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Injuries to Youth Living on U.S. Farms in 2001with Comparison to 1998

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ABSTRACT. To obtain sustained injury surveillance data for youth on farms, the National Institute for Occupational Safety and Health developed the Childhood Agricultural Injury Survey (CAIS) in collaboration with the U.S. Department of Agriculture. The first CAIS collected data for youth less than 20 years in 1998 through a regionally stratified telephone survey of 50,000 U.S. farm households; a second CAIS for 2001 was conducted using the same methodology. In 2001, there were approximately 1.2 million youth living on U.S. farms. These youth suffered an estimated 19,397 injuries (15.7/1,000 household youth). Approximately 60% (11,571) of the household youth injuries were to males. For all household youth, 10-15 year olds experienced the most injuries (49%, 9,486). In addition to providing estimates of demographics, injuries, and injury rates for household youth from the 2001 CAIS, this article provides a comparison to results from the 1998 CAIS. The number of household youth injuries on farms from 1998 to 2001 decreased by almost 30% (27,321 vs. 19,397).

The results of this study show an overall decrease in the injury rate for youth living on the farm from 1998 to 2001 (18.8/1,000 household youth vs. 15.7/1,000 household youth). However, there was a considerable increase in the number of injuries to household females less than 20 years of age during this same time period. There was also an increase in the number of all terrain vehicle (ATV) and horse-related injuries. Continued surveillance is needed to assess if these are significant trends or the result of changing farm demographics.

KEYWORDS. Farm injuries, youth, surveillance

INTRODUCTION

Youth on farms are exposed to a wide variety of hazards that are present not only for youth working on the farm but also to youth who are living on or visiting the farm. According to the U.S. Department of Agriculture (USDA), in 1997 there were an estimated 1.91 million

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farms in the U.S.[1] For 1998, the National Institute for Occupational Safety and Health (NIOSH) estimated there were 1.93 million youth less than 20 years of age who lived or worked on U.S. farms; 1.26 million of these youth lived on farms.[2]

Injuries to youth on farms continue to be an area of concern for public health researchers and safety and health professionals. According to the NIOSH 1998 Childhood Agricultural Injury Survey (CAIS), an estimated 32,800 injuries occurred to youth on farms in 1998. Forty-four percent of these injuries were work related. Youth living in the farm household accounted for 72% of these injuries.[2] The sources of injuries to youth on farms, regardless of their work status, were diverse, ranging from tractors and all terrain vehicles (ATVs) to hand tools.

In 1996, the National Action Plan for childhood agricultural injury prevention presented recommendations for the reduction of childhood injuries on farms. One of those goals was to "establish and maintain a comprehensive national database of fatal and nonfatal childhood agricultural injuries."[3] To address this goal, NIOSH conducted the CAIS in 1998, and again for 2001. CAIS is a periodic survey that is one component of NIOSH's efforts to provide routine data on childhood agricultural injuries. Using the results from the 2001 CAIS, this paper examines the demographics of youth living on farms during 2001 and their farm injury experience. Additionally, this examination will provide a comparison of the results from 2001 to those found in the 1998 CAIS.

METHODS

In 2002, NIOSH, in collaboration with the USDA, National Agricultural Statistics Service (NASS), conducted the 2001 CAIS. This regionally stratified telephone survey of farm households across the U.S. was used to collect information on farm-related injuries that occurred during calendar year 2001 to youth less than 20 years of age (includes youth aged 0 to 19 years). Stratification was based on the four major Census Bureau geographic regions.

A stratified random sample of 50,000 farming operations for the 2001 CAIS was obtained from the 1997 Census of Agriculture sampling frame. Of this sample, 30,744 farms completed the survey for a crude response rate of 61%. A farm was defined as any farm operation that had at least $1,000 in gross receipts in a calendar year. A farm was considered eligible for the 2001 CAIS regardless of whether youth were on the farm in 2001. This was necessary to allow for meaningful estimates of both injuries and the number of youth on farms.

