

**A Comparison of Injuries among Youth Living on Farms in the  
U.S., 1998 - 2001**

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Presented at the National Institute for Farm Safety Annual Conference,  
June 20-24, 2004,  
Keystone CO

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## **Abstract**

The problem of children being injured while in agricultural environments has been recognized for several decades. However, sustained surveillance data regarding the characteristics of these injuries have been lacking. To address this issue, the National Institute for Occupational Safety and Health (NIOSH) developed the Childhood Agricultural Injury Survey (CAIS) in collaboration with the U.S. Department of Agriculture, National Agricultural Statistics Service (NASS). The first CAIS was for 1998 with the second for 2001.

The 2001 CAIS was a sample of 50,000 U.S. farm households. Nonfatal injury information was collected for youth less than 20 years of age on U.S. farms. This included both work and non-work injuries occurring to youth living on, working on, or visiting the farm. In addition to injury information, the 2001 CAIS collected household youth demographic information.

There were about 1.1 million youth living on U.S. farms in 2001. During this time period, there were an estimated 22,648 farm-related injuries to all youth less than 20 years of age. Seventy-four percent (16,851) of these injuries were to youth living in the farm household (rate: 15.7/1,000 household youth). Approximately 60% of the household youth injuries were to males. Household youth between the ages of 10 and 15 years experienced the highest number of injuries (8,252).

This paper presents additional estimates of demographics, injuries, and injury rates for household youth from the 2001 CAIS. This examination will also provide a comparison to results from the 1998 CAIS.

## **Introduction**

Youth on farms are exposed to a wide variety of hazards, which are present not only for youth working on the farm but also to youth who are living or visiting the farm. In 1998, there were an estimated 1.9 million youth less than 20 years of age on U.S. farms, and about 1.26 million of these youth lived on the farm (Myers and Hendricks 2001).

Injuries to youth on farms continue to be an area of concern for researchers and safety and health professionals. An estimated 32,800 injuries occurred to youth on farms in 1998, of which 44% were work related. Youth living in the farm household accounted for 23,640 of the total injuries (Myers and Hendricks 2001). The sources of injuries to youth on farms, regardless of their work status, were diverse.

Using the results from a 2001 farm survey, this paper examines the number of youth living on farms during 2001. Analyses of the farm injuries experienced by these youth are also presented. Additionally, this examination will provide a comparison to results from the 1998 farm survey of non-fatal injuries to youth which used a similar methodology in that it was a national survey of the same population with identical definitions for farm, work, and injury.

## **Methods**

In 2002, the National Institute for Occupational Safety and Health (NIOSH) in collaboration with the U.S. Department of Agriculture (USDA), National Agricultural Statistics Service (NASS) conducted the Childhood Agricultural Injury Survey (CAIS), a regionally stratified telephone survey of 50,000 farm households across the United States to collect information on farm-related injuries to youth less than 20 years of age that occurred during 2001. Sampling was based on the Bureau of Census geographic regions.

The original random sample of 50,000 farming operations for the 2001 CAIS was obtained from the 1997 Census of Agriculture sampling frame. Of this original sample, 39,344 farms were contacted, of which 30,744 completed the survey. The adjusted response rate for the survey was 78%.

For this study, an injury was defined as any event occurring on the farm operation that required at least four hours of restricted activity or required the individual to seek professional medical attention. A farm was defined as any operation that had at least \$1,000 in gross receipts in a calendar year. Information was collected on both work and non-work injuries occurring to youth who were either living on the farm, visiting the farm, or hired directly by the farm operator to work on the farm, but excluded injuries to contract laborers. 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.

For all youth less than 20 years of age, general injury information, such as sex, age, nature of the injury, body part injured, work-relatedness of the injury, and an injury narrative were collected for up to four injuries per farm. The source that directly inflicted the injury and the type of injury event were coded by the authors from the injury narratives according to the Occupational Injury and Illness Classification System (BLS 1992). For farms with more than four injuries in 2001, respondents were asked for information on only the four most recent injuries. Demographic information was also collected for the youth in the farm household and for any youth hired to work on the farm.

Sampling weights were calculated based on the total number of farms responding by geographical region and the number of farms reported in the 1997 Census of Agriculture for each region. All estimates and variances for both the injury and the demographic data were obtained by the SAS surveymeans procedure (SAS 1999). Estimates and 95% confidence intervals (CI) are presented where the relative standard error does not exceed 33% of the estimate. Injury rates were calculated as the estimated number of injuries, divided by the estimated number of household youth. All rates are expressed in terms of 1,000 household youth. Confidence intervals, at 95%, were utilized to determine statistical significance.

