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ORIGINAL RESEARCH

Characteristics of Agriculture Related Motor Vehicle Crashes in Rural New York State

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ABSTRACT

Objective: The Centers for Disease Control and Prevention (CDC) data have shown that agriculture, forestry, and fishing as an occupational group have the third highest rate of work-related roadway crashes. Agriculture-related crashes have been explored in the Midwest and South; however, we know little about agriculture-related crashes in the Northeast, especially in New York.
Methods: To better understand this, researchers obtained motor vehicle crash data from 2010 to 2012 from the New York State Department of Motor Vehicles (NYSDMV). These data were then filtered to agriculture-related cases by both vehicle registration type and vehicle body type.
Results: We identified 203 agriculture-related vehicle crashes, involving 381 vehicles and 482 people. Of the agriculture incidents, 91.6% caused property damage, while 36.0% caused injury. The case fatality rate for roadway vehicle crashes was nearly five times as great (2.0/0.4 = 5.00) for agriculture versus non-agriculture crashes ($p = 0.0003$).
Conclusion: Using these data as a supplement to the New York Center for Agricultural Medicine and Health's existing surveillance system provided information useful in setting priorities involving roadway safety.

KEYWORDS
Agriculture; roadway; farm equipment; crash

Introduction

Rural roads in the United States carry a higher burden of traffic fatalities than urban roads, despite accommodating a smaller percentage of total traffic. According to the US Department of Transportation data, in 2012, 54% of all traffic fatalities were accounted for by the 19% of the US population that lived in rural areas. [1] Further, this same report found that the fatality rate per mile travelled was 2.4 times higher in rural versus urban areas (1.86 and 0.77, respectively). In 2013, rural roads had nearly 20% more traffic-related fatalities than urban roads.[2]

The Centers for Disease Control and Prevention (CDC) data have shown that agriculture, forestry, and fishing as an occupational group have the third highest rate of work-related roadway crashes.[3] In New York, agricultural roadway use is commonplace in rural areas. Compared to other drivers, farm vehicle operators are at a relatively higher risk of being involved in a crash when vehicle miles travelled are taken into consideration.[4] Previous studies have utilized various databases of crash reports to identify possible causative and contributory factors in rural motor vehicle crash fatalities; such as driver age and vehicle type.[5,6] EMS transport times have been shown to be longer in rural areas; however, the percentage of fatalities found dead on the scene were 70.5% in rural areas versus 57.1% in urban areas, respectively.[7] Agriculture related crashes have been explored in the Mid-West,[8–10] and South;[11] however we know little about agriculture-related crashes in the Northeast, especially in New York State.

Many farmers work non-contiguous tracts of land, or store their farm equipment at a location removed from their fields, thus necessitating the use of public roads to transport their farm vehicles or bring products to market.[12] Farm equipment is often wider than a typical vehicle's width and may lack the usual turn signal configuration of other vehicles.[13] Drivers lacking agricultural experience may be unfamiliar with the size and speeds at which farm vehicles travel, and may not be familiar with the slow-moving vehicle emblem (SMV).[14] In New York, farm vehicles (travelling at 25 mph or less on public roadways, day or

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night) should display an SMV emblem. If a tractor is operated a half-hour before sunrise or earlier, or a -half hour after sunset or later, it must be equipped with signalling devices, reflectors and lamps in good working condition.[15]

Other studies have investigated the efficacy of initiatives designed to prevent roadway incidents involving farm vehicles including the slow-moving vehicle emblem[16] and state laws regulating the age of farm tractor operators on public roads.[17] A common difficulty that many of these researchers expressed in their publications was the challenge of quickly and easily identifying and isolating roadway incidents involving farm equipment (which include tractors) within the databases of crash reports.[10]

The New York Center for Agricultural Medicine and Health (NYCAMH) researchers have many years of experience tracking agricultural injuries and fatalities.[18–24] However, motor vehicle crash reports have not been used as a data source in the current injury surveillance processes. The existing system may miss roadway events that cannot be captured using hospitalization records or ambulance reports due to a lack of sufficient coding of agricultural relatedness. In addition, it has been noted that different methods of collecting information about road traffic incidents do not always match even though they are describing the same incident.[25] To better understand the scope of agriculture-related motor vehicle incidents in New York State, NYCAMH researchers analysed electronic records from the NYS Department of Motor Vehicle (DMV) Accident Reports for 2010–2012.

Materials and methods

Study design and population

Researchers obtained motor vehicle crash[26] data from 2010 to 2012 through a Freedom of Information Law (FOIL) request submitted to the New York State Department of Motor Vehicles (NYSDMV). The de-identified dataset includes all records of motor vehicle crashes which occurred within New York State. These reports include information related to the type of accident, vehicles involved, injury severity (as determined by the responding officer), weather conditions, roadway type, and other contributing factors. The DMV data (MV-104) were received via a password-protected compact disc.

