# Pediatric Fall Injuries in Agricultural Settings: A New Look at a Common Injury Control Problem



**William Pickett, PhD**
**Suzanne Dostaler, MS**
**Richard L. Berg, MS**
**James G. Linneman, BA**
**Robert J. Brison, MD, MPH**
**Barbara Marlenga, PhD**

***Objectives:*** *Children on farms experience high risks for fall injuries. This study characterized the causes and consequences of fall injuries in this pediatric population.* ***Methods:*** *A retrospective case series was assembled from registries in Canada and the United States. A new matrix was used to classify each fall according to initiating mechanisms and injuries sustained on impact.* ***Results:*** *Fall injuries accounted for 41% (484/1193) of the case series. Twenty percent of the fall injuries were into the path of a moving hazard (complex falls), and 91% of complex falls were related to farm production. Sixty-one percent of complex falls from heights occurred while children were not working. Fatalities and hospitalized injuries were overrepresented in the complex falls.* ***Conclusions:*** *Pediatric fall injuries were common. This analysis provides a novel look at this occupational injury control problem.* (J Occup Environ Med. *2007;49:461–468*)

Falls are among the most common types of injury experienced in North American populations and are the leading cause of nonfatal childhood injury.[1–4] In most pediatric settings, fall injuries are generally experienced while children are walking, running, or engaged in recreational activities. Falls from heights are also common and typically involve children falling from stairs, beds, and playground equipment.[5] Falls involving children rarely result in death. Those that do typically involve children falling from excessive heights and landing on surfaces that impart major trauma to the head.[4,6,7]

In a recent policy statement, the American Academy of Pediatrics described common patterns of fall injury and presented a number of recommendations for prevention. These patterns focused on falls from heights such as windows, balconies, and roofs[4] and mainly cited evidence from urban-based studies. Pediatric falls in other settings (eg, rural settings, occupational environments) were not presented or discussed, probably because of a lack of contextual evidence about falls involving some pediatric populations. In occupational settings, existing child labor laws generally restrict children from entering the workplace, and, as a result, pediatric falls may not be perceived to be a problem. This perception may also exist for children in farm settings. However, farms are an occupational setting where many fall injury hazards are present and are potentially accessible to large populations of children.[8]

From the Department of Community Health and Epidemiology and Department of Emergency Medicine (Dr Pickett, Ms Dostaler, Dr Brison), Queen's University, Kingston, Canada; and Biomedical Informatics Research Center (Mr Berg, Mr Linneman) and National Children's Center for Rural and Agricultural Health and Safety (Dr Marlenga), Marshfield Clinic Research Foundation, Marshfield, Wisconsin.

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Address correspondence to: Barbara Marlenga, PhD, National Children's Center for Rural and Agricultural Health and Safety, Marshfield Clinic Research Foundation, 1000 North Oak Avenue, Marshfield, WI 54449; E-mail: marlenga.barbara@mcrf.mfldclin.edu.



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Underlying causes of pediatric fall injuries in the farm environment can be complex. Studies that describe the epidemiology of falls in agricultural settings do exist,[9–11] yet most existing studies have not characterized the multifactorial nature of fall injury events. Mechanisms associated with different types and severities of fall injury in these settings are not well documented. Combinations of farm worksite hazards that result in more serious types of pediatric fall injuries have also not been identified. This situation presents a challenge for the ongoing planning of fall injury prevention programs on farms and an opportunity for a more in-depth investigation.

We had the opportunity to use an existing registry of traumatic farm injuries to profile the occurrence of fall-related injuries to children on farms. Individual fall injury events were classified using a new matrix that considers both the initiating mechanisms of falls and the types of hazards that lead to injury on impact. We used this analysis to identify specific patterns of pediatric fall injuries that differentially lead to serious forms of injury. Our hope was that this analysis would provide foundational information to inform prevention efforts, as well as further the ongoing study of pediatric fall injuries on farms and in other settings.

