

The spectrum of motorcycle research in Maryland

Cynthia Burch MPH, Timothy Kerns MS

National Study Center for Trauma & EMS, University of Maryland School of Medicine

Abstract

Motorcycle riders experience significantly higher rates of fatal injury as compared to motor vehicle occupants; in 2011, motorcycle riders were more than 30 times more likely than passenger car occupants to die in a motor vehicle traffic crash and 5 times more likely to be injured. Motorcyclist fatalities have decreased in Maryland over the past five years, but still account for 16% of all traffic fatalities. This article will describe several motorcycle research studies that have been completed using a variety of traffic safety databases. These studies will go beyond the basic descriptive statistics typically seen and explain the importance of each component. Motorcycle safety is a complex issue that requires data integration, multi-tiered research studies, collaboration between partners, and an understanding of the multiple social and behavioral aspects of the riding population.

Introduction

Motorcycle riders experience significantly higher rates of fatal injury as compared to motor vehicle occupants; in 2011, the national passenger car occupant fatality rate per 100 million vehicle miles traveled was 0.80, the light truck occupant fatality rate was 0.81, and the motorcycle occupant fatality rate was 24.93 (NCSA, May 2013). Over the past decade, the frequency of motorcycle crashes and deaths in the United States have not declined. In 2011, motorcycle fatalities accounted for 14% of all traffic deaths in the United States (NCSA, May 2013). In 2011, motorcycle riders were more than 30 times more likely than passenger car occupants to die in a motor vehicle traffic crash and 5 times more likely to be injured (NHTSA, April 2013). Those figures are the results of the Fatality Analysis Reporting System (FARS) (NCSA, August 2013) which contains information on all fatal traffic crashes in the United States. Analyses of 2011 FARS data also found that 29% of motorcycle operators were impaired at the time of the fatal crash and 35% were reported to be speeding, both higher than passenger vehicle drivers (NCSA, April 2013).

Similar trends can be seen in Maryland crash data, with close to 16% of all traffic crash fatalities being motorcycle operators and passengers (NCSA, July 2013). In addition to speeding and operator impairment, this may be attributed to several factors including, but not limited to, warm weather leading to extended riding seasons, economic concerns leading to more motorcycles in use, increased risky behavior of motorcycle operators, or lack of recognition by motor vehicle drivers. Analyses of Maryland crash data are necessary to determine potential crash and operator characteristics that may be associated with higher injury severity.

Maryland first instituted a universal helmet law, requiring all motorcycle riders to wear a helmet, in 1968. That law was revised in 1979 to exempt riders over the age of 17; then reverted back to a universal, all-ages law in 1992 (IIHS, 2013). Approximately 14% of

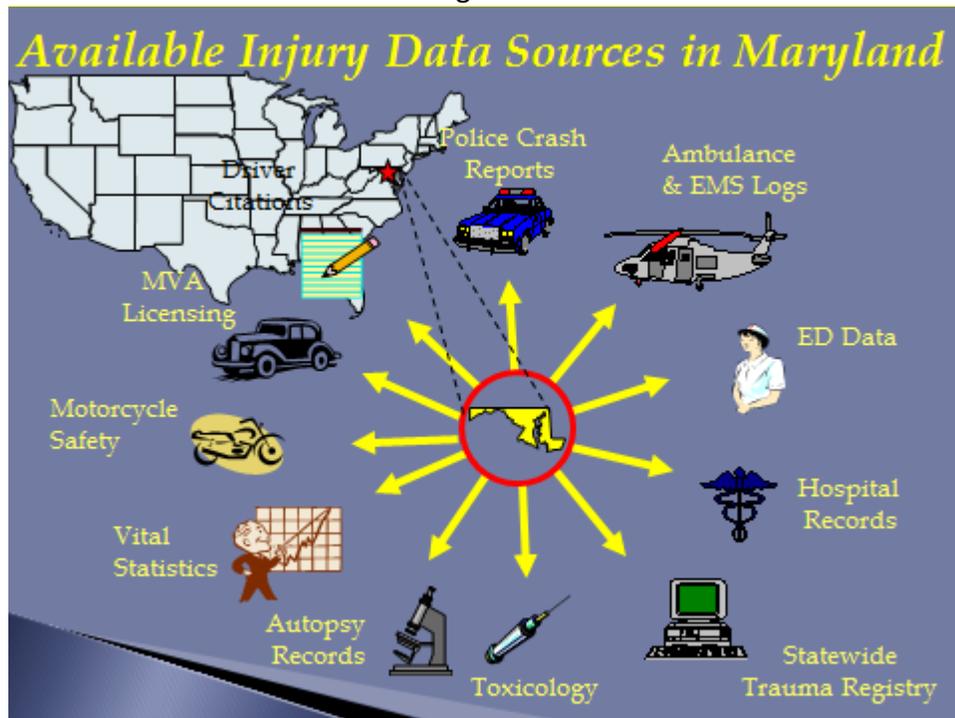
motorcycle fatalities in Maryland were not wearing a helmet at the time of the crash (NCSA, July 2013). However, due to the historical and comprehensive aspects of the Maryland helmet use law, helmet use will not be described in detail in this article.