## **Results**

### ***Demographics***

During 2001, there were an estimated 1.08 million (95%<sub>CI</sub> 1,062,313 to 1,089,205) youth living on farms in the United States. An estimated 599,862

(95%<sub>CI</sub> 590,909 to 608,815) youth lived on livestock farms, with the majority (59%) residing on beef farms. An estimated 444,513 (95%<sub>CI</sub> 435,671 to 453,355) youth lived on crop farms. Approximately 50% of household youth were male and 48% were female as shown in Table 1. Table 1 also shows the distribution of household youth on farms by age.

**Table 1. National estimates of household youth less than 20 years of age on farms in the U.S. by sex and age, 2001.**

Age	Total <sup>†</sup>		Male		Female		Unknown Estimate
	Estimate	95% <sub>CI</sub> <sup>§</sup>	Estimate	95% <sub>CI</sub> <sup>§</sup>	Estimate	95% <sub>CI</sub> <sup>§</sup>	
<10 years	362,268	±8,730	178,127	±6,860	184,141	±6,983	0
10-15 years	391,965	±8,849	200,323	±7,156	191,642	±7,021	0
16-19 years	297,800	±8,248	157,230	±6,513	140,446	±6,221	124
Unknown	23,727		2,702		3,161		17,864
<b>Total <sup>†</sup></b>	<b>1,075,759</b>	<b>±13,446</b>	<b>538,382</b>	<b>±9,214</b>	<b>519,389</b>	<b>±9,210</b>	<b>17,988</b>

<sup>†</sup> Estimates may not add to the total because of rounding.

<sup>§</sup> 95% Confidence Interval

An estimated 592,581 (95%<sub>CI</sub> 583,442 to 601,721) household youth performed work or chores on the farm. The highest proportion of working household youth (47%) was between the ages of 10 and 15 years (Table 2).

**Table 2. National estimates of working household youth less than 20 years by sex and age, 2001.**

	Estimate	95% <sub>CI</sub> <sup>§</sup>
Total <sup>†</sup>	592,581	±4,663
<b>Sex</b>		
Male	340,270	±8,538
Female	251,607	±7,746
Unknown	704	
<b>Age</b>		
< 10 years	97,230	±5,237
10-15 years	278,938	±8,032
16-19 years	214,655	±7,334
Unknown	1,757	

<sup>§</sup> 95% Confidence Interval

<sup>†</sup> Estimates may not add to the total because of rounding.

### *Injuries*

During 2001, there were an estimated 22,648 (95%<sub>CI</sub> 21,986 to 23,311) injuries to all youth less than 20 years of age on farms in the U.S. Almost three-quarters of these injuries (16,851 95%<sub>CI</sub> 15,700 to 18,002) occurred to youth who were living on the farm. An estimated 1,901 (95%<sub>CI</sub> 1,197 to 2,605) injuries occurred to youth hired to work on the farm, and 3,801 (95%<sub>CI</sub> 2,792 to 4810) injuries occurred to youth who were visiting the farm. For approximately 95 injuries, the youth's relationship to the farm was not reported.

Of the estimated 16,851 injuries occurring to youth living on the farm (15.7 injuries/1,000 household youth), 60% of the injuries occurred to males. Household youth between the ages of 10 and 15 years experienced the most injuries (8,252), followed by youth less than 10 years (5,327) and youth between the ages of 16 and 19 years (3,272). Table 3 shows a more complete breakdown

of injuries to household youth and corresponding injury rates, including injuries by type of farm and work status.

**Table 3. National estimates of injuries and injury rates for household youth less than 20 years of age on U.S. farms, 2001.**

	Number of Injuries		Injury Rates*	
	Estimate	95% <sub>CI</sub> <sup>§</sup>	Rate	95% <sub>CI</sub> <sup>§</sup>
Total <sup>†</sup>	16,851	±1,151	15.7	±1.09
<b>Sex</b>				
Male	10,091	±1,345	18.7	±2.52
Female	6,760	±1,221	13.0	±2.36
<b>Age (Years)</b>				
<10	5,327	±1,139	14.7	±3.16
10-15	8,252	±1,280	21.1	±3.30
16-19	3,272	±943	11.0	±3.18
<b>Work Status</b>				
Work	5,807	±1,162	9.8	±1.97
Non-work	11,045	±1,358	10.3	±1.27
<b>Farm Type</b>				
Crop	5,421	±1,135	12.2	±2.56
Livestock	11,430	±1,298	19.1	±2.18

\* Injury rate per 1,000 household youth

§ 95% Confidence Interval

† Estimates may not add to the total because of rounding.

