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All-terrain vehicle safety knowledge, riding behaviors and crash experience of Farm Progress Show attendees

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ABSTRACT

Introduction: Although all-terrain vehicles (ATVs) are very popular in rural areas for both recreation and work purposes, the epidemiology of agricultural ATV use remains largely unknown. *Methods:* Farm Progress Show attendees in 2012 (Boone, Iowa) and 2013 (Decatur, Illinois) were surveyed about ATVs, including riding behaviors, crash history, and safety knowledge. Descriptive and comparative analyses were performed (N = 635 surveys). *Results:* Over half of those surveyed lived on a farm and more than 90% had ridden on an ATV. Sixty-one percent rode at least once a week and 39% reported riding almost daily. Males and respondents who lived on farms were significantly more likely to be ATV riders. Regarding unsafe behaviors, >80% of ATV users had ridden with a passenger, 66% had ridden on a public road, and nearly one-half never or almost never wore a helmet. Nearly 40% reported having been in a crash. Multivariable logistic regression analysis of adult respondent's data showed males and younger adults were both more likely to report having crashed. In addition, those reporting riding on public roads (but not having ridden with passengers) were nearly five times more likely and respondents who reported both riding on public roads and having ridden with passengers were approximately eight times more likely to have been in a crash as compared to those not reporting these unsafe behaviors. Safety knowledge did not necessarily correspond with safer behaviors; 80% who knew there should be no passengers on an ATV still had ridden with extra riders. *Conclusion:* ATV use is prevalent in rural populations and most riders report engaging in unsafe riding behaviors. *Practical applications:* These findings may be used to inform ATV safety education and training programs targeted toward agricultural communities, with the goal of reducing occupational ATV-related deaths and injuries and their substantial economic costs.

1. Introduction

About 800 deaths and more than 400,000 injuries from all-terrain vehicle (ATV) crashes occur in the United States each year (U.S. Consumer Product Safety Commission, 2015). Although many ATV-related deaths and injuries occur during recreational riding, occupational use can also be hazardous. A study by the Bureau of Labor Statistics found that adult work-related deaths from ATV crashes rose nearly 400% from 1998 to 2007 (Helmkamp, Marsh, & Aitken, 2011). The highest fatality rate was among agricultural workers, 5.73 deaths per million workers per year. This death rate may be significantly underestimated, as both exposed and non-exposed workers were included in the denominator. A United States Department of Agriculture (USDA) survey showed that there were about 1.6 million ATVs on an estimated 2.2 million farms in 2011 with the vast majority being used for work purposes (Agricultural Statistics Board, 2013).

A number of vehicle design characteristics make ATVs prone to loss of control with resulting rollovers or collision events. These include a high center of gravity, low-pressure knobby tires, and lack of a rear differential. Because of these design features, ATV operation involves "active riding," defined as the timely shifting of the operator's body in response to changes in the vehicle's center of mass. Continuous assessment and good reflexes are needed to effectively manage uneven, inclined, and unexpected changes in terrain. Current models can weigh up to 800 lbs and travel at highway speeds, and larger, faster machines are involved in a growing proportion of ATV-related fatalities (Denning, Harland, Ellis, & Jennissen, 2013; Denning, Harland, & Jennissen, 2014).

Abbreviations: aOR, adjusted odds ratio; ATV, all-terrain vehicle; CI, confidence intervals; NIOSH, National Institute of Occupational Safety and Health; OR, unadjusted odds ratio; USDA, United States Department of Agriculture.

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Previous survey studies examined youth exposure, riding habits and crash outcomes (Burgus, Madsen, Sanderson, & Rautiainen, 2009; Campbell et al., 2010; Hafner, Hough, Getz, Whitehurst, & Pearl, 2010; Hendricks, Myers, Layne, & Goldcamp, 2005; Jennissen, Harland, et al., 2014; Williams et al., 2011), and one study looked at ATV owning households (Rodgers, 1999). To our knowledge, no surveys have been done focusing on adult ATV users, and the epidemiology of agricultural-related use in the United States is largely unknown. To address this question, we surveyed participants at a large agricultural show to determine characteristics and outcomes of their ATV use and to assess their basic ATV-related safety knowledge.

2. Methods

2.1. ATV survey

Study participants were recruited during their visit to an ATV safety booth at the 2012 (Boone, Iowa) and 2013 (Decatur, Illinois) Farm Progress Show, the nation's largest outdoor farm show (Farm Progress Show, 2016). Participants were administered a survey which collected basic demographic data, ATV exposure, safety practices, and ATV-related knowledge. An ATV was defined as a vehicle with low-pressure tires, a straddle seat and handlebars for steering, and a picture of an ATV was provided for survey participants. Questions related to side-by-side vehicles such as utility task vehicles (UTVs) and recreational off-highway vehicles (ROVs) were not included in the study. Table 1 provides survey questions and potential responses. The survey was administered as a paper copy or responses were collected electronically using the TurningPoint™ audience-response system (https://www.turningtechnologies.com/). The authors' Institutional Review Board (IRB) deemed this study exempt.