For the CAIS, an injury was defined as any event occurring on the farm operation that resulted in at least four hours of restricted activity or required the individual to seek professional medical attention. While the total number of childhood agricultural injuries was requested for the calendar year 2001, descriptive information was collected for only the four most recent injuries on each farm. 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 who were injured, 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.[4] Demographic information was also collected for youth living in the farm household and for any youth hired to work on the farm. This analysis focuses only on household youth, defined as youth who were living 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.[5] 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. Variances for injury rates were calculated using a linear combination of the numerator and denominator variances. Confidence intervals were utilized as a basic measure of statistical significance.

RESULTS

Demographics

During 2001, there were an estimated 1.2 million youth living on farms in the U.S. An estimated 691,894 ($95\%_{CI}$ 681,669 to 702,119) youth lived on livestock farms, with the majority (58%) residing on beef farms. An estimated 510,650 ($95\%_{CI}$ 500,556 to 520,744) youth lived on crop farms. Approximately 50% (619,790) of household youth were male and 48% (598,096) were female as shown in Table 1. Table 1 also shows the distribution of household youth on farms by age, with 36% (451,422) between 10 and 15 years old, 34% (417,050) less than 10 years old, and 28% (342,807) between 16 and 19 years old.

More than half of all household youth (55%: 681,150) performed work or chores on the farm. Table 2 shows that the largest number of these youth were between the ages of 10 and 15 years (47%: 320,745) and were male (57%: 391,136).

Injuries

During 2001, there were an estimated 26,086 ($95\%_{CI}$ 25,343 to 26,829) injuries to all youth less than 20 years of age on farms in the U.S. Almost three-quarters of these injuries (74%: 19,397) occurred to youth who were living on the farm. The following results are limited to these household youth.

Table 3 provides a breakdown of injuries and injury rates by various demographic characteristics. Of the estimated 19,397 injuries occurring to household youth, 60% occurred to males. Males also had a significantly higher injury rate (18.7/1,000 household youth) than females (13.1/1,000 household youth). When age was considered, household youth between the ages of 10 and 15 years experienced the most injuries (9,486) and had a significantly higher rate (21.0 injuries/1,000 household youth). Although the estimated number of non-work related injuries (12,711) was almost double the number of work-related injuries (6,686), the injury rates were similar (10.3 vs. 9.8). Youth living on livestock operations had more injuries (13,223) and a higher injury rate (19.1) than their counterparts on crop operations (6,174 injuries: 12.1 injuries/1,000 household youth).

The most common type of injury to occur to household youth was a broken bone or fracture (6,116: $95\%_{CI}$ 4,799 to 7,433), followed by cuts and lacerations (3,405: $95\%_{CI}$ 2,351 to 4,459). The arm (3,110: $95\%_{CI}$ 2,118 to 4,102) was the most commonly injured body part, followed closely by the hand, wrist, and fingers (3,088: $95\%_{CI}$ 2,053 to 4,123) and the foot, an-

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

	Total †		Male		Female		Unknown
Age	Estimate	95%CI§	Estimate	95%CI§	Estimate	95%CI§	Estimate
<10 years	417,050	± 9,984	205,036	±7,834	212,014	±7,979	0
10-15 years	451,422	± 10,119	230,780	±8,175	220,642	±8,016	0
16-19 years	342,807	± 9,430	180,855	±7,432	161,816	±7,113	135
Unknown	27,619		3,119		3,624		20,877
Total †	1,238,898	± 29,171	619,790	±10,482	598,096	±10,480	21,012

† Estimates may not add to the total because of rounding
§ 95% Confidence Interval

TABLE 2. National estimates of working household youth less than 20 years of age on farms in the U.S. by sex and age, 2001.

	Total †		Male		Female		Unknown
Age	Estimate	95%CI§	Estimate	95%CI§	Estimate	95%CI§	Estimate
<10 years	111,739	± 5,972	58,722	± 4,406	53,017	± 4,239	0
10-15years	320,745	± 9,173	183,985	± 7,473	136,759	± 6,511	0
16-19 years	246,654	± 8,371	147,847	± 6,797	98,672	± 5,678	135
Unknown	2,012		582		780		650
Total †	681,150	±10,455	391,136	±9,751	289,228	± 8,842	786

† Estimates may not add to the total because of rounding
§ 95% Confidence Interval