The most common type of injury to occur to household youth was a broken bone or fracture (5,321 95%<sub>CI</sub> 4,171 to 6,472), followed by cuts and lacerations (2,925 95%<sub>CI</sub> 2,014 to 3,836). The arm (2,713 95%<sub>CI</sub> 1,843 to 3,583) was the most commonly injured body part, followed closely by the hand, wrist, and fingers (2,686 95%<sub>CI</sub> 1,818 to 3,554) and the foot, ankle, and toes (2,682 95%<sub>CI</sub> 1,782 to 3,582). Structures and surfaces (5,660 95%<sub>CI</sub> 4,476 to 6,844), which included the ground (3,378 95%<sub>CI</sub> 2,396 to 4,360), were the most frequent source of injury. Other common sources of injury included animals (2,856 95%<sub>CI</sub> 1,994 to 3,718) and vehicles (3,109 95%<sub>CI</sub> 2,200 to 4,018), which were most frequently off-road



vehicles (1,413 95%<sub>CI</sub> 762 to 2,064). Falls (5,749 95%<sub>CI</sub> 4,559 to 6,939) were the most common type of injury event, followed by contact with objects (4,434 95%<sub>CI</sub> 3,362 to 5,506) and transportation incidents (2,877 95%<sub>CI</sub> 1,983 to 3,771), which were predominately non-highway events (2,576 95%<sub>CI</sub> 1,729 to 3,423).

When examining the number of injuries associated with some of the common contributors to injury, we find that an estimated 5,807 injuries were work-related, 3,055 injuries were associated with horses, 1,667 injuries were associated with ATVs, and 650 were tractor-related.

### ***Work-related injuries***

Males experienced approximately 70% (4,046 95%<sub>CI</sub> 3,033 to 5,059) of the work-related injuries. Youth between the ages of 10 and 15 years experienced the highest number of work-related injuries (3,047 95%<sub>CI</sub> 2,113 to 3,983), followed by youth 16 to 19 years of age (2,217 95%<sub>CI</sub> 1,435 to 2,999).

Fractures and broken bones were most common for work-related injuries (1,109 95%<sub>CI</sub> 499 to 1,719), followed by cuts and lacerations (973 95%<sub>CI</sub> 426 to 1,520). The foot, ankle, and toe (1,186 95%<sub>CI</sub> 571 to 1,801) were the most common part of the body injured during work activities, followed by the hand, wrist, and finger (1,039 95%<sub>CI</sub> 508 to 1,570). Animals were the most common source of work-related injuries for household youth (1,184 95%<sub>CI</sub> 622 to 1,747), followed by vehicles (1,118 95%<sub>CI</sub> 556 to 1,681). Eighty-eight percent of the work-related animal injuries were incurred by females (1,043 95%<sub>CI</sub> 490 to 4,596), with 71% of these being attributable to horses. The most frequent type of

injury event for working household youth was being struck by an object (1,309 95%<sub>CI</sub> 652 to 1,966), followed by animal assaults (959 95%<sub>CI</sub> 438 to 1,480), struck against an object (902 95%<sub>CI</sub> 392 to 1,412), and non-highway transportation incidents (852 95%<sub>CI</sub> 339 to 1,366).

### ***Injuries by Region***

The Midwestern region of the U.S. experienced the most injuries (7,958 95%<sub>CI</sub> 7,066 to 8,850), followed by the South (5,430 95%<sub>CI</sub> 4,777 to 6,083), West (2,551 95%<sub>CI</sub> 2,261 to 2,841), and Northeast (913 95%<sub>CI</sub> 774 to 1,052). However, when comparing regions by rate of injury, which takes into consideration the number of youth on farms, there are minimal differences. The Northeast had the lowest rate of injury at 11.5/1,000 household youth. Injury rates for the Midwest (15.7/1,000 household youth), South (16.3/1,000 household youth), and West (16.1/1,000 household youth) regions were all comparable.

As seen in Table 4, within all four regions of the country, the injury rate was higher on livestock farms than on crop farms. Although the household youth population estimates in the Midwest and the West were similar for crop and livestock farms, the injury rates on livestock farms were still much higher.

