BRIEF REPORT

Animal-Related Motorcycle Collisions in North Dakota

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Objective.—To study the epidemiology and mortality of animal-motorcycle collisions.

Methods.—A retrospective study of all motorcycle collisions recorded in the North Dakota Department of Transportation Crash Reporting System from January 2007 to December 2009 was conducted. Mortality was designated as the main outcome measure.

Results.—Seven hundred sixty-six collisions involving 798 motorcycles were included in this study; 48 of these collisions were with animals (6.3% of all motorcycle collisions). Deer were the most common animal involved (81%). Most animal-motorcycle collisions took place during nighttime with clear weather and on straight rural roads. Drivers were older in animal collisions compared with nonanimal collisions (median of 44 vs 30 years old, respectively, $P < .0001$). Most drivers were males, whereas most passengers were females. Helmets were worn by only 32% of drivers and 12% of passengers. There were 4 (8%; 95% CI, 3%–20%) fatal animal collisions; 9% of the collisions with large animals were fatal compared with 3% of nonanimal collisions ($P = .0411$).

Conclusions.—Animal-motorcycle collisions are a small subgroup of all motorcycle collisions, but with a high mortality rate. Efforts should be made to increase helmet usage, mitigate these collisions, and increase awareness of this problem among motorcycle riders.

Key words: animal, collision, deer, mortality, motorcycle

Introduction

Each year in the United States, it is estimated that 1 to 2 million collisions occur between vehicles and large animals (defined as an animals capable of causing substantial property damage on impact; eg, deer and larger).¹ Most animal-vehicle collisions (AVCs) occur in rural areas, on roads with 55 mph or higher speed limits, during evening or nighttime hours, and in the darkness.^{2,3} Kangaroos and wallabies are the predominant animals that cause AVCs in Australia, camels cause many accidents in Saudi Arabia, and moose and deer primarily cause accidents in Europe and Canada.⁴ The vast majority (as high as 90% in some states) of reported AVCs in the United States involve deer.¹

Motorcycles are the second most common vehicles involved in fatal AVCs in the United States. Williams

and Wells reviewed 147 fatal AVCs between 2000 and 2002 in 9 states in different regions of the United States (Colorado, Georgia, Minnesota, Missouri, North Carolina, Ohio, Pennsylvania, South Carolina, and Wisconsin); 37% of these fatalities involved a motorcyclist striking an animal and falling off the vehicle (65% of the killed motorcyclists were not wearing helmets).³ In another study, motorcycles were 6 times more likely to be involved in fatal AVCs than other vehicles.²

In these previous studies, motorcycles were a subgroup of all the vehicles colliding with animals. Studies looking specifically at animal-motorcycle collisions in the medical literature are lacking. We therefore sought to analyze the epidemiology of animal-motorcycle collisions in North Dakota.

Methods

In this retrospective study, we examined all motorcycle collisions recorded in the database of the North Dakota

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Department of Transportation Crash Reporting System from January 2007 to December 2009. The information in this database is obtained from a Crash Report completed by the law enforcement officer investigating the collision. The report includes where and when the crash occurred, who was involved, what the drivers were doing, what kind of vehicles were involved, what caused the collision, and whether there were injuries or fatalities. When the investigation is complete the Crash Report is submitted to the North Dakota Department of Transportation and uploaded into the Crash Reporting system. In North Dakota, reporting of vehicle accidents resulting in injury to or death of any person, or property damage to an apparent extent of at least \$1000, is mandatory.⁵

On March 23, 2010, the Crash Reporting System was queried for the purpose of this study. The data collected included: time, date, and location of the collision; environmental conditions at the time and the site of the collision; type of road; age and gender of the driver and passenger of the motorcycle; presence of alcohol; use of helmet; and whether the collision was fatal. A fatality is defined as any person who dies within 30 days of the collision. We manually reviewed all animal collisions to identify the animal. In addition, information about motorcycle license was manually obtained from the original police report in all animal collisions and all fatalities.