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

	Number of Injuries		Injury Rates*	
	Estimate	95%CI§	Rate	95%CI§
Total†	19,397	±1,319	15.7	±1.12
Sex				
Male	11,571	±1,541	18.7	±2.51
Female	7,826	±1,403	13.1	±2.35
Age (Years)				
<10	6,138	±1,303	14.7	±3.14
10-15	9,486	±1,466	21.1	±3.27
16-19	3,773	±1,082	11.0	±3.18
Work Status				
Work	6,686	±1,331	9.8	±1.96
Non-work	12,711	±1,556	10.3	±1.27
Farm Type				
Crop	6,174	±1,198	12.1	±2.55
Livestock	13,223	±1,488	19.1	±2.16

* Injury rate per 1,000 household youth
§ 95% Confidence Interval
† Estimates may not add to the total because of rounding

kle, and toes (3,087: 95%CI 2,052 to 4,122). Structures and surfaces (6,526: 95%CI 5,168 to 7,884), which included the ground (3,909: 95%CI 2,778 to 5,040), were the most frequent primary source of injury. Other common sources of injury included vehicles (3,577: 95%CI 2,536 to 4,618), which were most frequently off-road vehicles (1,627: 95%CI 880 to 2,374), and animals (3,335: 95%CI 2,333 to 4,337). Falls (6,631: 95%CI 5,265 to 7,997) were the most common type of injury event, followed by contact with objects (5,061: 95%CI 3,838 to 6,284) and transportation incidents (3,316: 95%CI 2,293 to 4,339), which were predominately non-highway events (2,954: 95%CI 1,990 to 3,918).

When examining the number of injuries associated with some of the common contributors to farm injury, an estimated 3,582 injuries were associated with horses, 2,150 injuries were associated with ATVs, and 894 were tractor-related.

Work-Related Injuries

Males experienced approximately 70% (4,625: 95%CI 3,471 to 5,779) of the work-related injuries to household youth. Youth between the ages of 10 and 15 years experienced the highest number of work-related injuries (3,497: 95%CI 2,429 to 4,565), followed by youth 16 to 19 years of age (2,557: 95%CI 1,659 to 3,455).

Fractures or broken bones were the most common type of work-related injury (1,273: 95%CI 577 to 1,969), followed by cuts and lacerations (1,130: 95%CI 497 to 1,763). The foot, ankle, and toes (1,363: 95%CI 657 to 2,069) were the most common part of the body injured during work activities, followed by the hand, wrist, and fingers (1,195: 95%CI 591 to 1,799). Animals were the most common primary source of work-related injury (1,388: 95%CI 733 to 2,043), followed by vehicles (1,290: 95%CI 647 to 1,933). Eighty-eight percent of the work-related animal injuries were incurred by females (1,217: 95%CI 574 to 1,860), with 81% (981: 95%CI 391 to 1,571) of these being attributable to horses. The most frequent type

of injury event for working household youth was being struck by an object (1,496: 95%$_{CI}$ 745 to 2,247), followed by animal assaults (1125: 95%$_{CI}$ 484 to 1,766), struck against an object (1034: 95%$_{CI}$ 448 to 1,620), and non-highway transportation incidents (980: 95%$_{CI}$ 396 to 1,564).

Injuries by Region

The Midwestern region of the U.S. experienced the most injuries to household youth (8,847: 95%$_{CI}$ 7,851 to 9,843), followed by the South (6,427: 95%$_{CI}$ 5,653 to 7,201), West (2,971: 95%$_{CI}$ 2,632 to 3,310), and Northeast (1,150: 95%$_{CI}$ 976 to 1,324). However, when comparing regions by rate of injury, which takes into consideration the number of youth on farms, there were minimal differences. The Northeast had the lowest rate of injury at 11.5/1,000 household youth. Injury rates for the Midwest (15.8/1,000 household youth), South (16.3/1,000 household youth), and West (16.0/1,000 household youth) regions were all similar.

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.

When examining regional injuries by sex, the Midwest had the largest discrepancy of rates. Males in the Midwest had an injury rate of 19.8/1,000 household males compared to 12.0/1,000 household females. In the South, the difference was 19.6/1,000 household males to 13.8/1,000 household females. The injury rates by sex in the Northeast and West were more equal (Northeast: 12.7/1,000 household males vs. 10.6/1,000 household females; West: 16.6/1,000 household males vs. 16.4/1,000 household females).