These data were filtered to agriculture-related cases using two of the data sets template variables, (1) vehicle registration type (farm and agricultural commercial) and (2) vehicle body type of farm tractor (not registered), sand or agricultural tractor, or feed processing machine. If a record included a vehicle that satisfied either of these two, or both, conditions, it was included in the final dataset. These records also include information about other vehicles involved in the incident, in addition to injury details regarding the drivers or any passengers. The records for agriculture crashes were limited to those which occurred in areas with population densities of less than 1,000 people per square mile.

Data analysis

The gender distribution of the injured subjects was compared to the population distribution using the Z test of a single-hypothesized population proportion. The mean age of those involved in agriculture crashes was compared to the mean age of the population using the Z test of a hypothesized population mean. Comparisons between those injured in agriculture cases versus non-agriculture cases were conducted using chi-square (for categorical variables). Probability values less than 0.05 were considered statistically significant. All data were analysed using SAS 9.3.1 (Cary, NC).

This study was approved by the Institutional Review Board of the Mary Imogene Bassett Hospital.

Results

We identified 203 agriculture-related vehicle crashes, involving 381 vehicles and 482 people. Among these, 33 (16.2%) involved a single vehicle, 163 (80.3%) involved two, and 7 involved three or more (3.5%). In contrast, non-farming crashes in New York State during the same period involved only a single vehicle in 32.5% of cases, two vehicles in 60.5%, and three or more vehicles in 7.1% ($p < 0.0001$).

Of crashes involving agriculture vehicles, 186 (91.6%) caused property damage (damage to vehicle or property of $1,000 or more), while 73 (36.0%) caused injury, and four (2.0%) were fatal. Non-farming vehicle crashes in New York ($n = 398,910$) yielded the following: property damage 362,269

(90.8%), injury 86,058 (21.6%), and fatal 1,560 (0.4%). Thus, the case fatality rate for roadway vehicle crashes is nearly 5 times as great (2.0/0.4 = 5.00) for agriculture versus non-agriculture crashes (p = 0.0003).

Among the 482 individuals involved in agriculture crashes, 120 (24.9%) sustained non-fatal injuries. Among the 119 where severity was reported, 20 (16.8%) were given an injury rating of severe, 26 (21.8%) moderate, and 73 (61.3%) minor. Of the 891,630 individuals involved in non-agriculture vehicle crashes, a total of 162,289 suffered a non-fatal injury which was significantly lower than agriculture vehicle crashes (24.9% vs 18.2%, p = 0.001). Further, based on those with known severity (n = 159,889) the injuries that *did* occur were significantly (p < .0001) less likely to be either severe (10.4% versus 16.8%) or moderate (16.2% versus 21.8%).

Of the agriculture-related incidents, the most common event was a collision with another vehicle (n = 164, 80.8%). The second most common was a collision with a fixed object such as a ditch or embankment (n = 21, 10.3%), followed by an overturn/non-collision event (n = 7, 3.4%). In comparison, the three most common events in non-agriculture crashes were a collision with another vehicle (n = 215,574, 54.0%), striking fixed objects (n = 91,468, 22.9%) and deer involvement (n = 64,297, 16.1%). When contrasting all four categories: (collision with other vehicles, collision with fixed object, overturns, and deer involvement), the two groups differed significantly (p < .0001).

A higher proportion of non-agriculture crashes (n = 243,044, 60.9%) occurred on straight and level roads than agriculture crashes (n = 104, 51.2%) (p = .0046). Non-agriculture crashes occurred more frequently on curved roads than agriculture vehicle crashes: 15.7% versus 10.3%, respectively (p = .0345). In contrast, inclines were involved in a far higher proportion (43.4%) of agriculture crashes than non-agriculture crashes (26.0%), p < .0001. Over three quarters (156/203 = 76.8%) of agriculture crashes occurred during daylight versus 59.1% (235.632/398.910) of non-agriculture crashes (p < .0001). Nearly 90% of agricultural crashes occurred on clear or cloudy days.

Of the 482 individuals involved in agriculture crashes, 110 were passengers (22.8%). In contrast, for non-agriculture crashes, (290,740/891,630) = 32.6% were passengers (p < .0001). The mean ages of drivers involved in agriculture versus non-agriculture incident were 41.1 (median = 40) and 44.3 (median = 45) respectively (p = 0.0016).

In the 203 incidents involving agriculture vehicles, the 203 drivers of the moving agriculture vehicles received a citation 45 times (22.2%) while the 169 non-agriculture vehicle drivers in these crashes received a citation 46 times (27.2%). This difference was not statistically significant. Moreover, drivers in agriculture crashes received a higher percentage of citations than their non-agriculture crash counterparts = 24.5% versus 19.5% (n = 116,944).

Results are summarized in Table 1.

