All-Terrain Vehicle Injuries to Youth Living and Working on Farms in the U.S., 2001 – 2006.

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Objectives/Goals/Purpose: ATV safety on farms is increasing in importance as researchers and educators recognize the prevalence of the vehicle and the associated injuries to farm youth. The objective of this research is to provide ongoing surveillance of ATV injuries to youth living and working on farms in the U.S.

Methods/Narrative/Efforts/Activity: The National Institute for Occupational Safety and Health (NIOSH), in collaboration with the United States Department of Agriculture (USDA) National Agricultural Statistics Service (NASS), provides surveillance of injuries to youth on farms through the Childhood Agricultural Injury Surveys (CAIS). These surveys are conducted via telephone through a random sample of 50,000 U.S. farms. In the years 2001, 2004, and 2006, these surveys included questions on All-Terrain Vehicle (ATV) injuries to youth living and/or working on farms in the U.S.

Results/Findings/Conclusion/Summary: CAIS data for 2001, 2004, and 2006 indicated that ATV use and associated injuries have remained consistent. Over these three years an average of 513,936 youth living and working on U.S. farms rode ATVs, indicating that approximately one-third of all youth who lived and/or worked on a farm have ridden an ATV. Over the three years, these youth experienced a total of 5,321 injuries or an average of 1,774 injuries annually at a rate of 3 per 1,000 youth who rode ATVs during these years.

The majority of ATV-related injuries occurred to youth who were less than 14 years of age. This age group accounted for 64% (1,127 annually) of the injuries. Sixty-four percent of the injuries were to male youth (1,144 annually). Less than half (40%, 700 annually) of the injured youth were wearing a helmet when they were injured.

Despite aggressive efforts to promote safe ATV operation on farms, these data suggest that ATV safety continues to be an issue. Efforts to reduce ATV-related injury should be continued and periodically reviewed for effectiveness.

Application to Field/Research: This research provides multi-year surveillance data that may be used to focus ATV safety education and interventions. In addition, these data suggest that ongoing surveillance of ATV injury is needed to monitor effectiveness of intervention strategies.

Introduction:

The all-terrain vehicle (ATV) has grown in popularity among people of all ages in the United States. The Consumer Product Safety Commission (CPSC) estimates that four-wheeled ATVs in use in the U.S. increased from 4.9 million in 2001 to 8.6 million in 2006.[1] Since their introduction in the 1970s, originally as three-wheeled vehicles, these machines have generally been used for recreation.[2,3,4,5,6] Modern ATVs tend to be off-road vehicles with 4 (or more) wheels utilizing low-pressure tires and rider controls similar to that of a motorcycle.[1,2,7,8,9] ATVs are generally large machines weighing between 100 and 600 pounds with engine displacements up to 800cc.

Although ATVs in use among the general population increased 76% from 2001 to 2006, ATV-related injuries to the general population increased less dramatically, from 110,100 in 2001 to 146,600 in 2006 (a 25% increase).[1] This was a marked decrease from previous CPSC research which showed an 140% increase in injuries from 1997 to 2001.[10] However, both studies show that approximately 30% of the injury events are to youth younger than 16 years of age. When considering amount of use in terms of riding hours, the younger drivers are at greater risk for injury.[10] Other risk factors for ATV riders include inexperience, ATV size, and training.

As ATVs transitioned into 4-wheeled machines and attachments were developed to assist in work activities, these vehicles have become prevalent in the agriculture industry.[2,3,4,11,12,13,14] Research suggests that, for youth living on farms, ATV operation has become more common than tractor operation.[2] This increased exposure to the hazards of ATV operations may lead to increased injuries, including injuries to youth on farms.

To better understand the potential risk for ATV-related injury to youth on farms, the National Institute for Occupational Safety and Health (NIOSH) conducted a series of farm surveys that included ATV exposure and injury questions for youth less than 20 years of age. The data were collected for the years 2001, 2004, and 2006. This paper provides an overview of youth ATV exposure and injury for these years.

