

National Estimates of Youth and Injuries on U.S. Farms, 2012

K. J. Hendricks, L. A. Layne, E. M. Goldcamp



ABSTRACT. *The National Institute for Occupational Safety and Health (NIOSH), in order to provide injury surveillance for youth on farms in the U.S., partnered with the USDA to conduct the Childhood Agricultural Injury Survey (CAIS). CAIS data for all farm youth less than 20 years of age have been collected intermittently since 1998. CAIS data from 2012 indicated that an estimated 25.9 million youth lived on, worked on, or visited U.S. farms. These youth experienced almost 14,000 injuries while on the farm. The majority of these injuries occurred to males (7,290) and youth between the ages of 10 and 15 years (5,766). Approximately 20% (2,739) of the injuries were related to work being done on the farm. Youth living on the farm incurred 56% (7,784) of the injuries. An additional 5,771 injuries occurred to hired and visiting youth. Although youth injuries on farms have declined, the numbers are still unacceptably high. Additional research and detailed assessments of subsets of the youth population would help to better direct safety intervention programs and focus future research activities.*

Keywords. *Agriculture, Injury, Youth.*

Agriculture has consistently ranked among the most dangerous industries for U.S. workers (BLS, 2015). Previous research has shown that farms are a unique environment for youth, with a wide variety of hazards that are present not only for working youth but also for youth living on or visiting farms (Pickett et al., 2005; Rivara, 1997). Injuries to youth on farms have been an area of concern for public health researchers and safety and health professionals for decades (Castillo et al., 1999; Schulman et al., 1997).

According to the USDA National Agricultural Statistics Service (NASS), there were 2.11 million farms in operation in the U.S. in 2012. Of these farms, 87% were considered family or individually operated farms (NASS, 2014). The Childhood Agricultural Injury Survey (CAIS), which is collected by NASS for the National Institute for Occupational Safety and Health (NIOSH), is designed to produce national and regional estimates of the number of youth and injuries to youth less than 20 years of age on U.S. farms. The CAIS reported an estimated 27.6 million youth less than 20 years of age who lived on, worked on, or visited U.S. farms, with over one million youth living on farms in 2009 (NIOSH, 2014). This article focuses on the findings of the 2012 CAIS.

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The authors are **Kitty J. Hendricks**, Research Health Scientist, **Larry A. Layne**, Health Statistician, and **E. Michael Goldcamp**, Epidemiologist, Division of Safety Research, National Institute for Occupational Safety and Health, Morgantown, West Virginia. **Corresponding author:** Kitty Hendricks, 1095 Willowdale Rd., Morgantown, WV 26505; phone: 304-285-6252; e-mail: KHendricks@cdc.gov.

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Methods

In 2013, NIOSH, in collaboration with NASS, conducted the 2012 CAIS, a regionally stratified telephone survey of 50,000 farm households across the U.S., to collect information on farm-related injuries to youth less than 20 years of age that occurred during the twelve months prior to data collection. Sampling was based on the Bureau of Census geographic regions and value of sales. The 2012 CAIS used a random sample of 50,000 farming operations that was obtained from the 2007 Census of Agriculture sampling frame. Of the original sample, 32,992 farms were able to be contacted. Of those contacted, 3,065 farms were determined to be out of business and 20,061 completed the survey, for an overall response rate of 46.3%. Of the 29,927 eligible farms (i.e., currently operating) that could be contacted, the response rate was 67%.

For this study, a farm was defined as any operation from which \$1,000 or more of agricultural products were produced or sold, or normally would have been sold, during the census year (NASS, 2014). An injury was defined as any event occurring on the farm that required at least four hours of restricted activity or required the individual to seek professional medical attention. Information was collected for both work and non-work injuries occurring to all youth on farms. This included youth who were living on the farm, visited the farm at least once, or were hired directly by the farm operator. Injuries to youth contract laborers were not collected in this study. A work-related injury was defined as any injury that occurred while performing activities that had a direct impact on the farming operation as a business, regardless of whether the activity was performed for pay. Details about the CAIS are available at: <https://www.cdc.gov/niosh/topics/childag/cais/techinfo.html>.

For all youth on farms, common injury information, such as affected body part, type of injury, location on the farm where the injury occurred, and an injury narrative, was collected for up to four injuries per farm, beginning with the most recent injury. The injury narratives were examined, and primary and secondary source of injury and injury event were coded by NIOSH staff according to the Occupational Injury and Illness Classification System (OIICS v2.01; BLS, 2012). The Bureau of Labor Statistics developed OIICS for use in coding the case characteristics of injuries, illnesses, and fatalities.