## Materials and Methods

The study involved a primary review of a registry of pediatric farm injuries totaling 1193 injury events from 4 data sources. These data sources were assembled to represent fatal injuries, hospitalized injuries, and two forms of restricted activity injuries (among the general farm population and the minority farm population). Our ethics committees approved the study protocol.

### Definitions

Pediatric farm injuries were defined as injuries to children younger than 18 years old that occurred at a farm worksite (including the farmhouse yard) or during activities related to the operation of a farm, or both. Injuries that occurred inside the farm residence were excluded.[11] Pediatric farm injuries involving falls were defined inclusively as any injury event that involved 1) a fall on the same level (including slips/trips); or 2) a fall from a height, irrespective of the location from which children fell. Falls were identified from preexisting codes in combination with narrative descriptions of events of the injury.

### Fall Matrix

We developed a matrix to classify fall injuries according to both the initiating fall mechanism (four categories: falls from stationary objects on the same level, falls from moving objects on the same level, falls from stationary heights, or falls from moving heights), as well as the type of physical injury sustained on impact (four categories: blunt, penetrating, submersion, or complex fall injuries). The four categories describing initiating fall mechanisms were an extension of the standard categories used in the International Classification of Diseases E-Code system.[12] The four categories of physical injury on impact were based on standard categories used in trauma systems,[13] with one additional category. Simple blunt, penetrating, and submersion injuries were coded using standard trauma categories,[13] while complex fall injuries observed in our case series were classified as those in which the child fell into the path of any moving or operating hazard(s), and were subsequently injured in any manner.

The complete fall matrix is presented as Table A (supplementary). Because falls from moving objects on the same level ($n = 5$) and penetrating injuries ($n = 8$) were both uncommon in our registry, we merged some cells from the matrix for the present analysis. Therefore, the working matrix used in the current analyses was represented with a $3 \times 3$ structure (Table 1).

### Data Sources

### Fatalities

We obtained fatality data using methods developed by the Canadian Agricultural Injury Surveillance Program (CAISP).[14] The CAISP contains a comprehensive, population-based fatal injury data set. Canada has farming practices and child labor laws that are analogous to that observed in much of the United States,[15–17] and Canadian fatalities are considered to be typical of the spectrum of pediatric agricultural fatalities experienced in North America. An enhanced database was developed that contained every known case of a fatal agricultural childhood injury experienced in Canada between 1990 and 2001. The Canadian fatality case series data were supplemented with 17 US occupational fatality case reports from the National Institute for Occupational Safety and Health (NIOSH)

**TABLE 1**
Distribution of Number of Pediatric Fall Injuries in the Case Series According to the $3 \times 3$ Working Version of the Fall Injury Matrix*

| | Impact of Fall | | | |
|---|---|---|---|---|
| Initiation of Fall | Blunt/Penetrating Injury | Submersion Injury | Complex Fall Injury | Total |
| On same level | 53 | 10 | 15 | 78 |
| From stationary height | 135 | 22 | 9 | 166 |
| From moving height | 162 | 3 | 75 | 240 |
| Total | 350 | 35 | 99 | 484 |

*The complete fall matrix is available as supplemental tables online.

Fatal Assessment and Control Evaluation program from 1992 to 2000.[18]

### Injuries Resulting in Hospitalization

Similar to fatalities, a national registry of hospitalized farm injury cases has been developed in Canada.[19] We used the CAISP case identification approach to identify injured children treated at five regional pediatric hospitals and two general hospitals in Canada. These hospitals were from the provinces of Alberta and Ontario. We used a study period of 1989 to 2002 for the hospitalized injury portion of this study.

### Injuries Resulting in Restricted Activity

Data files from the 1998 Childhood Agricultural Injury Survey[20] and the 2000 Childhood Agricultural Injury Survey on Minority-Operated Farms[21] were obtained electronically from the NIOSH. Injuries identified within these surveys represent a spectrum of pediatric farm injuries that resulted in at least 4 hours of restricted activity or required medical care. Data for both surveys were collected by telephone interview from random samples of United States farm operators. Analogous data were not available in Canada.