Methods:

The 2001, 2004, and 2006 Childhood Agricultural Injury Survey (CAIS) data were collected for NIOSH through an agreement with the U.S. Department of Agriculture (USDA), National Agricultural Statistics Service (NASS). A random sample of 50,000 farm households stratified by geographic region was selected for inclusion in the telephone survey conducted by NASS. The sample frame for each survey was the USDA Census of Agriculture. The 1997 census provided the sampling frame for the 2001 CAIS, while the 2002 census was used for the 2004 and 2006 surveys. Data for each calendar year were collected in February and March of the following year (i.e., 2005 for 2004 data). Table 1 provides response rate information for each survey.

Table 1. CAIS Survey Response Rate Calculations, 2001, 2004, and 2006

CAIS Year	Sample Size	Contacted	Out of Business	Contact Refused	Completed Surveys	Crude Response Rate[1]	Adjusted Response Rate[2]
2001	50,000	39,344	4,320	8,600	26,424	61.5%	78.1%
2004	50,000	40,885	3,229	8,092	29,564	65.6%	80.2%
2006	48,251	38,592	2,853	8,462	27,277	62.4%	78.1%

[1]Crude Response Rate = (Completed Surveys+Out of Business)/Sample Size
[2]Adjusted Response Rate = (Completed Surveys+Out of Business)/Contacted

CAIS data include information about the farm operation and demographic data for youth living in the farm household (household youth), and for youth hired to work on the farm (hired youth). Exposure data related to specific hazards, including ATVs, were collected for household and hired youth. Injury data were collected for up to four non-fatal injuries occurring to household and hired youth under 20 during the calendar years 2001, 2004, and 2006. In these three years, no farm reported more than 4 injuries meeting the requirements for inclusion. Youth laborers hired by contractors working on the farm were excluded from the demographic and injury data.

To qualify for inclusion in the CAIS data, an injury event was defined as having resulted in at least four hours of restricted activity or having required professional medical attention. An injury was considered work-related if the event occurred while the youth was performing activities that had a direct impact on the farming operation as a business, regardless of whether the activity was performed for pay. For example, an injury to a youth while operating an ATV to haul feed would be considered work-related regardless of whether or not the youth was being compensated for the activity.

A narrative description of the injury was collected for all reported injuries. Standardized coding of the source of injury and event was completed by NIOSH staff per the Occupational Injury and Illness Classification System (OIICS).[15] Estimates for injuries and demographic data were obtained using the SAS v9.1 (SAS Institute, Cary, NC) Surveymeans procedure.[16] All results were benchmarked to the 2002 Census of Agriculture based upon region (i.e., estimates based on the sampled farms were re-weighted by region to match the published 2002 farm count by region).[17] Regions were defined through the nine Bureau of the Census geographic regions.

Results:

Youth ATV Riding Population

The number of farms in operation in the United States decreased from 2,157,780 ($CI_{95\%}$ ±17,391) in 2001 to 2,089,790 ($CI_{95\%}$ ±15,839) in 2006. This 3% decrease in farms was accompanied by an almost 20% decrease in the number of youth less than 20 years of age who lived or were hired to work on these farms (See Table 2). During the three years 2001, 2004, and 2006, an average 1.6 million youth lived or were hired to work on a farm. Close to one-third of these youth (513,936, $CI_{95\%}$ ±19,407) rode ATVs on the farms (see Table 2).

Table 2. Household and Hired Youth Population and ATV Riders on U.S. Farms, 2001, 2004, and 2006

	2001	2001 $CI_{95\%}$	2004	2004 $CI_{95\%}$	2006	2006 $CI_{95\%}$
Youth Population						
Household	*1,352,948*	*±36,932*	*1,256,989*	*±35,188*	*1,121,392*	*±34,729*
Hired	*425,317*	*±33,571*	*337,311*	*±22,705*	*306,734*	*±29,251*
Total youth†	**1,778,266**	**±50,625**	**1,594,300**	**±42,448**	**1,428,125**	**±46,113**
Youth ATV Riders						
Household	*460,733*	*±17,601*	*473,455*	*±17,542*	*419,748*	*±15,947*
Hired	*66,452*	*±7,575*	*60,565*	*±8,020*	*60,855*	*±7,374*
Total Youth†	**527,185**	**±19,863**	**534,020**	**±19,976**	**480,603**	**±18,338**
Youth ATV Riders per 1,000 youth						
Household	*341*	*±16*	*377*	*±17*	*374*	*±18*
Hired	*156*	*±12*	*180*	*±27*	*198*	*±31*
Total Youth†	**296**	**±14**	**335**	**±15**	**337**	**±17**

† Estimates may not add to the total due to rounding.