Sampling weights were calculated based on the total number of farms responding by geographic region, adjusted for the gross value of sales reported for each respondent. Farm counts for 2012 by region and value of sales were obtained from NASS (2013). All estimates and variances for both the injury and demographic data were obtained with the SurveyMeans and SurveyFreq procedures in SAS (1999). Estimates and 95% confidence intervals (CI) are presented when the relative standard error does not exceed 33% of the estimate. Percentages are based on the total sample (i.e., missing values are included). Injury rates were calculated as the estimated number of injuries divided by the estimated number of youth. Reported percentages are based on the total sample (i.e., missing values are included in percentage calculations). All rates for household and hired youth are expressed in terms of 1,000 youth.

Results

Farms

In 2012, NASS reported that 2.17 million farms were in operation in the U.S. (NASS, 2014). Based on the CAIS, NIOSH estimated that 75% of these farms had youth less than

Table 1. National estimates of U.S. farms with youth, 2012.

	Farm Estimate	Standard Error
Total U.S. farms	2,170,000	-
Farms with any youth	1,617,253	12,213
Farms with household youth	483,436	9,024
Farms with hired youth	117,322	4,182
Farms with visiting youth relatives	1,302,764	12,155
Farms with non-relative youth visitors	765,851	10,741

20 years of age on them at some point during 2012. An estimated 22% of farms had youth living on the farm, 60% had youth relatives visiting, 35% had non-relative youth visitors, and 5% of farms stated that they had directly hired youth to work on the farm (table 1).

All Youth

There were an estimated 25.9 million youth less than 20 years of age on farms in the U.S. in 2012 (table 2). Of these youth, 95% were visitors to the farm, of which 41% were related to the farm operator. An estimated 258,835 youth were hired directly by the farm operator to work on the farm, and an estimated 955,406 youth lived on the farm (i.e., household youth). Of the 10 million youth relatives who visited farms, 6% (630,506; SE = 29,485) performed unpaid work activities while visiting.

Household Youth

Of the estimated 955,406 household youth less than 20 years of age, approximately 50% were male and 47% female (table 3). Table 3 also provides the distribution of household

Table 2. National estimates of youth on U.S. farms, 2012.

	Farm Estimate	Standard Error
Total youth on farms	25,906,151	1,366,023
Household youth	955,406	20,811
Hired youth	258,835	11,497
Visiting youth	24,691,910	1,363,368
Non-related youth visitors	14,599,530	1,293,470
Related youth visitors	10,092,380	365,357

Table 3. National estimates of household and hired youth less than 20 years of age on U.S. farms, 2012.

		Household Youth ^[a]	SE ^[b]	Hired Youth ^[a]	SE ^[b]
Total youth		955,406	20,811	258,835	11,497
Sex	Male	473,324	9,543	202,858	6,727
	Female	452,760	10,112	30,113	2,978
Age group	<10 years	297,594	9,426	5,823	937
	10 to 15 years	343,992	8,852	35,947	2,647
	16 to 19 years	273,651	7,277	174,995	6,881
	16 to 17 years	146,016	5,103	88,921	4,828
	18 to 19 years	127,635	4,877	86,074	5,060
Type of farm	Crop	448,581	12,891	133,925	7,464
	Livestock	506,825	13,593	124,909	6,929
Work	Yes	471,954	10,999	258,835	11,497
	No	457,076	11,794	-	-
Horse	Yes	238,178	9,154	18,482	2,171
	No	688,983	13,141	220,779	8,030
Tractor	Yes	239,069	3,822	64,825	3,766
	No	594,282	12,622	173,686	7,976
ATV	Yes	353,800	9,436	63,360	4,575
	No	480,038	12,347	175,705	7,370

^[a] Subcategories may not sum to total due to missing values.

^[b] SE = standard error.

youth by age group, type of farm, work status, and exposure to some common farm hazards. Of household youth, 49% reported performing work on the farm in the past year, 25% reported riding a horse for work or recreation, 37% operated an all-terrain vehicle (ATV) for work or recreation, and 25% operated a tractor. An estimated 53% of the household youth lived on livestock farms, with the majority (285,456; SE = 9,954) residing on cattle farms. An estimated 448,581 household youth lived on crop operations. By value of sales, the majority of household youth (492,847; SE = 18,946) lived on farms with less than \$10,000 in annual sales, 230,829 (SE = 7,325) lived on farms with between \$10,000 and \$99,999 in annual sales, and 231,730 (SE = 7,543) lived on farms earning more than \$100,000 annually (data not shown).