Research Studies

The National Study Center for Trauma & EMS (NSC) at the University of Maryland, School of Medicine has conducted the Maryland Crash Outcome Data Evaluation System (CODES) project for close to 20 years. CODES involves the integration and analysis of traffic safety databases to characterize injury outcomes. Researchers at the NSC have expanded the CODES program to include a variety of data sources (depicted in Figure 1) including:

- Police-reported crash data – Maryland State Police “Maryland Automated Accident Reporting System” (MAARS)
- Medical examiner data – Office of the Chief Medical Examiner (OCME)
- EMS ambulance run report data – Maryland Institute for Emergency Medical Services Systems (MIEMSS) “Maryland Ambulance Information System” (MAIS) & the Electronic Maryland EMS Data System (eMEDS)
- Citation data - Maryland District Court
- Geographic Information System – geographic depiction of crashes
- Motorcycle Rider Training – Motor Vehicle Administration (MVA)
- Driver license data – Motor Vehicle Administration (MVA)
- Vehicle Registration file – Motor Vehicle Administration (MVA)
- Hospital Discharge Data – Maryland Health Services Cost Review Commission (HSCRC) “Hospital Discharge Data Set”
 - Inpatient Data set
 - Ambulatory Care Data set

Figure 1



This article will describe several motorcycle research studies that have been completed using the datasets listed above. Through collaboration with the Maryland Highway Safety Office, the NSC has reported motorcycle statistics from the statewide police crash report database to state agencies, their partners, and the public. These studies will go beyond the basic descriptive statistics typically seen and explain the importance of each component. To accurately understand and evaluate motorcycle safety, multiple data sources are necessary. There is no accurate exposure measure, such as vehicle miles traveled, and traditional traffic safety sources focus on passenger vehicles so the integration of those sources is often necessary to analyze motorcycles effectively.

Police Crash Report Data

The MAARS database contains records of all police-reported traffic crashes throughout Maryland, with a minimum reporting threshold of a vehicle tow away being necessary. Annually, that file contains approximately 95,000 crashes with 1,900 (2%) involving a motorcycle.

Of those crashes, intersection and intersection-related crashes make up 72% of all motorcycle crashes, however rear-end collisions have been of particular interest. Basic analyses of crash data identify approximately 17% of multiple vehicle crashes were rear-end collisions, but do not identify which vehicle struck the other. By combining the collision type, vehicle movement, and damage location information it was determined that 47% of the time the motorcycle was hitting the rear of the motor vehicle. That information is helpful in identifying educational countermeasures to reduce the incidence. Also, there were 129 same direction-left turn

crashes involving motorcycles between 2008-2010. Of those, the motorcycle was only turning left in 10 incidents (8% of the total), indicating that most likely a motor vehicle was turning in front of the motorcyclist.

To understand the effect of operator behavior and environmental factors, crash contributing factors were analyzed. Close to 40% of operators were reported to be distracted, 25% were aggressive, and 14% were speeding. Also, only 3% of all motorcycle crash reports listed road debris, holes, or highway construction as contributing to the crash. Finally, the behavior of motor vehicle drivers identified as at-fault in motorcycle crashes are of interest. The most common factors were distracted (failure to give full time and attention), failure to yield right of way, following too closely (an aggressive characteristic), and improper turn. The last behavior corresponds to intersection crashes where the motor vehicle turns in front of a motorcycle without seeing them approach.