StatView (version 5.0; SAS Institute, Cary, NC) was used for statistical analyses. Data are summarized as median (interquartile range [IQR]) or percentages. The proportion of motorcycle collisions with animals was calculated. Animal collisions were compared with non-animal collisions, and fatal animal collisions were compared with nonfatal animal collisions. Comparisons for continuous data were made using the Mann-Whitney *U* test, and for categorical data, the χ^2 or the Fisher exact tests. The 95% confidence interval (CI) was calculated when needed. A probability value of less than .05 was considered statistically significant. The Institutional Review Board of Saint Alexius Medical Center, Bismarck, North Dakota, approved the study, and a waiver of informed consent was granted. In addition, a data use agreement for disclosure of protected (individually identifiable) health information was obtained from the North Dakota Department of Health.

Results

Between 2007 and 2009, 810 collisions occurred involving 843 motorcycles in North Dakota. After excluding 44 of these collisions (45 motorcycles) because the motorcycle was parked with no operator, 766 collisions involving 798 motorcycles (27 collisions involved 2 or more motorcycles) were included in this study. Forty-eight of

these collisions (49 motorcycles) were with animals (6.3% of all motorcycle collisions); 39 (81%) with a deer, 4 (8%) with a dog, 1 (2%) with an antelope, 1 (2%) with a donkey, 1 (2%) with a horse, 1 (2%) with a moose, and 1 (2%) with a pheasant. Compared with nonanimal collisions, most animal collisions took place during nighttime with clear weather and on straight rural roads (Table 1).

Compared with nonanimal collisions, drivers were older in animal collisions (Table 2). Most drivers were males, whereas most passengers were females. Alcohol was present in a small proportion of the drivers (4% in animal and 11% nonanimal collisions); however, testing was not performed in the majority of collisions. The proportion of drivers and passengers wearing a helmet was similar in both types of collisions (Table 2).

Of the 49 drivers involved in animal collisions, 8 (16%) had no motorcycle license, 6 (12%) had an out-of-state motorcycle license, and in 1 (2%) the information was missing. Thirty-four (69%) drivers were licensed in North Dakota, and had been for a median (IQR) of 9 years (3–30). No difference was noted when comparing the years of motorcycle license between fatal and nonfatal animal collisions (data not shown).

FATALITIES

Four (8%; 95% CI, 3%–20%) fatal animal collisions occurred compared with 22 (3%; 95% CI, 2%–5%) fatal nonanimal collisions ($P = .0510$). The 4 fatal animal collisions caused 4 deaths: 3 drivers died in deer collisions, and 1 passenger died in a moose collision. The 22 fatal nonanimal collisions caused 24 deaths, 18 drivers and 6 passengers. If the collisions with small animals (dog and pheasant) are excluded, then 9% of the collisions with large animals were fatal compared with 3% of nonanimal collisions ($P = .0411$).

Information regarding the drivers and passengers who died is presented in Table 3.

Discussion

Animal-vehicle collisions are a serious public health problem. Most studies looking into AVCs have analyzed the characteristics and risk factors of fatal animal collisions.^{2,3} We were able to find only one study looking at the mortality of animal-motorcycle collisions. In the study by Nelson et al,⁶ a retrospective chart review at a tertiary referral center in Wisconsin for a 9-year period (1993–2002), the authors identified 55 deer-motorcycle collisions in which 7 (12.7%) individuals died. This mortality rate, however, can be an overestimation if only the sickest patients were admitted and then referred to