Hired Youth

Youth hired directly by the farm operator comprised less than 1% of all youth on farms. Of these youth, 42% were hired on crop farms, and 48% were employed on livestock operations (table 3). The majority (78%) of hired youth were male. The average age of youth hired to work on farms was 16.6 years. Of the hired youth, 25% were reported to have operated a tractor, 24% drove an ATV, and 7% rode a horse while working.

All Youth Injuries

An estimated 13,996 injuries were incurred by youth less than 20 years of age on U.S. farms in 2012. Of these injuries, 7,784 occurred to youth living in the farm household, and 5,771 injuries occurred either to youth hired directly by the farm operator or youth visiting the farm. The relationship to the farm was unknown for 441 injured youth. Table 4 presents the distribution of youth injuries by various demographic characteristics.

Youth between the ages of 10 and 15 years incurred 41% of all injuries, followed by youth less than 10 years of age (30%). Slightly more than half (52%) of all injuries occurred to males. An estimated 62% of youth were injured on livestock farms, with the remaining 38% of injuries occurring on crop farms. When examining the number of injuries by region, over half (52%) of all injuries occurred in the Midwest.

Injury characteristics for youth on farms are shown in table 5. For all youth, the most common types of injuries were fractures or broken bones (37%), followed by cuts and lacerations (21%) and contusions (17%). The lower extremities (27%) were the most com-

Table 4. National estimates of injuries to youth less than 20 years old for all youth on U.S. farms, 2012.

		All Youth	
		Estimate ^[a]	Standard Error
Total injuries	-	13,996	954
Sex	Male	7,290	799
	Female	6,658	1,097
Age group	<10 years	4,235	750
	10 to 15 years	5,766	902
	16 to 19 years	3,443	646
Work status	Work	2,739	450
	Non-work	10,733	1,130
Type of farm	Crop	5,351	948
	Livestock	8,644	873
U.S. region	Northeast	1,578	134
	Midwest	7,277	790
	South	2,870	482
	West	2,270	192

^[a] Subcategories may not sum to total due to missing values.

Table 5. National estimates of farm injury characteristics for youth less than 20 years of age for all youth and household youth, U.S., 2012.

		All Youth		Household Youth	
		Estimate	SE ^[a]	Estimate ^[b]	SE ^[a]
Total injuries	-	13,996	954	7,783	846
Type of injury	Fracture	5,126	910	2,777	690
	Laceration	2,891	577	2,475	564
	Contusion	2,321	630	NR	-
	Other injuries	3,658	628	NR	-
Body part	Lower extremity	3,788	752	2,577	654
	Upper extremity	3,620	721	1,351	328
	Head, skull, face, and neck	2,491	599	2,096	580
	Other body parts	4,097	593	1,759	430
Primary source	Persons/plants/animals/minerals	5,070	1,021	2,566	678
	Vehicle	2,229	533	1,149	318
	Tool, instrument, equipment	1,881	564	NR	-
	Other sources	4,816	701	NR	-
Event	Fall, slip, trip	4,686	754	3,647	700
	Transportation incident	3,278	720	1,358	436
	Contact with object or equipment	2,726	590	1,858	496
	Other events	3,306	710	NR	-

^[a] SE = standard error.

^[b] NR = estimate is not reportable.

monly injured body part, followed by the upper extremities (26%), and the head (including the skull, face, and neck; 18%).

When examining injuries by source of injury and injury event, the primary source for more than one-third (36%) of all injuries was persons/plants/animals/minerals (table 5). Of these injuries, 67% (3,506; SE = 950) were identified as animal-related, with horses being the most frequent source (2,669; SE = 894) for all animal-related injuries. Vehicles accounted for 16% of all injuries (2,229; SE = 533), with ATVs accounting for over half (1,143; SE = 315) of all vehicle-related injuries. Other sources of injury, which accounted for over one-third of all injuries (4,816; SE = 701), is an aggregated category comprising sources that did not meet the individual reporting requirements for this study. This category includes sources such as machinery, tools, and structures. Injuries related to tractors and other hazards, such as grain bins, were not individually reportable in this survey. Falls, slips, and trips were the most common injury event, accounting for one-third of all injuries, followed by transportation incidents (23%).