Medical Examiner Data

Death records provide injury and cause-of-death details not found in other databases. The *Bodily Injury Locations in Fatally Injured Motorcycle Riders* report clearly outlines findings from death records (NHTSA, 2007). One significant finding was that 36% of unhelmeted riders died from head injuries while only 19% of helmeted riders did the same, illustrating the benefit of motorcycle helmets in preventing significant head trauma.

Emergency Medical Services (EMS) Reports

Similar to death records, EMS runsheets provide initial injury and person characteristics that are not available from other data sources. Due to the immediacy of the EMS response and that the provider may be the first person to encounter the crash victim, the runsheet contains the first known vital signs, injury codes, occupant positioning, and witness reports. The narrative portion of the EMS runsheet is invaluable to traffic safety research because it is the only objective depiction of the crash scene.

Citation/Adjudication Data

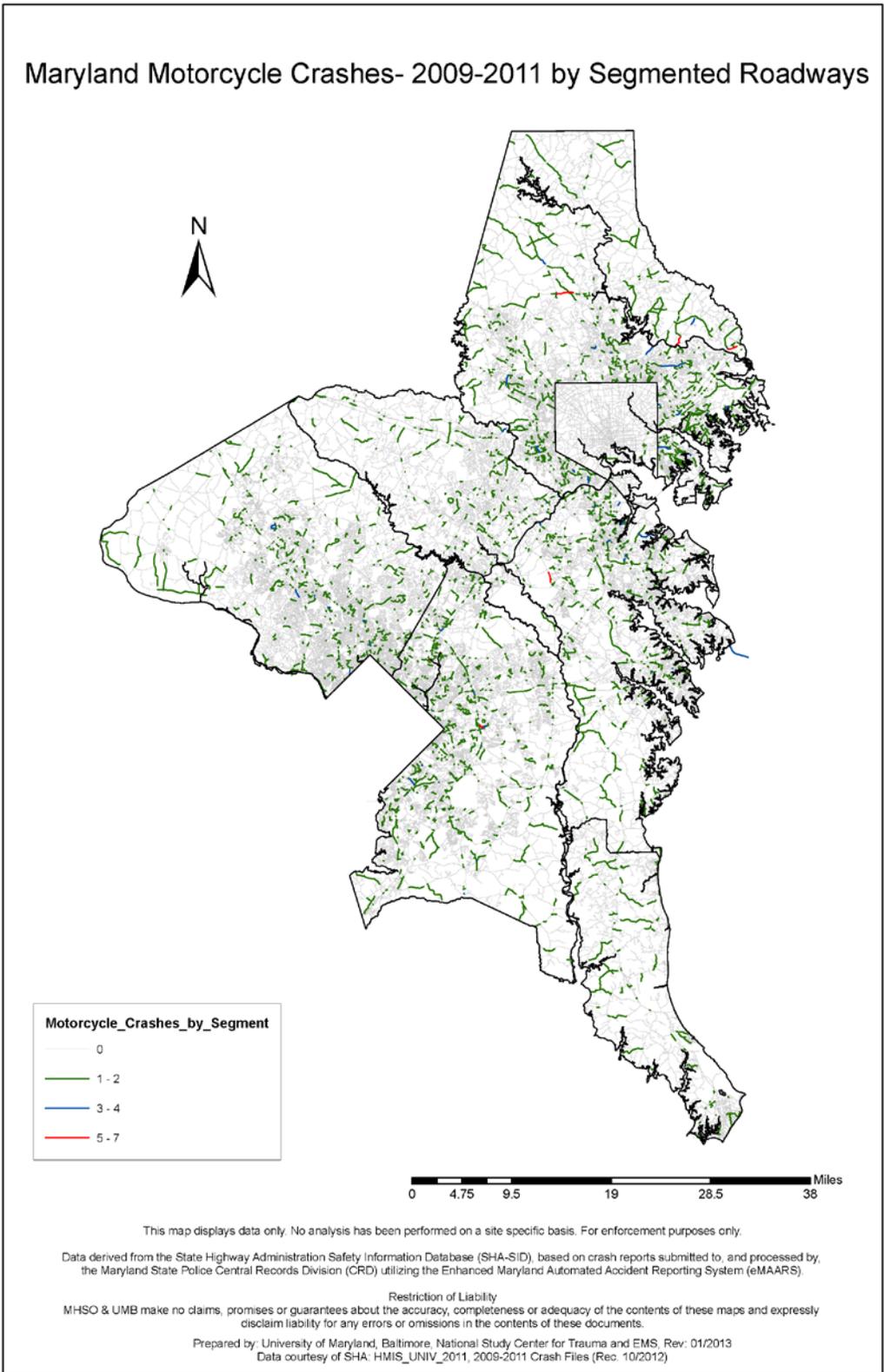
Traffic violation databases are helpful to evaluate the scope and impact of law enforcement efforts. However, it may be challenging in the case of motorcycles because many agencies have 'no-chase' policies which prevent officers from pursuing a motorcycle that is attempting to elude police. Knowing that, approximately 0.3% of all traffic violations written annually in Maryland are issued to motorcycle operators. The citation record itself does not indicate the type of vehicle in operation, but linking the citation to the registered vehicle database using the vehicles tag number allows researchers to distinguish violations by vehicle type. Typically motorcycle operators also drive motor vehicles at times, so determining which vehicle is critical when evaluating riding and driving behaviors.