2.2. Inconsistent exposure responses

Ideally, respondents not exposed to ATVs would have answered 'Never' to the question 'How often do you drive or ride on an ATV?' and then 'Never been on an ATV' for subsequent safety behavior questions. However, inconsistent responses to these questions were sometimes observed. As the most conservative approach for determining exposure, we considered those answering 'Never' for the riding frequency question unexposed. Subsequent answers inconsistent in this respect (27 of 635 surveys, 4.3%) were not included in further analysis of questions regarding ATV safety behavior. Those who did not answer the exposure question were also excluded from further analysis related to exposure (9 of 635 surveys, 1.4%).

Table 1
Farm Progress Show ATV safety survey.

Demographics
1. How old are you?
Answers: <6, 6–12, 13–15, 16–20, 21–30, 31–65, >65
2. What is your sex?
Answers: Male, Female
3. Where do you live?
Answers: On a farm, In the country but not on a farm, In town
ATV Knowledge
1. Most ATVs are made to carry how many people?
Answers: 1, 2, More than 3, I don't know
2. According to previous guidelines, what is the largest ATV engine size recommended for use by 12–15 year olds?
Answers: Under 70 cc, 90 cc, 200 cc, 300 cc, I don't know
3. According to Iowa law, when can someone ride an ATV on a public road?
Answers: When it is a gravel road, For farming purposes, You can never operate an ATV on public roads, I don't know
ATV Riding Practices
1. How often do you drive or ride on an ATV?
Answers: Almost daily, About once a week, About once a month, Only a few times a year or less, Never
For those who had ridden an ATV:
2. Have you ever ridden or driven an ATV with more than one person on the ATV?
Answers: Yes, No
3. Have you ever ridden or driven an ATV on a public road?
Answers: Yes, No
4. How often do you wear a helmet when riding an ATV?
Answers: *Always or almost always, More than half the time, Less than half of the time, Never or almost never*
5. Have you ever been in an ATV crash (rolled over, hit something, fallen off)?
Answers: Yes, No

2.3. Data analysis

Descriptive and comparative analyses were performed using SAS® software, Version 9.2 of the SAS System for Microsoft (SAS Institute Inc., Cary, NC, USA) or SPSS (IBM SPSS Statistics 22). Participant ages were grouped into 5 categories: <16, 16–20, 21–30, 31–65, and >65 years old. Comparisons of categorical variables were completed using the chi-square test. To determine the unadjusted odds ratios (OR) and 95% confidence intervals (95% CI) for 2 × 2 comparisons, we performed the chi square test on the Vassar statistics website (http://vassarstats.net/). All p-values shown are for a two-sided test and significance was defined as $p < 0.05$. Multivariable logistic regression analysis was used to calculate adjusted odds ratios (aOR) and 95% CI for dichotomous outcome variables, after controlling for covariates. Covariates for inclusion in the model were selected a priori based on previous knowledge and on results from bivariate analysis. Respondents with missing data for one or more of the variables used in the regression model were not included in multivariable analysis.

3. Results

3.1. Demographics

Of the 635 surveys completed, 64% of respondents were males, 80% were 16 years of age or older, and more than half lived on a farm (Table 2). Among survey participants, 90% reported having ridden on an ATV (i.e. were exposed). A higher proportion of males were exposed as compared to females (OR 4.15, 95% CI 2.30–7.49, $p < 0.0001$). In addition, there was no significant difference in exposure when comparing youth and adults. However, a lower percentage of respondents over 65 years of age reported having ridden on an ATV relative to younger adults, 16–65 years old (82% vs. 92%, OR 0.41, 95% CI 0.20–0.83, $p = 0.012$). In addition, differences in adult ATV exposure were seen based on where the respondent lived, with the highest exposure among participants living on farms (94%).

Table 2
Demographics of survey respondents and comparison of respondents reporting having ridden on an ATV (exposed) versus not (unexposed).

Variable	All respondents (N = 635)[2]	Exposed (N = 571)[2]	Unexposed (N = 55)[2]	p-Value[1]
	n (Col%)	n (Row %)	n (Row %)	
Sex				
Male	401 (64%)	380 (95%)	18 (5%)	<0.0001
Female	229 (36%)	188 (84%)	37 (16%)	
Youth vs. adults				
<16 years old	129 (20%)	121 (95%)	6 (5%)	0.07
≥16 years old	506 (80%)	450 (90%)	49 (10%)	
Adult age range				
16–20 years old	92 (15%)	85 (92%)	7 (8%)	
21–30 years old	63 (10%)	60 (95%)	3 (5%)	
31–65 years old	286 (45%)	252 (90%)	27 (10%)	
>65 years old	65 (10%)	53 (82%)	12 (18%)	
Residence				
On a farm	335 (53%)	315 (94%)	19 (6%)	0.0084
In country, not on farm	115 (18%)	102 (89%)	12 (11%)	
In town	179 (28%)	152 (86%)	24 (14%)	

[1] Chi square comparison of respondents exposed vs. not exposed to ATVs.
[2] The variable's column sum or row sum may not equal group N due to missing data.