**Table 4. Regional estimates of injuries, youth, and injury rates for household youth by type of farm on U.S. farms, 2001.**

Region	Crop			Livestock		
	Household			Household		
	Injuries	Youth	Rate*	Injuries	Youth	Rate*
Total <sup>†</sup>	5,421	444,513	12.2	11,430	599,862	19.1
Northeast	110	25,694	4.3	803	51,358	15.6
Midwest	2,883	237,798	12.1	5,075	257,060	19.7
South	1,619	105,323	15.4	3,811	213,328	17.9
West	809	75,699	10.7	1,742	78,115	22.3

\* Injury rate per 1,000 household youth

<sup>†</sup> Estimates may not add to the total because of rounding.

When examining regional injuries by sex, the Midwest had the largest discrepancy of rates between males and females in the household. Males in the Midwest had an injury rate of 19.8/1,000 household males compared to 11.8/1,000 household females. In the South, the difference was 19.5/1,000 household males to 13.8/1,000 household females. The injury rates by sex in the Northeast and West were more comparable (Northeast: 12.8/1,000 household males vs. 10.6/1,000 household females; West: 16.8/1,000 household males vs. 16.4/1,000 household females).

### ***Comparison to 1998 CAIS***

Table 5 provides a comparison of the number of injuries and injury rates for household youth from the 1998 CAIS and 2001 CAIS. When comparing the results of this study to results from the 1998 CAIS (Myers and Hendricks 2001), we see that there was a 29% decrease in the number of injuries to youth living on farms. However, there was also a 13% decrease in the number of farms, and a 15% decrease in the number of youth living on farms. Although, the injury rate

for household youth did decline from 18.7/1,000 household youth in 1998 to 15.7/1,000 household youth in 2001, this difference was not statistically significant.

One decrease in household injury rates that was significant was for males. The injury rate for males decreased from 27.5/1,000 household males in 1998 to 18.7/1,000 household males in 2001. The injury rate for working household males also declined significantly. In 1998, the rate was 20.2/1,000 working household males. In 2001, this rate dropped to 11.9. The only substantial increase in injury rates, although not significant, was for household females. However, when examining female injuries by age group, the injury rate for females between the ages of 10 and 15 years more than doubled from 8.1/1,000 household females in 1998 to 17.3/1,000 household females in 2001. This increase was statistically significant.

Tractor-related injuries were another area where there was a significant drop in the injury rate. In 1998, there were an estimated 3,149 injuries with an injury rate of 2.5/1,000 household youth. In 2001, the number of tractor-related injury for household youth dropped to 650 (0.6/1,000 household youth).

Other notable changes in rates, though not statistically significant, were for injuries related to horses and ATVs. The injury rates for both horses and ATVs increased from 1998 to 2001.

**Table 5. A comparison of injuries and injury rates from 1998 and 2001 among household youth less than 20 years of age on U.S. farms.**

	1998			2001		
	Injuries	Rate*	95% CI <sup>§</sup>	Injuries	Rate*	95% CI <sup>§</sup>
Total <sup>†</sup>	23,640	18.7	±2.87	16,851	15.7	±1.09
<b>Sex</b>						
Male	18,307	27.5	±4.76	10,091	18.7	±2.52
<10	4,866	21.5	±5.25	2847	16.0	±5.01
10-15	5,797	23.6	±5.15	4935	24.6	±5.64
16-19	3,652	18.9	±5.51	2309	14.7	±5.19
Female	5,333	8.9	±2.31	6,760	13.0	±2.36
<10	1864	9.1	±3.88	2480	13.5	±4.61
10-15	1832	8.1	±3.51	3317	17.3	±5.00
16-19	499	3.0	±2.35	963	6.9	±3.90
<b>Age (Years)</b>						
<10	8,738	20.3	±4.42	5,327	14.7	±3.16
10-15	9,932	21.0	±4.55	8,252	21.1	±3.30
16-19	4,971	13.8	±4.05	3,272	11.0	±3.18
<b>Work Status</b>						
Work	10,254	14.1	±3.08	5,807	9.8	±1.96
Male	8786	20.2	±4.90	4046	11.9	±3.00
Female	1468	5.0	±2.41	1761	7.0	±2.76
Non-work	13,386	10.6	±1.92	11,045	10.3	±1.27
Male	9521	14.3	±3.02	6045	11.2	±2.27
Female	3865	6.5	±1.96	4999	9.6	±2.16
<b>Farm Type</b>						
Crop	9,143	14.8	±3.12	5,421	12.2	±2.58
Livestock	12,897	20.2	±4.00	11,430	19.1	±2.18
<b>Hazard</b>						
Horse	2,388	1.9	±0.71	3,055	2.8	±0.83
ATV	1,431	1.1	±0.56	1,667	1.5	±0.66
Tractor	3,149	2.5	±0.85	650	0.6	±0.43