### Instrument

A standardized data abstraction instrument was developed. This instrument was informed by existing literature and occupational injury classification systems that included falls.[1,22–27] A study glossary was developed to support application of the instrument. This glossary detailed the exact specifications and circumstances under which fall injury events were to be coded. Data elements covered within the instrument included case demographics, detailed descriptions of the injury event, factors associated with the initiation of the fall injury event (narrative description of where children fell from; documented evidence of falls from height versus falls on the same level, documented evidence of falls from a moving versus stationary hazard), and factors associated with the impact of the fall injury event (narrative description; documented evidence of blunt, penetrating, submersion, or complex injury).

### Case Identification

Using a standard protocol, three investigators independently abstracted and coded all 1193 cases according to whether a fall was involved in the injury event. We took a liberal approach to the identification of fall injuries and included all events in which there was direct evidence of a fall injury mechanism, as per our operational definitions. An initial series of 50 cases was selected purposefully to represent a variety of potential mechanisms of pediatric farm injury. Three raters coded each of the 50 cases according to whether a fall was involved. Discrepancies in inclusions and exclusions among these 50 cases were resolved by consensus, and the coding exercise was repeated with a second series of 50 cases and written decision rules. This step resulted in almost perfect agreement on inclusions and exclusions. The full case series was then coded; 486 of 1193 cases were initially identified as possible fall injury events. In two cases, it was subsequently determined that there was insufficient information available in the narrative to classify these cases as falls. In 49 of the remaining 484 cases, the location of injury was not recorded, but all (484 of 484) fall cases had sufficient data available in the narrative to code the cases according to the matrix.

### Classification of Fall Injury Events

We developed a second coding protocol using a series of validation exercises. In each exercise, 20 randomly selected cases were reviewed and coded by the three raters according to the fall matrix and associated instrument. Inter-rater agreement was then assessed. All disagreements were resolved through discussion, and the coding protocol and study glossary were updated. This process was repeated three times, and agreement reached 90% in the third exercise and the final case review proceeded. Any subsequent uncertainties in coding were resolved by consensus.

### Data Analysis

We profiled the fall injury case series according to data source, demographic factors, and fall-related study variables. Subsequent analyses described these injuries according to the fall matrix and other salient descriptors (age group, location of injury, activity leading to injury, data source, nature/anatomical site of injury). All analyses were descriptive.

### Prevention Priorities

Priorities for injury prevention were identified based on an a priori criterion. We first described patterns of injury using the new matrix. For each of the nine cells in the matrix, we calculated percentages of injuries within that cell that had a particular characteristic and compared those percentages with the percentage expected if the characteristic were distributed randomly. For example, one important descriptor is the age group of children injured by falls. Therefore, we calculated the percentage of injured children described in each cell for a particular age group and compared the cell proportions with the overall proportion of children in the particular age group. A fall injury priority was chosen if the proportion within the cell of the matrix was greater than the expected overall proportion for that characteristic.

## Results

### Overview

Results include the description of the events of the fall injury according to the working version of the fall matrix (Table 1) and other major descriptors (Table 2). In Table 3, the fall matrix is presented with values indicated by a double dagger foot-