Household Youth Injuries

When examining only the 7,783 injuries occurring to household youth, those less than 16 years accounted for 79% of all injuries to youth living on farms (table 6), with the highest number of injuries seen among youth less than 10 years of age. Household youth less than 10 years of age also had the highest injury rate, at 11.3 injuries per 1,000 household youth, a rate nearly twice that of household youth 16 to 19 years of age (5.8 per 1,000 youth). Household youth 10 to 15 years of age had an injury rate of 8.2 injuries per 1,000 youth, a rate 1.4 times that of household youth 16 to 19 years of age. Males incurred slightly more injuries than females (53%) and had an injury rate slightly higher than household females (8.7 vs. 8.1). Most injuries to household youth were not work-related (83%).

Over one-third (36%) of household youth injuries were fractures, with lower extremities being the most frequently injured body part (table 5). Generally, household youth sustained

Table 6. National estimates of injuries and injury rates for household youth less than 20 years of age on U.S. farms, 2012.

		Injuries ^[a]	SE ^[b]	Injury Rate ^[c]	SE ^[b]
Total injuries	-	7,784	846	8.1	0.9
Sex	Male	4,136	605	8.7	1.3
	Female	3,648	804	8.1	1.8
Age group	<10 years	3,367	649	11.3	2.2
	10 to 15 years	2,811	713	8.2	2.1
	16 to 19 years	1,577	452	5.8	1.7
Work status	Work	1,323	329	2.8	0.7
	Non-work	6,460	862	6.8	0.9
Type of farm	Crop	2,890	651	6.4	1.5
	Livestock	4,894	733	9.7	1.5
Region	Northeast	819	138	11	1.9
	Midwest	4,474	741	10.7	1.8
	South	987	280	3.1	0.9
	West	1,503	265	10.7	1.9

^[a] Subcategories may not sum to total due to missing values.

^[b] SE = standard error.

^[c] Rate per 1,000 household youth.

injury patterns similar to those found for all youth, with the exception that household youth sustained a higher proportion of head injuries (27%) than was found for all youth (18%).

Persons/plants/animals/minerals were the primary source on injury in 33% of incidents involving household youth. Almost two-thirds (62%) of these injuries were animal-related, with horses accounting for 76% of the injuries. Vehicles, which include tractors and ATVs, were the primary source in 15% of household youth injuries. Almost half (47%) of household youth injuries were due to falls, slips, and trips, which is a slightly higher proportion than found for all youth farm injuries. Household youth also reported a higher proportion of injuries due to contact with objects and equipment and fewer transportation incidents than were found for all youth on farms.

Work-Related Injuries

Approximately 20% of injuries (2,739; SE = 450) to all youth were work-related, with an injury rate of 3.8 injuries per 1,000 working youth. Household youth accounted for 48% (1,323; SE = 329) of work-related injuries, and an estimated 31% (859; SE = 249) of work-related injuries occurred to hired youth. Males incurred 82% (2,245; SE = 425) of all work-related injuries. Youth less than 16 years of age accounted for 47% (1,289; SE = 358) of work-related injuries, increasing to 65% (855; SE = 272) for household youth. The distribution of work-related injuries by type of farm was comparable, with youth working on livestock farms incurring 51% (1,404; SE = 362) of work-related injuries.

Discussion

Surveillance data are an important tool for understanding youth injury on farms. An estimated 75% of U.S. farms reported having youth present on them at some time during 2012. The 13,996 estimated injuries to youth on farms in 2012 represent a 52% decrease from the number of injuries reported on farms in 2001 (NIOSH, 2014). Although this is an impressive decline, more than 38 youth on farms are still injured each day. Almost three-quarters (71%) of injuries occurred to youth less than 16 years old, and nearly one-third were to youth less than 10 years of age. The remarkable decline in injuries that has occurred

over the past decade should not overshadow the fact that farms remain dangerous workplaces. Farms also present diverse challenges when addressing hazards to workers, as well as the hazards that exist for those who call the farm home.

One area of concern is the number of injuries to youth less than 16 years of age. Since 2001, youth between the ages of 10 and 15 have consistently incurred the highest proportion of injuries for youth on farms, followed by youth less than 10 years of age (NIOSH, 2014). The same pattern is true for injuries sustained by household youth, with youth less than 16 years of age accounting for 77% of all household youth injuries reported in the five CAIS surveys conducted between 2001 and 2012. Youth less than 16 years of age also account for over 60% of household youth work-related injuries in these surveys.

