(0.30–0.59)
Gender				
Male	ref	–	ref	–
Female	1.28	(0.81–2.04)	1.06	(0.65–1.75)
Day of occurrence				
Weekday	ref	–	ref	–
Weekend	1.15	(0.88–1.51)	0.97	(0.75–1.26)
Time of occurrence				
Workday (6:00 a.m. to 5:59 p.m.)	ref	–	ref	–
Non-workday	1.07	(0.84–1.37)	1.10	(0.83–1.47)
Month of occurrence				
Winter (January to March)	ref	–	ref	–
Planting season (April to May)	0.90	(0.62–1.29)	1.04	(0.70–1.54)
Growing season (June to August)	0.68	(0.50–0.95)	0.79	(0.56–1.12)
Harvest season (September to December)	0.72	(0.52–1.00)	0.77	(0.55–1.10)
Event/exposure type				
Animal-related	13.06	(7.09–24.06)	14.19	(7.62–26.41)
Violence by persons/self-inflicted injury	1.29	(0.59–2.83)	1.06	(0.48–2.35)
Contact with objects or equipment	1.04	(0.81–1.35)	1.02	(0.78–1.33)
Falls	2.37	(1.51–3.71)	2.52	(1.60–3.99)
Harmful substances/environmental exposures	2.06	(1.22–3.46)	1.71	(1.01–2.91)
Transportation-related	ref	–	ref	–
Other	0.74	(0.30–1.81)	0.77	(0.31–1.92)

[a] Midwest = Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin

[b] Data for analyses was obtained restricted access to the CFOI research file.