Generally, household youth were twice as likely as hired youth to have ridden an ATV on a farm in the U.S. (Table 2). There was a significant increase in youth riders per capita from 2001 to 2004 for household youth. The rate of hired youth riding ATVs increased each year from 2001 to 2006, as the estimated number of riders remained

constant while the overall population of hired youth declined. This increase, however, was not significant.

Regionally, the Midwest had the highest overall number of ATV riding youth with a three year average of 223,715 ($CI_{95\%}$ ±12,996) household and hired youth ATV riders, and the South had the highest rate of household and hired farm youth who had ridden ATVs at an average of 351 ($CI_{95\%}$ ±31) riders per 1,000 household and hired youth (Table 3). The Northeast had the lowest number and rate of riders (25,234 riders annually, $CI_{95\%}$ ±2202, and 212 riders per 1,000 youth, $CI_{95\%}$ ±21).

Table 3. ATV Riding Household and Hired Youth Per 1,000 Youth on U.S. Farms by region, 2001, 2004, and 2006

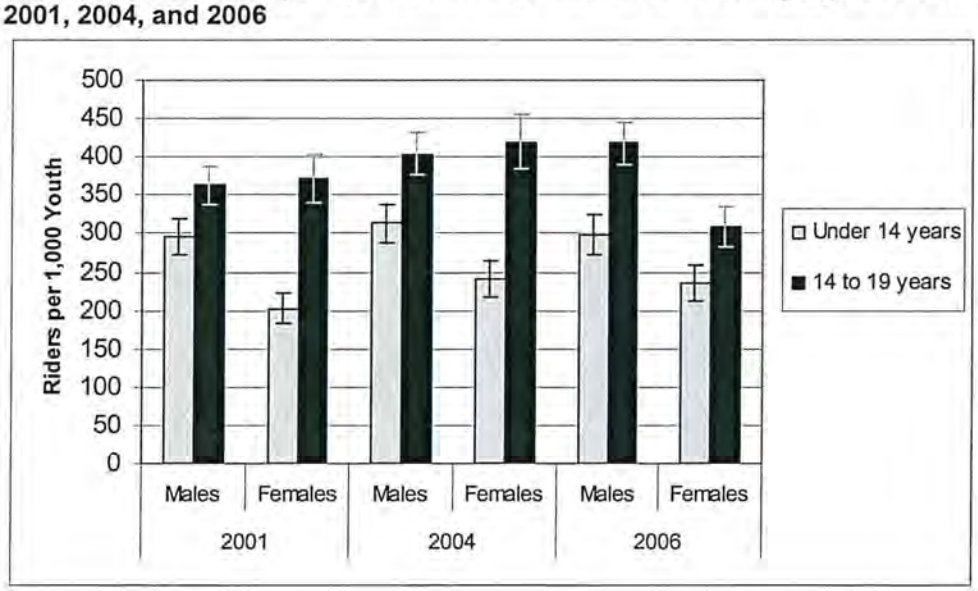
Riders per 1,000 Youth	2001	2001 $CI_{95\%}$	2004	2004 $CI_{95\%}$	2006	2006 $CI_{95\%}$
Household Youth	**341**	**±16**	**377**	**±17**	**374**	**±18**
Northeast	*245*	*±16*	*254*	*±17*	*247*	*±18*
South	*358*	*±23*	*402*	*±24*	*399*	*±27*
Midwest	*338*	*±33*	*379*	*±45*	*364*	*±36*
West	*356*	*±26*	*368*	*±29*	*409*	*±33*
Hired Youth	**156**	**±12**	**180**	**±27**	**198**	**±31**
Northeast	*105*	*±22*	*92*	*±27*	*108*	*±31*
South	*188*	*±27*	*194*	*±23*	*218*	*±32*
Midwest	*163*	*±51*	*188*	*±66*	*202*	*±62*
West	*118*	*±41*	*175*	*±37*	*202*	*±56*
Household and Hired Youth	**296**	**±14**	**335**	**±15**	**337**	**±17**
Northeast	*208*	*±14*	*215*	*±15*	*213*	*±17*
South	*321*	*±19*	*365*	*±21*	*368*	*±23*
Midwest	*298*	*±29*	*337*	*±31*	*332*	*±33*
West	*285*	*±31*	*317*	*±24*	*340*	*±42*