**TABLE 2**
Description of Demographics and Injury Circumstances Associated With Pediatric Fall Injuries

| | Fatalities | | Hospitalized | | Restricted Activity | | Total | |
|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % |
| Total case series | 243 | 100.0 | 361 | 100.0 | 589 | 100.0 | 1193 | 100.0 |
| Nonfall related | 143 | 58.8 | 206 | 57.1 | 360 | 61.1 | 709 | 59.4 |
| Fall related | 100 | 41.2 | 155 | 42.9 | 229 | 38.9 | 484 | 40.6 |
| Fall-related total | 100 | 100.0 | 155 | 100.0 | 229 | 100.0 | 484 | 100.0 |
| Gender | | | | | | | | |
| Male | 82 | 82.0 | 105 | 67.7 | 158 | 69.0 | 345 | 71.3 |
| Female | 18 | 18.0 | 50 | 32.3 | 60 | 26.2 | 128 | 26.4 |
| Unknown | 0 | | 0 | | 11 | 4.8 | 11 | 2.3 |
| Age group | | | | | | | | |
| 1–6 yr | 50 | 50.0 | 55 | 35.5 | 41 | 17.9 | 146 | 30.2 |
| 7–12 yr | 25 | 25.0 | 70 | 45.2 | 111 | 48.5 | 206 | 42.6 |
| 13–17 yr | 25 | 25.0 | 30 | 19.4 | 77 | 33.6 | 132 | 27.3 |
| Fell from | | | | | | | | |
| Height | 85 | 85.0 | 137 | 88.4 | 184 | 80.3 | 406 | 83.9 |
| Same level | 15 | 15.0 | 18 | 11.6 | 45 | 19.7 | 78 | 16.1 |
| Leading location of fall | | | | | | | | |
| Farm or house yard | 30 | 30.0 | 21 | 13.5 | 99 | 43.2 | 150 | 31.0 |
| Barn (inside) | 5 | 5.0 | 51 | 32.9 | 25 | 10.9 | 81 | 16.7 |
| Crop field/orchard | 21 | 21.0 | 17 | 11.0 | 17 | 7.4 | 55 | 11.4 |
| Pasture | 3 | 3.0 | 5 | 3.2 | 44 | 19.2 | 52 | 10.7 |
| Farm or public road/drive | 16 | 16.0 | 3 | 1.9 | 22 | 9.6 | 41 | 8.5 |
| Leading hazards fell from | | | | | | | | |
| Horse or pony | 4 | 4.0 | 11 | 7.1 | 60 | 26.2 | 75 | 15.5 |
| Ground surface | 22 | 22.0 | 14 | 9.0 | 33 | 14.4 | 69 | 14.3 |
| Farm tractor | 33 | 33.0 | 19 | 12.3 | 11 | 4.8 | 63 | 13.0 |
| Farmstead equipment | 7 | 7.0 | 30 | 19.4 | 16 | 7.0 | 53 | 11.0 |
| Height in barn or silo | 5 | 5.0 | 41 | 26.5 | 4 | 1.7 | 50 | 10.3 |
| Hay bales | 0 | 0.0 | 18 | 11.6 | 3 | 1.3 | 21 | 4.3 |
| Bicycle | 2 | 2.0 | 0 | 0.0 | 19 | 8.3 | 21 | 4.3 |
| Play structure | 0 | 0.0 | 3 | 1.9 | 16 | 7.0 | 19 | 3.9 |
| All-terrain vehicle | 1 | 1.0 | 1 | 0.6 | 15 | 6.6 | 17 | 3.5 |
| Leading hazards fell onto | | | | | | | | |
| Ground | 50 | 50.0 | 84 | 54.2 | 159 | 69.4 | 293 | 60.5 |
| Floor | 5 | 5.0 | 41 | 26.5 | 25 | 10.9 | 71 | 14.7 |
| Roadway | 8 | 8.0 | 4 | 2.6 | 31 | 13.5 | 43 | 8.9 |
| Water or liquid | 28 | 28.0 | 4 | 2.6 | 1 | 0.4 | 33 | 6.8 |
| Machinery | 5 | 5.0 | 13 | 8.4 | 4 | 1.7 | 22 | 4.5 |

note symbol identifying priorities for prevention for children of different ages and in Table 4 children's activities associated with work and production hazards. Leading natures and anatomical sites of injury associated with different cells of the matrix are summarized in Table 5. The observed patterns of fall injury lead to a number of summary observations.

## Falls are a Relatively Common Form of Injury Experienced by Children on Farms

Fall injuries accounted for 484 of 1193 (40.6%) of the injuries contained in the registry, a proportion that was consistent across data sources. The case series included 100 fatalities, 155 hospital admissions, and 229 injuries resulting in restricted activity.