Comparison to 1998 CAIS

In order to begin assessing trends, a comparison to the 1998 CAIS[a] data was completed. The 1998 CAIS methodology[2] is comparable to the 2001 CAIS. Table 5 provides a comparison of the number of injuries and injury rates

TABLE 4. Regional estimates of injuries, injury rates, and number of household youth less than 20 years of age on farms in the U.S. by type of farm, 2001.

	Crop			Livestock		
		Household			Household	
Region	Injuries	Youth	Rate*	Injuries	Youth	Rate*
Total†	6,174	510,650	12.1	13,223	691,894	19.1
Northeast	139	32,480	4.3	1,011	64,784	15.6
Midwest	3,161	263,356	12.0	5,687	284,087	20.0
South	1,930	125,315	15.4	4,497	251,900	17.9
West	944	89,499	10.5	2,028	91,123	22.3

* Injury rate per 1,000 household youth

† Estimates may not add to the total because of rounding

for household youth from the 1998 CAIS and 2001 CAIS. There was a 29% decrease in the number of injuries to youth living on farms; this decrease was not statistically significant. However, the CAIS data also show a 13% decrease in the number of farms (2.2 million vs. 1.9 million), and a 15% decrease in the number of youth living on farms (1,455,314 vs. 1,238,898). Although the injury rate for household youth did decline from 18.8/1,000 household youth in 1998 to 15.7/1,000 household youth in 2001, this difference was not statistically significant.

The difference in injury rates for household males was significant, decreasing from 26.7/1,000 household males in 1998 to 18.7/1,000 household males in 2001. The injury rate for working household males also declined significantly from 20.3/1,000 working household males in 1998 to 11.8 in 2001. While the injury rate for household males decreased, the number of injuries and injury rates for females living on the farm increased. Although this overall increase for household females was not significant, a significant increase was found for 10-15 year old household females. The injury rate for females in this age group increased from 10.8/1,000 household females in 1998 to 17.4/1,000 household females in 2001.

Tractor-related injuries were another area where there was a substantial drop in the injury rate; this decrease, however, was not statistically significant. In 1998, there were an estimated 3,357 tractor-related injuries (2.3/1,000 household youth). In 2001, the number of trac-

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

	1998			2001		
	Injuries	Rate*	95% CI§	Injuries	Rate*	95% CI§
Total†	27,321	18.8	±2.84	19,397	15.7	±1.13
Sex						
Male	20,466	26.7	±4.58	11,571	18.7	±2.50
<10	6,811	26.5	±6.97	3,271	16.0	±4.98
10-15	8,568	30.1	±7.62	5,655	23.9	±5.45
16-19	5,087	22.6	±7.00	2,645	14.6	±5.15
Female	6,855	9.9	±2.56	7,826	13.1	±2.36
<10	3,482	15.0	±5.34	2,868	13.5	±4.59
10-15	2,846	10.8	±4.28	3,831	17.4	±4.98
16-19	526	2.7	±2.26	1,127	7.0	±3.95
Age (All youth)						
<10	10,293	21.0	±4.57	6,138	14.7	±3.15
10-15	11,414	20.8	±4.50	9,486	21.0	±3.28
16-19	5,613	13.4	±3.89	3,773	11.0	±3.17
Work Status						
Work	11,633	14.1	±3.06	6,686	9.8	±1.96
Male	10,001	20.3	±4.88	4,625	11.8	±2.97
Female	1,632	4.9	±2.31	2,061	7.1	±2.79
Non-work	15,687	10.8	±1.94	12,711	10.3	±1.28
Male	10,465	13.7	±2.85	6,946	11.2	±2.26
Female	5,222	7.6	±2.29	5,765	9.6	±2.15
Farm Type						
Crop	10,200	14.5	±3.04	6,174	12.1	±2.55
Livestock	14,616	19.8	±3.90	13,223	19.1	±2.17
Hazard						
Horse	2,828	1.9	±0.75	3,582	2.9	±0.83
ATV	1,930	1.3	±0.61	2,150	1.7	±0.70
Tractor	3,357	2.3	±0.91	894	0.7	±0.44

* 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

tor-related injuries for household youth dropped to 894 (0.7/1,000 household youth). Other notable changes in injury rates, though not statistically significant, were for those related to horses and ATVs, both of which increased from 1998 to 2001.