Discussion

Incidents involving agriculture vehicles tend to be more severe than their non-agriculture counterparts in terms of the number of vehicles involved, the extent of the injuries, and the case fatality rate. Poor weather conditions were rarely a factor in agricultural crashes, and this is echoed in similar research conducted at the Great Plains Center for Agricultural Health.[27] It is probable that agricultural traffic uses roadways more frequently on clear weather days, as farmers are more likely to be doing fieldwork or travelling between land parcels. More agriculture vehicle crashes occurred during daylight hours, compared to non-agriculture vehicle crashes.

Crashes on straight roads with a grade were twice as common in agriculture-related crashes than in non-agriculture crashes. We hypothesize these are due to non-agriculture vehicles attempting to pass slower moving agriculture machinery. This could also be a factor in the slightly higher percentage of ticketed violations among agriculture crashes over non-agriculture crashes. Addressing crashes on hilly, straight roadways would be a valuable place to influence safety, by engineering the roadways with a passing lane, by adding signage at these vulnerable spots or by using other traffic control devices. Similar to research conducted by Ranapurwala[27] et al., we saw fewer relative agriculture vehicle crashes on curved roads, compared to non-agriculture vehicle crashes. Driving behaviours for agriculture vehicle drivers on curvy roadways likely differ over straight roads and may contribute to the more cautious operation.

Table 1. Summary of results.

	Agricultural Vehicle Crash	Non-Agricultural Vehicle Crash
No. Crashes	203	398,910
No. Vehicles	381	638,591
No. People	482	891,630
Vehicle Number		
Single vehicle crash	16.2%	32.5%
Two vehicle crash	80.3%	60.5%
Three or more vehicle crash	3.5%	7.1%
Damage/Severity		
Property damage	91.6%	90.8%
Injury	36.0%	21.6%
Fatality	2.0%	0.4%
Known Injury Severity		
Minor	61.3%	73.4%
Moderate	21.8%	16.2%
Severe	16.8%	10.4%
***Top* Event Types**		
Primary	Collision with another vehicle	Collision with another vehicle
Secondary	Collision with fixed object	Striking fixed objects
Tertiary	Overturn/non-collision event	Deer involvement
***Road* Conditions**		
Not Applicable	0.0%	0.0%
Unknown	1.5%	5.7%
Straight and Level	51.2%	60.9%
Straight and Grade	29.6%	15.8%
Straight at Hill Crest	7.4%	1.9%
Curve and Level	3.9%	7.3%
Curve and Grade	4.9%	7.7%
Curve at Hill Crest	1.5%	0.7%
Lighting Conditions		
Unknown	1.0%	5.7%
Daylight	76.9%	59.1%
Dawn	0.5%	2.5%
Dusk	3.5%	2.9%
Dark-Road Lighted	2.5%	11.1%
Dark-Road Unlighted	15.8%	18.7%
Weather		
Unknown	1.0%	5.7%
Clear	52.2%	46.7%
Cloudy	37.0%	27.7%
Rain	5.4%	9.5%
Snow	3.0%	8.7%
Sleet/Hail/Freezing Rain	0.0%	1.2%
Fog/Smog/Smoke	1.5%	0.5%
Other	0.0%	0.1%
Driver Age	41.1	44.3
Citations		
Driver of Agricultural Vehicle	24.5%	
Driver of non-agricultural vehicle		19.5%

Crash data, such as the MV-104 data from NYS Department of Motor Vehicle are a useful supplement to the existing passive injury surveillance system for agricultural injuries. These data would be valuable for any roadway injury incidents. Although injury and fatalities are documented in only a portion of the MV-104 records (36% for agriculture crashes), property damage is also financially detrimental to a farm operation, and unnecessarily adds additional stress on the business. It would be worth exploring the NYS Crash Outcome Data Evaluation System (CODES) database for further data related to the injury event and treatment.[28] Reducing these types of events would not only save life and limb but money. NYCAMH is actively working with the New York State Governor's Traffic Safety Committee on such issues surrounding slow-moving vehicle use.[15] These initiatives bring together the farming community, safety professionals, and emergency services to raise awareness of slow moving vehicles on the roadway.

Limitations

As stated in the methods, incidents that occurred in areas with population densities greater than 1,000 per square mile were not considered in these analyses. This was done because only 5.6% (12/215) of the crashes involving agriculture vehicles occurred in these areas whereas the majority (56.4%) of the non-agriculture crashes occurred there. Therefore, it was felt that a comparison that included these areas would be weighted more heavily towards an urban versus rural perspective than an agricultural versus non-agricultural one. The idea of stratified analyses that included these high population density areas were considered but was not performed due to the small (12) number of agriculture crashes that occurred there. Because of this, the conclusions in this manuscript are limited to crashes that occurred in rural areas.

Conclusions

In New York State, agriculture roadway crashes are on average, more severe than non-agriculture roadway crashes, having a case fatality rate nearly five times that of non-agriculture crashes. As traffic continues to increase on rural roadways, the importance of this issue will only grow. Using these data as a supplement to NYCAMH's existing surveillance system can provide useful information for setting priorities around roadway safety. Interventional work particularly on straight, graded roadway segments in rural areas might have a substantial impact on reducing these incidents.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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