## A Number of Hazards on Farms are Commonly Associated With Fall Injuries to Children

Farm children fall in a number of different places and from a variety of associated hazards. Although some variations were observed by data source (Table 2), leading locations of fall injury included farmyards and barns. Approximately three-quarters of the falls were onto the ground or floor surfaces.

## Fall Injury Prevention Priorities Differ by Age Group and Activity

Priorities were selected by comparing observed versus expected percentages in cells of the fall injury matrix. To illustrate, priorities in the youngest (ages 0–6) children were blunt injuries (eg, falls from heights in barns), submersion injuries (eg, falls into ponds and lagoons), and complex falls (eg, falls from tractors and farm machinery) (Table 3).

**TABLE 3**
Percentages of Different Types of Fall Injury By Age Group According to the Fall Matrix*

| Initiation of Fall | Impact of Fall: Blunt/Penetrating Injury | Submersion Injury | Complex Fall Injury |
|---|---|---|---|
| | 0–6 years No. = 146 (30.2%) | | |
| On same level | 17.0% | 90.0% | 20.0% |
| From stationary height | 34.8% | 63.6% | 77.8% |
| From moving height | 14.8% | 0% | 44.0% |
| | 7–12 years No. = 206 (42.6%) | | |
| On same level | 43.4% | 0% | 26.7% |
| From stationary height | 47.4% | 22.7% | 22.2% |
| From moving height | 50.0% | 33.3%† | 34.7% |
| | 13–17 years No. = 132 (27.3%) | | |
| On same level | 39.6% | 10.0% | 53.3% |
| From stationary height | 17.8% | 13.6% | 0% |
| From moving height | 35.2% | 66.7%† | 21.3% |

*Observed percentage of all fall injuries with similar initiation/impact experienced by children in the age group.
†Total number of submersion injuries from moving heights = 3.
Shading indicates that the observed percentage exceeded that expected.

**TABLE 4**
Percentages of Different Types of Fall Injury Experienced During Two Types of Child Activities According to the Fall Matrix*

| Initiation of Fall | Impact of Fall: Blunt/Penetrating Injury | Submersion Injury | Complex Fall Injury |
|---|---|---|---|
| | Children Directly Involved in Farm Work No. = 111 (22.9%) | | |
| On same level | 34.0% | 10.0% | 80.0% |
| From stationary height | 15.6% | 13.6% | 22.2% |
| From moving height | 19.8% | 0% | 29.3% |
| | Nonworking Children Exposed to a Farm Production Hazard No. = 222 (45.9%) | | |
| On same level | 22.6% | 40.0% | 20.0% |
| From stationary height | 51.1% | 59.1% | 66.7% |
| From moving height | 42.0% | 66.7%† | 60.0% |

*Observed percentage of all fall injuries with similar initiation/impact experienced by children engaged in the activity.
†Total number of submersion injuries from moving heights = 3.
Shading indicates that the observed percentage exceeded that expected.

**TABLE 5**
Leading Natures and Anatomical Sites of Pediatric Fall Injury Observed Within Each Category of the Fall Injury Matrix*

| Initiation of Fall | Impact of Fall: Blunt/Penetrating Injury (%) | Submersion Injury (%) | Complex Fall Injury (%) |
|---|---|---|---|
| On same level | Laceration (40)<br>Soft tissue injury (13) | Asphyxia (100) | Intracranial injury (27)<br>Crushing injury (27) |
| From stationary height | Fracture, upper limb (34)<br>Intracranial injury (20) | Asphyxia (100) | Fracture, lower limb (56)<br>Asphyxia (22) |
| From moving height | Fracture, upper limb (27)<br>Soft tissue injury (24) | Asphyxia (100) | Intracranial injury (36)<br>Crushing injury (29) |

*Percentage of fall injuries with similar initiation/impact that resulted in type of injury.