Table 1. Comparison of environmental factors in animal vs nonanimal collisions

	<i>Animal collisions</i> (<i>n</i> = 48)	<i>Nonanimal collision</i> (<i>n</i> = 718)	<i>P value</i>
Number of motorcycles, N	49	749	
Nighttime (18:00–5:59), N (%)	32 (67)	304 (42)	<.01
Clear weather, N (%)	45 (94)	589 (82)	.04
Spring or summer, N (%)	45 (94)	635 (88)	.26
Weekday, N (%)			.62
Sunday	7 (15)	104 (14)	
Monday	7 (15)	68 (9)	
Tuesday	4 (8)	84 (12)	
Wednesday	9 (19)	90 (13)	
Thursday	7 (15)	99 (14)	
Friday	7 (15)	108 (15)	
Saturday	7 (15)	165 (23)	
On road, N (%)	47 (98)	544 (76)	<.001
National highway system, N (%)	9 (19)	159 (22)	.58
Rural road, N (%)	41 (93)	201 (31)	<.0001
Normal road conditions, N (%)	47 (98)	646 (90)	.07
Asphalt or concrete road, N (%)	44 (92)	668 (93)	.72
Dry road, N (%)	48 (100)	671 (93)	.07
Straight road, N (%)	46 (96)	575 (81)	.01
Nonjunction, N (%)	48 (100)	441 (61)	<.0001
Nonintersection, N (%)	48 (100)	527 (73)	<.0001
Going straight, N (%) ^a	48 (98)	513 (68)	<.0001
No visual obstruction, N (%) ^a	48 (98)	712 (95)	.36
Motorcycle built year, median (IQR)	2003 (1997–2007)	2004 (1999–2007)	.75

All comparisons were done using the Fisher exact test except for weekday, in which the χ^2 test was used, and for motorcycle built year, in which Mann-Whitney *U* test was used.

IQR, interquartile range.

^a The denominator is the number of motorcycles.

this tertiary medical center; additionally, this approach could underestimate the mortality because motorcycle drivers who died at the scene were not admitted. To

avoid these limitations, we looked into the North Dakota Department of Transportation Crash Reporting System, which captures all motorcycle collisions in the state.

Table 2. Comparison of the drivers and passengers in animal and nonanimal collisions

	<i>Drivers</i>			<i>Passengers</i>		
	<i>Animal</i> (<i>n</i> = 49)	<i>Nonanimal</i> (<i>n</i> = 749)	<i>P value</i>	<i>Animal</i> (<i>n</i> = 8)	<i>Nonanimal</i> (<i>n</i> = 100)	<i>P value</i>
Age, median (IQR)	44 (35–51)	30 (22–46)	<.0001	45 (36–55)	30 (21–45)	.80
Males/females, N/N	47/2	689/59 ^a	.60	0/8	11/65 ^a	.13
Alcohol present, N (%)	2 (4)	84 (11)	.12			
Alcohol test not given, N (%)	45 (92)	668 (89)	.56	8 (100)	97 (97)	.62
Helmet worn, N (%)	19 (39)	235 (31)	.28	2 (25)	11 (11)	.24
Fatal, N (%)	3 (6)	18 (2)	.12	1 (13)	6 (6)	.47
Taken to medical facility, N (%) ^b	26/37 (70)	292/586 (50)	.02	7/7 (100)	36/57 (63)	.05

Age was compared using the Mann-Whitney *U* test; for all other comparisons the Fisher exact test was used.

IQR, interquartile range.

^a In 1 driver and 24 passengers in nonanimal collisions the gender was missing.

^b In 175 drivers and 44 passengers the information was missing.

Table 3. Comparison of driver and passenger fatalities in animal and nonanimal collisions

	Drivers				Passengers			
	Total (n = 21)	Animal (n = 3)	Nonanimal (n = 18)	P value	Total (n = 7)	Animal (n = 1)	Nonanimal (n = 6)	P value
Age, median (IQR)	38 (26–50)	51 (44–51)	33 (25–49)	.16	46 (30–49)	53	41 (28–46)	.13
Males/females, N/N	21/0	3/0	18/0	—	2/5	0/1	2/4	.49
Alcohol present, N (%) ^a	8 (38)	0 (0)	8 (44)	.14	0 (0)	0 (0)	0 (0)	—
Helmet worn, N (%)	4 (19)	0 (0)	4 (22)	.36	0 (0)	0 (0)	0 (0)	—
Motorcycle license, N (%)	12 (57)	3 (100)	9 (50)	.10				
Years licensed, median (IQR)	7 (2–27)	8 (4–27)	6 (2–25)	.64				

The age and years licensed were compared using the Mann-Whitney *U* test; for all other comparisons the Fisher exact test was used.

IQR, interquartile range.

^a The presence of alcohol was measured in all fatalities.

Animal-motorcycle collisions accounted for a minority of all motorcycle collisions (about 6%), but collisions with large animals had a higher mortality than nonanimal collisions. The overall animal-motorcycle collision mortality in our study was 8%.