Youth living on crop farms were as likely as youth living on livestock farms to have ridden an ATV. The three year average rate by operation type was 362 riders per 1,000 household youth ($CI_{95\%}$ ±28) on crop operations and 376 per 1,000 ($CI_{95\%}$ ±26) on livestock operations. In 2001, 172 ($CI_{95\%}$ ±28) of every 1,000 hired youth on livestock operations had ridden ATVs compared to 141 ($CI_{95\%}$ ±34) of every 1,000 hired youth on

crop operations. In 2006, the rates increased for both farm types to 235 ($CI_{95\%}$ ±45) of every 1,000 hired youth on livestock operations and 167 ($CI_{95\%}$ ±41) hired youth per 1,000 on crop operations.

During 2001, 2004, and 2006, 40% ($CI_{95\%}$ ±2%) of the household and hired youth 14 to 19 years of age were found to have ridden ATVs. The rate grew slightly from 366 ($CI_{95\%}$ ±20) per 1,000 youth 14 to 19 years of age in 2001 to 421 ($CI_{95\%}$ ±24) per 1,000 youth in 2006. Youth younger than 14 years of age were found to have ridden ATVs at a rate of 270 ($CI_{95\%}$ ±18) per 1,000 youth, with little variation in each recorded year. Males were more likely than females to have ridden an ATV. Approximately 35% ($CI_{95\%}$ ±2%) of males living or working on the farm rode an ATV compared to 30% ($CI_{95\%}$ ±2%) of females. As shown in Figure 1, in 2001 and 2004, males and females 14 to 19 years of age had similar riding rates, with the rate of older female riders decreasing significantly in 2006. Among youth less than 14 years of age, females were less likely than their male counterparts to have ridden an ATV in each year.

Figure 1. ATV Riders per 1,000 Household and Hired Youth by Age and Sex on U.S. Farms, 2001, 2004, and 2006



ATV-related Injuries to Household and Hired Youth

Over the three years included in this study household and hired youth on U.S. farms experienced 5,321 ($CI_{95\%}$ ±2,824) ATV-related injuries, an annual average of 1,774 ($CI_{95\%}$ ±943) injuries. As shown in Table 4, the number of ATV-related injuries decreased each year, but the decrease was not significant. The rate of injury per 1,000 household and hired youth who rode an ATV remained relatively constant at an average of 3.5 ($CI_{95\%}$ ±1.8) injuries per 1,000 riders.

Table 4. ATV-related Injuries to Household and Hired Youth on U.S. Farms, 2001, 2004, and 2006

	2001	2001 $CI_{95\%}$	2004	2004 $CI_{95\%}$	2006	2006 $CI_{95\%}$
ATV Injuries	2,092	1,009	1,649	980	1,580	835
Injury Rate (per 1,000 riders)	4.0	1.0	3.1	1.8	3.3	1.8

Regionally, the majority of ATV-related injuries occurred in the South. On average there were 847 ($CI_{95\%}$ ±725) ATV-related injuries to youth in the South region for a rate of 4.6 ($CI_{95\%}$ ±3.9) injuries per 1,000 ATV riding youth. The range of injury rates in the South region was found to be 3.0 ($CI_{95\%}$ ±2.9) per 1,000 riding youth in 2001 to 5.4 ($CI_{95\%}$ ±4.2) in 2006. The 2006 rate for the South was the highest for any region and year. The highest number of injuries, however, was 1,041 ($CI_{95\%}$ ±784) in the Midwest in 2001.