Among 7- to 12-year-olds, all forms of blunt injuries were identified as priorities (eg, slipping/tripping on ground surfaces, falls from heights in barns, falls from horses), while among 13- to 17-year-olds, blunt injuries (eg, slipping/tripping on ground surfaces, falls from horses), and complex injuries (eg, slipping/tripping on ground surfaces) were identified (Table 3). Few injuries from a stationary height were experienced in this older age group.

Also, varying priorities were identified by child activity (Table 4; see also supplementary Table B). Approximately 70% (333 of 484) of the fall injury events happened in the farm production environment, yet two-thirds of these cases (222 of 333 [66.7%]) happened when the child was not working. Complex falls were almost exclusively associated with production activities (90 of 99 [90.9%]). Initiating events associated with children who were working typically happened on the same level (12 of 15 [80.0%]), whereas the initiating events for children injured while not working were primarily from heights (51 of 84 [60.7%]). Submersions most often happened to children who were not working (30 of 35 [85.7%]). However, these injuries were frequently associated with farm production hazards (eg, manure lagoons). Nonproduction hazards and activities accounted for approximately one-quarter of the case series. These hazards were not associated with complex injuries (5 of 99 [5.1%]) and more often resulted in submersions (11 of 35 [31.4%]) and blunt or penetrating injury (109 of 350 [31.1%]).

## Fall Injuries to Children on Farms Can Have Serious Consequences. Some Mechanisms Are Lethal

Blunt or penetrating injuries were common in all three categories of initiating events. However, these injuries were typically nonfatal (see supplementary Table C). The vast

majority of submersion injuries were fatal (32 of 35 [91.4%]). Complex mechanisms of injury typically involved production hazards (90 of 99 [90.9%]) and resulted in fatality (52 of 99 [52.5%]) or hospitalization (39 of 99 [39.4%]). Complex mechanisms of injury rarely occurred in non-worksite environments (5 of 125 [4.0%]). The relative severities of the different mechanisms of fall injury are reflected in the natures and anatomical sites of the injury sustained (Table 5). Blunt injuries from falls on the same level typically resulted in lacerations and soft tissue injuries, with fractures becoming more common with the involvement of heights. All submersion injuries involved asphyxiation. The more complex mechanisms of injury were dominated by major injuries to the head, chest, and lower limbs, reflecting a relatively high level of severity compared with the purely blunt mechanisms.

## Discussion

This study profiles patterns of pediatric fall injuries that are unique to the farm worksite, and the medical consequences of these pediatric fall injury events. A new fall injury matrix was developed and proved useful in the delineation of prevention priorities. The results illustrate the importance and unique severity of this common pediatric injury control problem, and the observed patterns provide foundational information that can be applied to the development of injury prevention strategies surrounding known occupational hazards. The matrix approach could also be adapted to the study of causes and consequences of fall injuries in other research contexts.

The operational definition of a fall injury used in this analysis was not constrained by traditional definitions. This meant that we included all pediatric injury events that involved a fall mechanism, irrespective of the fact that these events might not be viewed as falls in existing coding systems.[9–11,28] Using this approach, we observed that 4 in 10 traumatic injuries on farms were caused by falls, a substantial proportion that exceeded prior estimates. Examples of the types of falls that might have been excluded previously included falls involving animals, falls from operating vehicles and agricultural machinery, and some falls that involved asphyxiations. We would argue that the magnitude of the fall injury problem might have been underestimated in past work, which, in turn, limited prevention efforts surrounding this problem.

Our case series described a number of conventional types of falls that resulted in serious consequences because of the innately hazardous nature of the farm production environment. Examples include falls from structures (haylofts, ladders) that involved significant heights, falls into the path of animals, and complex falls involving operating machinery. The latter are especially traumatic, typically resulting in lower limb fractures, intracranial injuries, and major crush injuries. Although no evidence suggests that children on farms have a propensity to fall more often than other children, the consequences of a fall in the farm worksite can be especially severe due to the hazards present in the farm work environment. In some circumstances, such as those involving children falling into the path of operating machinery, the injury consequences appear to be so severe that complete avoidance is the safest option.[5] The fall itself is not the full problem; it is the hazardous environment that children are permitted to occupy whether they are at work or at play that compounds the traumatic injury.