Motorcyclists in northern states are more likely to ride their bikes in summer or spring as opposed to winter and fall because of the inclement weather.⁶ As a consequence, given the cold winter in North Dakota, most of the collisions took place in summer or spring, similar to the study by Nelson et al.⁶ Most animal collisions happened at night; this observation is typically explained by the fact that deer and other large animals are moving around dusk and dawn, combined with relatively high traffic volume in the early morning and late afternoon.¹ Like previous investigations looking for risk factors associated with fatal AVCs,^{2,3,7,8} most animal collisions happened in apparently ideal driving conditions, with clear weather, and on straight dry asphalt or concrete rural roads. These ideal driving conditions suggest that drivers were surprised by the animal. As in other studies,^{1,3,9} most collisions in North Dakota were with deer, followed by collisions with other large animals. Several interventions have been and are being studied to try to mitigate AVCs and are reviewed elsewhere¹; but, of these interventions, wildlife fencing, with or without wildlife crossing structures, animal detection systems, and long tunnels or bridges were found to provide the greatest reduction of AVCs.¹

Like a study about helmet usage and mortality conducted in North Dakota between 1977 and 1980,¹⁰ most motorcycle drivers and all the drivers who died in the present study were males (as opposed to the passengers who were mostly females). A likely explanation for the male predominance is that men are the primary participants in motorcycling. In North Dakota, for example, as of August 2011, there are 64 120 total licensed motor-

cycle operators of whom 87% are males (data provided by L.F.H.). The observation that drivers were older in animal collisions compared with nonanimal collisions (median age 44 vs 30 years) has been previously reported; the reason is unclear.¹ Previous work also has shown no increase in AVCs for young drivers, suggesting that the chance of being involved in an AVC does not decrease with experience.¹ It has also been hypothesized that young drivers drive less on the types of roadways where AVCs occur (such as low flow, two lane), resulting in relatively few AVCs for this age group.¹ Another possibility is that trained and older riders may have more confidence in their driving skills, in spite of a slower reaction time,¹¹ and thus drive with more risk-taking behaviors.¹² Among the fatalities, the driver's age in animal and nonanimal collision was not statistically different, but the number of deaths was too small to make an accurate analysis.

In 1967, North Dakota passed a statute requiring the use of helmets for all motorcycle riders, for both drivers and passengers. However, the State Legislature amended this law in 1977 requiring only those younger than 18 years old to use helmets. Between 1977 and 1980, in a study by Heilman et al,¹⁰ the helmet usage rate in North Dakota was 39.5%. Three decades later—even though helmets have been shown to significantly reduce head injuries, the likelihood of death, and medical costs¹²—the usage of helmets in North Dakota remains about the same at best. In the present study, helmets were worn in only 32% and 12% of motorcycle drivers and passengers, respectively (and in 19% and 0% of the dead drivers and passengers). Legislators and the public need to be informed about the benefits of wearing helmets and efforts made to require the use of helmets on public highways.

Our study has several limitations. It was a retrospective design, information regarding ethnic groups was not available in the database, and we need to acknowledge

that our findings might not be applicable outside North Dakota, which can be considered a rural state, with a small population and a severe long winter season. Second, the influence of alcohol in AVCs could not be analyzed because the test was not performed in most of the motorcycle drivers. Third, it is possible that the North Dakota Department of Transportation Crash Reporting System missed animal-motorcycle collisions that caused no injury to or death of any person, or damage to the motorcycle estimated to be less than \$1000. Fourth, and more important, we have only analyzed the hard end point of mortality, but we have not looked into the morbidity of animal-motorcycle collisions, which can be devastating, leaving drivers and passengers disabled for life.

We show in this study that animal-motorcycle collisions are a small subgroup of all motorcycle collisions, but with a high mortality rate. Efforts should be made to increase helmet usage, reduce AVCs, and increase awareness of this problem among motorcycle riders. Similarly, strategies aimed at preventing animals crossing roads appear to have the best chance to mitigate this problem. Future studies should include larger geographical regions, and investigate variables not currently present in the Crash Reporting system such as length of time since last operated motorcycle.

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