Farm type appeared to have little impact on ATV injury rate as livestock operations had a three year average rate of 3.6 ($CI_{95\%}$ ±1.8) per 1,000 ATV-riding youth while crop operations had a rate of 3.3 ($CI_{95\%}$ ±2.9) per 1,000. The lowest injury rate by farm-type was 3.0 ($CI_{95\%}$ ±1.9) per 1,000 ATV riding youth on crop farms in 2006 and the highest was 4.3 ($CI_{95\%}$ ±2.6) on livestock operations in 2001.

Youth less than 14 years of age had more injuries (1,127 annually, $CI_{95\%}$ ±759) than youth 14 to 19 years of age (648 annually, $CI_{95\%}$ ±579). The three year average injury rate for youth less than 14 was 5.9 ($CI_{95\%}$ ±4.0) injuries per 1,000 household and hired youth who rode ATVs in this age group, while the rate for youth 14 to 19 years of age was 2.0 ($CI_{95\%}$ ±1.8) per 1,000. Male and female riders were injured at approximately the same rate on average. The three year average rate for males was 3.6 ($CI_{95\%}$ ±2.2, 1,144 annually) injuries per 1,000 household and hired male youth riders while the female rate was 3.2 ($CI_{95\%}$ ±3.2, 632 annually) injuries per 1,000 youth. The 2001 and 2004 data indicated that youth less than 14 years of age were likely to be injured on large ATVs (i.e., those with an engine displacement greater than 200cc). In 2001 and 2004, approximately half of all ATV-related injuries were to youth less than 14 years of age riding ATVs ranging in size from 201 to 400cc. In 2001, there were 1,048 ($CI_{95\%}$ ±788) injuries to youth less than 14 on adult sized ATVs (i.e., greater than 90cc) and there were 838 ($CI_{95\%}$ ±758) of these injuries in 2004. ATV engine displacement size data were not available for 2006.

The majority of ATV injury events to youth on farms occurred when the ATV was being used for recreation. The average number of these recreational ATV injuries incurred by household and hired youth was 1,081 ($CI_{95\%}$ ±595), which is approximately 61% of all injuries. In 2006, 72% (1,136, $CI_{95\%}$ ±461) of all ATV injuries were related to recreational use. The remainder of the injuries were related to general transportation, farm work, or other activities.

The injured youth was found to be the ATV operator in the vast majority of the injury events. The three year average of 1,457 ($CI_{95\%}$ ±633) injuries indicated that in

over 80% of the events the injured youth was operating the ATV. A similar result was found regarding ATV operation training. Annually, 1,417 ($CI_{95\%}$ ±620) injury events occurred to household and hired youth who had not received training on safe ATV operation. Regarding helmet use, on average, less than half of the injured youth were wearing helmets when they were injured (700, $CI_{95\%}$ 499).

Most injury events were non-collision incidents, which accounted for 1,154 ($CI_{95\%}$ ±773) events per year. Approximately half (523, $CI_{95\%}$ ±507) of these events were found to be overturns. The respondent reported minor to moderate injuries for the majority of the events (1,136 per year, $CI_{95\%}$ ±725), with very few incidents causing long-term disability.

Discussion:

Health care providers and consumer advocates have recognized the hazards presented to youth riding ATVs and have worked with the ATV production/distribution industry to address these issues.[20, 21] The 1988 consent decree and 1998 Voluntary Action plan, agreed upon by the CPSC and the ATV industry, outline recommendations intended to reduce ATV injuries among youth.[22] In addition, the North American Guidelines for Children's Agricultural Tasks (NAGCAT)[23] provides recommendations and procedures that can be implemented to reduce the hazards associated with ATV use on a farm. These include recommendations on supervision, the size of the ATV operated by riders less than 16 years of age, protective equipment use, and training for safe operation.

Adult sized ATVs, those with engine displacements greater than 200cc, are not recommended for youth less than 16 years of age.[22] CAIS data indicate that this recommendation is not being followed. The vast majority of injury events (in 2001 and 2004) occurred on ATVs with engine sizes ranging from 201cc to 400cc, these include cases in which the operator was less than 14 years of age. In addition, CAIS data show that most of these youth were operating the ATV at the time of the incident. These data indicate that a number of youth ATV injuries have occurred to youth riding ATVs that are deemed too large for safe operation by the injured youth.