The Department of Labor's Wage and Hour Division sets restrictions, the Hazardous Occupations (HOs) Orders for Agriculture, for hired youth working in agriculture. The Agricultural HOs were designed to provide some level of protection to hired youth less than 16 years of age working on farms from hazards such as tractors, other agricultural machines, and livestock (DOL, 2007). It is important to note that youth of any age who work on their family farm are exempt from the protections provided to hired youth less than 16 years of age by the Agricultural HOs.

In 2012, animals were the leading cause of injuries to youth on farms, with almost 14 animal-related injuries occurring each day. Animals have also been the leading cause of work-related injuries on farms for both hired and household youth. The unpredictability of animals, particularly large animals, presents unique challenges for keeping youth safe. In 2012, horses were the primary source in 78% of all animal-related injuries occurring to youth on farms. Horses are common on both livestock and crop farms and are used for both work and recreation by youth. In 2012, 25% of household youth reported having ridden a horse for either work or recreation. Increased use of safety helmets for riders on farms could help reduce the number and severity of horse-related injuries. Previous research has shown that without a helmet, the injury severity associated with being thrown from a horse is comparable to being struck by a car (Bond et al., 1995).

Organizations such as the National Children's Center for Rural and Agricultural Health and Safety (NCCRAHS) and the USDA Extension service provide valuable safety resources for youth working on farms that address animal safety. Resources such as the Agricultural Youth Work Guidelines, the latest generation of the North American Guidelines for Children's Agricultural Tasks (NAGCAT), provide guidelines, based on an understanding of childhood growth and development, to help parents and others make informed decisions about appropriate tasks for youth, as well as resources on grain handling, machinery, animals, and ATV safety (NCCRAHS, 2017). The USDA Extension provides a variety of online safety training for youth, including Horse Sense: Youth Equine Safety Education (Extension, 2017), which covers horse behavior and safe handling procedures. The USDA Extension also supports the Safety in Agriculture for Youth (SAY) project, which in addition to providing safety resources, maintains a national clearinghouse for agricultural safety and health curriculum for youth (USDA, 2017).

An additional concern should be the disparity in the proportional decreases between work and non-work injuries. From 2001 to 2012, work-related injuries declined by 71% (from 9,593 to 2,739). Non-work injuries also declined (45%) during that period (from 19,574 to 10,733) but at a much slower rate. These non-work injuries are a major driver in the high number and rate of injuries for youth less than 16 years of age, particularly for youth less than 10 years of age. The separation of the home and work site on farms is often

indistinct. Although efforts such as Creating Safe Play Areas on Farms (Esser et al., 2012) have provided guidance on developing child-safe areas on farms, the challenge of having youth present on farms while keeping them safe from work hazards remains.

Limitations

Although CAIS data provide exposure information for household and hired youth, a major limitation of this study is the lack of exposure information for visiting youth. Although respondents were asked to provide the overall number of visiting youth who performed unpaid work on the farm, there was no indication of what other activities these youth may have participated in while visiting. In addition, similar to other exposure questions found in the CAIS, no data are available regarding the extent and duration of exposure that relatives and others who visited the farm experienced. Injury rates that do not consider exposure are likely to underestimate the risk associated with specific farming hazards.

In addition to these limitations, CAIS data are subject to recall and response bias due to the time lapse between injury events and survey administration (3 to 15 months) and the fact that, in most cases, the injured party is not the respondent. To reduce the impact of recall bias, the respondents were asked to recall the most recent severe injuries incurred on the farm, as research has shown that recall bias is not as strong for more severe events (Harel et al., 1994). With regard to response bias, an assumption was made that the female head of household would be the person in the household most likely to be knowledgeable regarding all injuries occurring to youth on the farm. The potential for non-response bias is also a concern. Due to the survey design, it was not possible to make a second contact to farm operators who refused to participate in the survey. This did not allow a follow-back questionnaire to assess these refusals.

Conclusions

Although the CAIS data indicated that youth injuries have declined over the study period, farms continue to be a hazardous environment for young farm workers and farm family youth. The high proportion of animal-related injuries, particularly involving horses, demonstrates a continuing need for education on animal behavior and the importance of helmets and other protective equipment when riding or working around horses. The number of injuries to the youngest residents of farms, both working and non-working, should also be of concern. An examination of current injury prevention initiatives, as well as the extensive distribution and dissemination of educational resources for youth living on farms, is needed. Finally, researchers should continue to monitor areas of concern, with further examination and intervention programming efforts that target the most vulnerable populations, such as children less than 10 years of age.

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