The fall matrix developed for this analysis provides a useful tool for the characterization of fall injury events in analogous occupational settings. It does this by considering circumstances associated with the initiation of the fall, as well as the nature of the injuries sustained, due to hazards associated with its impact. Both dimensions are important. Clearly, the height, movement, and exact nature of the hazards that children are falling from are important determinants of the type and severity of the injury that inform primary prevention efforts. Knowledge of what children are falling onto or into is also important, because the nature of these hazards may also dictate both the types and consequences of the injuries sustained. This information is relevant to both secondary (minimizing the impact of fall events) and tertiary (treatment related) prevention strategies.[29]

With respect to primary prevention strategies, rules that restrict children from gaining access to heights[30] or mechanized hazards,[31] as well as the installation of passive safety barriers for younger children,[32] are most likely to be effective. Secondary prevention strategies that minimize the potential for physical injury once a fall injury event has occurred include the use of helmets for common recreational pursuits on farms,[33] automated warning and braking systems on farm vehicles that limit the opportunity for a falling person to be injured by moving equipment,[34] and development of practical, impact-resistant surfaces that can be installed surrounding structural fall hazards. Finally, identification of the common types of injury experienced under different fall circumstances assists in the planning of tertiary strategies. These strategies include optimization of first aid training and development of diagnostic and treatment protocols for ambulatory and hospital-based medical care.

Strengths and limitations of this analysis warrant recognition. The study is unique because it profiles the occurrence of fall injuries in children in an occupational setting. This is one of only a few existing analyses that have examined this problem specifically and comprehensively within the agricultural sector. We used a novel descriptive approach and developed a new matrix that can be used to profile the occurrence of fall injuries. Although developed using

pediatric data, the matrix approach is likely adaptable to the description of fall injuries in other demographic groups. It may also be applicable to other occupational settings with mechanical and height-related risk factors. A final strength is that we took steps to ensure the reliability and validity of our data collection methods and case interpretations.

With respect to limitations, although our study examined a large case series, we were restricted to available data sources and the data sources were likely to have poor coverage of minor fall events. The absence of estimates of person-years of exposure to various activities also precluded the calculation of rates and associated estimates of effect.

The generalizability of our analysis is also an important concern, especially whether patterns of fall injuries among farm children observed primarily in Canada can be generalized to the United States. This concern has been addressed generally for our case series elsewhere.[35] In brief, record-level data describing pediatric farm fatalities exist in the United States[36] but are not available to researchers operating outside its federal government. Hospital medical records are also not available for similar reasons; hence our partial reliance on Canadian data sources. Leading causes of farm injury to children in the present case series are very similar to those presented for the United States.[37] Although regional differences exist, leading types of crops and livestock produced on US and Canadian farms are also similar.[16,17,38] Exemptions from occupational health and safety legislation that would prohibit the participation of children in hazardous work activities also exist in the two countries.[15] We therefore argue that our findings are likely generalizable to farm children in both countries.

## Conclusion

This novel study addressed an unappreciated public health problem on North American farms, the occurrence of fall injuries to populations of children. This was accomplished through descriptive analyses as well as the development of a new matrix used to characterize important patterns of fall injuries. Findings from our study provide strong and objective evidence in support of the following: 1) fall injuries are common among children on farms, 2) the farm worksite possesses a unique set of operational hazards that make exposed children especially vulnerable to serious fall injuries, and 3) the medical consequences of specific types of fall injury events (complex injuries) are particularly severe. Overall, the results present a compelling case that falls are a common and traumatic injury control problem for children on farms. This pediatric health issue is not fully recognized in clinical circles, and is certainly worthy of additional prevention efforts that focus on farm environments.

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