\* Injury rate per 1,000 household youth

§ 95% Confidence Interval for the injury rate

† Subtotals may not sum to total due to missing values and/or rounding

## Discussion

Injury surveillance data provide a valuable tool for understanding the causes of injury to youth on farms. Information about the incidence and circumstances of injuries to youth under 20 years of age on farms is needed to target and develop effective injury prevention strategies. This study estimates that fifteen out of

every 1,000 youth living on a U.S. farm during 2001 suffered an injury. Many of these injuries occurred to youth under the age of 16 years.

At first, the decrease in injuries from 1998 to 2001 looks substantial. However, when you factor in that there were fewer farms in 2001 than in 1998 (1.9 million vs. 1.65 million) and the changing demographics of the farm population, the decrease in injuries does not have the same impact.

One area of interest is the decrease in injuries for household males as compared to the increase for household females. Upon further examination, this appears to be primarily associated with the number of horse-related injuries. In 1998, 52% of the horse-related injuries were to females compared to 48% to males. In 2001, this proportion changed substantially to 72% of horse-related injuries for females and 28% to males.

Another area where we see a noticeable difference in the number of injuries by sex is for ATVs. In 1998, 76% of the ATV injuries were to males and 24% to females; in 2001, the number of male ATV-related injuries decreased to 65% and increased for females to 35%.

The significant decrease in the number of tractor-related injuries is also notable. One possible explanation for this decrease is the increasing availability of specialized farm implement attachments for ATVs (Tormoehlen and Shelden

1996). These attachments allow ATVs to be used for farm tasks which were once solely the domain of tractors. This premise is supported by the slight increase in the number of ATV injuries that are seen on farms. However, further research and continued surveillance in this area are needed to determine if the decrease in the number of tractor-related injuries is accurate or just an idiosyncrasy of these data. Another possible explanation for the decrease in tractor injuries to consider is that recent efforts, such as the North American Guidelines for Childhood Agricultural Tasks (NAGCAT<sup>1</sup>, NCCRAHS 1999), and a recommendation for a review of Hazardous Orders<sup>2</sup> (NRC/IOM 1998) may have increased the visibility of tractors as an issue for youth on farms. As a result of this increase in visibility, there may have also been an increase in safety awareness and training for youth who operate tractors.

### *Limitations*

There are some limitations to the results presented in this paper. First, although the recall period for an injury was less than 15 months and information was collected on more serious injuries, the possibility of recall bias in this survey exists. A study of recall for nonfatal injuries for children and adolescents found that although recall bias exists to some degree regardless of severity, the effects of

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<sup>1</sup> NAGCAT provides guidelines for parents to follow in assigning tasks to children age 7-16 based on their developmental abilities.

<sup>2</sup> The Fair Labor Standards Act of 1938 permits the prohibition of youth employment in occupations designated as hazardous. The regulations that list these hazardous jobs are referred to as Hazardous Orders.

recall bias are significantly lower for severe injuries (Harel et al. 1994). Although this present study collected data on more severe injuries that required at least four hours of restricted activity or required medical attention, the number of injuries reported should be considered a conservative estimate. Another type of bias also possible is response bias. Most of the surveys were conducted with the female head of household and not the injured individual. Furthermore, there was no way to verify the accuracy of the responses given for the survey, which could impart some response bias into the overall survey results.

The sample for the 2001 CAIS was taken from the 1997 Census of Agriculture list frame. USDA is currently revising this list to take into consideration off-list farms and farms that have been established since the 1997 Census of Agriculture. This will affect the weighting system used for these estimates. A final limitation is that in the 1998 CAIS the estimates for age, sex, and work status were adjusted for unknown data. Due to a small number of unknowns, this adjustment was not performed on the 2001 CAIS data.

## **Conclusions**

Although the results of this study indicate an overall decrease in the rate of injuries for youth living on the farm, farms continue to present a hazardous environment for youth. This rate decline will need continued surveillance to assess if it is a significant trend or the result of changing farm demographics. However, the substantial increase in the number of female injuries may indicate a



shift in the gender disparity that has been present on farms in the past. The rise in the number of ATV- and horse-related injuries should also be an area of concern.

Agricultural safety and health researchers should consider targeting these areas for further examination.

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