Helmet use and ATV rider training are recommended to increase safety of all riders, [22] but CAIS data suggest that these recommendations are not being followed. Less than half of the injured youth were wearing helmets when injured and less than one-quarter had received any training on ATV operation. Voluntary compliance with these recommendations clearly has not produced the results intended.[10]

Overall, on crop and livestock operations youth exhibited a similar likelihood of having ridden an ATV in these years. Although youth on livestock operations were slightly more likely to ride an ATV than those on crop operations, the result was not significantly different. On livestock operations, however, the rate of hired youth riding ATVs appears to be increasing more quickly than the rate on crop operations. This does not appear to be accompanied by a corresponding increase in injuries to hired youth. This may be related to supervision and training; a hired youth may receive some training and supervision upon beginning work on the farm. Although CAIS includes data on supervision and training, the data do not allow for an examination of their relationship to the type of use at the time of injury due to the limited number of events.

Limitations

The primary limitation of this study is the small number of events available for analysis. As the youth population on farms decreases each year, the number of injury events available for analysis also decreases (although the rate of injury may increase or remain the same). As ATV events account for approximately 10% of all reported injuries in the CAIS data in each year, the number of ATV-related events in the database is relatively low. In addition, the low number of observations results in high standard errors for many estimates. Due to confidentiality and data quality concerns, data are not reportable if the number of observations is too low or the standard error is above a specific limit. Therefore, results that were reportable in 2001 may become un-reportable in 2004 and/or 2006 due to too low numbers of observations or high relative standard errors (>50%). In many instances combinations of variables will produce un-reportable results in each year.

Other limitations are associated with the survey methodology itself. Response and recall bias are likely to impact the CAIS data. Response bias is a concern because the respondent was typically the female head of household and not the injured party. Recall bias may have been introduced because data for injury events were collected early in the calendar year that followed the year of the events. For example, an injury occurring in 2006 was reported in early 2007. For some injuries more than 12 months may have elapsed between the event and the administration of the survey. The respondent was asked to provide information on the most serious injuries, beginning with

the most recent, in an effort to alleviate this bias. Although this may reduce recall bias, elimination is unlikely.[24]

Conclusions:

The major conclusion to be drawn from these results is that despite the presence of warning labels placed on ATVs,[10] recommendations by health and safety professionals,[20] and guidelines set forth in the NAGCAT[23] related to safe ATV use, ATV injury rates are not declining at an appreciable rate for children who live and work on farms. There have been attempts at legislative responses to the hazards presented by ATVs[5], but many of these have been unsuccessful and would have had little impact on the farming community. States have begun adopting restrictive ATV regulations, but these regulations typically have little impact on private property use as they are directed toward use on public roads and lands. The injuries included in CAIS data occurred on farm property, therefore it is unlikely that recent legislation would apply or have been enforceable in these events. In 2002, NIOSH made recommendations for federal child labor laws that would prohibit youth younger than 16 years of age from operating ATVs while performing farm work.[25] These recommendations, however, have not yet been adopted and would likely have had little impact on the injuries in this study since the majority of farms in the CAIS sample are exempt from federal child labor laws. In addition, federal child labor laws would not impact recreational use of ATVs, the most common use resulting in youth injuries. Also in 2002, CPSC received a request from the Consumer Federation of America to restrict the sale of adult-sized ATVs to youth younger than 16 years of age.[20, 21] CPSC denied this petition in 2005 due to the limited

value of such a ban since most ATV distributors already deny the sale of large ATVs to youth under 16 years of age and used-ATVs sales would not be impacted.[22] Given the shortcomings of recent legislative attempts to reduce ATV injuries, hazard awareness education and access to training for ATV and farm operators continue to be the sole means of impacting ATV injury to youth on farms.

Ongoing surveillance of ATV injuries should be utilized to determine the effectiveness of educational programs. Surveillance specific to ATV use and injury may be necessary as general farm injury data do not provide the specificity needed to examine ATV injury events in detail. Since ATVs are operated during both work and recreational activities on the farm, ATV safety should be an integral component of effective farm safety programs.

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