DISCUSSION

Injury surveillance data provide a valuable tool for understanding the causes of injury to youth on farms and assessing trends over time. 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 15 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.

The decrease in injuries from 1998 to 2001, though not significant, is substantial; however, there has also been a decrease in the total number of farms from 1998 to 2001 (2.2 million vs. 1.9 million) and a decrease in the total number of farm household youth (1.46 million vs. 1.24 million). Further, there has been no significant decline in the overall injury rate. These changing farm demographics should be considered when evaluating the decrease in injuries to youth on farms.

One area of interest is the decrease in injuries for household males compared to the increase for household females. Upon closer examination, this appears to be primarily associated with the number of horse-related injuries. In 1998, horse-related injuries were similarly distributed among males and females. In 2001, this proportion changed substantially to 70% of horse-related injuries for females and 30% for males. The gender difference among horse-related injuries has also been found in previous studies.[7,8] Another area where we see a noticeable change in the number of injuries by sex is for ATVs. In 1998, 79% of the ATV injuries were to males and 21% to females; in 2001, the proportion 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.[9] 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.

A more detailed analysis of the ATV injuries found in the 2001 CAIS is provided in Goldcamp et al.[10] Another possible explanation for the decrease in tractor injuries is recent efforts such as the North American Guidelines for Children's Agricultural Tasks[11] (NAGCAT[b]) and various state tractor certification programs. These efforts may have increased the visibility of tractors as a hazard 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. However, further research and continued surveillance in this area are needed to determine if the decrease in the number of tractor-related injuries continues to be a significant trend or if it is merely an artifact of the most recent data.

Although the number of work-related injuries for youth living on farms decreased by almost half (11,633 to 6,686) from 1998 to 2001, the number of non-work injuries did not experience the same level of decline (15,687 to 12,711). This indicates that non-work injuries remain an important issue for youth living on farms. Further, this discrepancy highlights the need to include non-work injuries into farm safety programs; and the importance of ensuring that public health researchers, when examining farm injuries, are inclusive of the entire farm, not just the work setting.

Limitations

There are some limitations to the results presented in this paper. The possibility of recall and response bias exists for this study. The recall period for the 2001 CAIS was less than 15 months and information was collected on injuries that resulted in at least four hours of restricted activity or required medical attention. 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 recall bias are significantly lower for severe injuries.[12]

Although this present study collected data on more severe injuries, the number of injuries reported should be considered a conservative estimate. Further, most of the surveys were conducted with the female head of household and not the injured individual, and there was no way to verify the accuracy of the responses given for the survey. These factors could impart response bias into the overall survey results.

Also, the sample for the 2001 CAIS was taken from the 1997 Census of Agriculture list frame. While this list is considered to be one of the most complete lists available, there will always be farms that are not included. USDA revised their methodology to take into consideration these so-called off-list farms, as well as farms that have been established since the 1997 Census of Agriculture.

A final limitation is that in the 1998 CAIS the estimates for age, sex, and work status were adjusted for unknown data.[1] Due to a small number of unknowns, these adjustments were not performed on the 2001 CAIS data.

CONCLUSIONS

The results of this study indicate an overall decrease, although not statistically significant, in the number and rate of injuries for youth living on the farm. However, the largest decrease in injuries is seen for work-related injuries. The injury rate for non-work injuries has not shown a similar decrease. Therefore, the farm continues to present a hazardous environment for youth. The rate decline will need continued surveillance to assess if it is a significant trend or the result of changing farm demographics. 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. Due to the frequency and severity of injuries associated with ATVs and horses, the increase in these injuries should also be an area of concern. Agricultural safety and health researchers should consider targeting these areas for further examination and intervention programming efforts.

NOTES

a. For this comparison, the 1998 CAIS data were adjusted based on changes made by USDA to capture missed or misclassified farms.[6] The estimates used in this comparison do not match those published in Myers and Hendricks, 2001.[2]

b. NAGCAT provides guidelines for parents to follow in assigning tasks to children age 7-16 based on their developmental abilities.

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