Annually, close to one-half of all citations written to motorcycle operators were for speeding (exceeding the speed limit or too fast for conditions). More than 10% were for impairment by alcohol and/or drugs, another 10% were for reckless or negligent operation of the motorcycle. Smaller proportions, slightly less than 10%, were for suspended or revoked licenses or operating the motorcycle without the proper license (i.e. no motorcycle endorsement). The adjudication of these citations are available to the NSC researchers to determine the likelihood of a court appearance and disposition, typically guilty, probation before judgment, or not guilty.

Geographic Information System Data Visualization

Maryland traffic citations issued on paper do not contain geo-coded information so they cannot be displayed on a map. The state is currently implementing an electronic citation system that will include latitude and longitude coordinates allowing users to map locations in the near future. However, crash reports do contain logmile reference information that allows for geo-coding and mapping. Many spatial analyses have been conducted to identify motorcycle crash locations by injury severity, segmented roadways, jurisdiction-spanning corridors, and overlays with other available data points. Figure 2 below depicts segmented roadways of motorcycle crashes in Baltimore and Anne Arundel Counties in Maryland. The colors correspond to the number of motorcycle crashes on that segment, with red being the highest

Figure 2



Motorcycle Training, Operator Licensing, Vehicle Registration Data

There are two methods for obtaining a motorcycle license/endorsement in Maryland, through a safety training course or the conventional method of testing at the licensing offices. The Maryland Motor Vehicle Administration (MVA) is responsible for all licensing and also certifying and managing all motorcycle safety training courses in the state. Upon successful completion of the safety course, a written test, and skills evaluation the student may receive a license waiver that must then be presented at an MVA licensing office in order to receive a full motorcycle license. Table 1 below shows the number of safety course students, their completion, and receipt of waivers.

Table 1 – 2011 Maryland Motorcycle Training Numbers

Course Title	# Enrolled	# Completed	# Passed	# Received Waiver
Basic Rider Course	7,928	7,138	6,663	6,340
Alternate Basic Rider Course	769	753	720	695
Total	8,697	7,891	7,383	7,035
Percentage of those Enrolled		91%	85%	81%

Driver license information is captured for all drivers involved in a crash or issued a traffic citation. Since the motorcycle license is rarely issued by itself, and is usually an added endorsement to the primary motor vehicle driver license, it is not always identified on police reports. In Maryland, the regular driver license is a Class C and the motorcycle license is Class M, so it is possible for someone who holds both licenses to be listed as C or CM on the crash report. To investigate the accuracy of the driver license field in the MAARS system, crash reports were linked to the MVA driver license file, which contains the most accurate information for any driver. In 2011, 2,037 motorcycle operators were involved in a crash in Maryland, of which 24% were reported to hold out-of-state licenses. So 1,522 operators with a Maryland license were found in the crash report file, of those 1,513 were successfully linked to the driver file by the soundex number. Of those, 896 (59%) had a valid Motorcycle endorsement on their record at the time of the crash. However, only 339 (22% of all Maryland resident operators in crashes) had an M in the license class field on the crash report. Therefore, analyzing crash report data alone to determine levels of licensure is inaccurate due to reporting errors.

Vehicle title and registration records are a valuable source of information about the type and power of the motorcycle. By decoding the Vehicle Identification Number (VIN), details about the engine size, body type, wheelbase, and other characteristics can be analyzed. The Insurance Institute for Highway Safety (IIHS) has developed an algorithm for decoding the VIN of motorcycles and classifying them into several classes. After decoding Maryland's registration

file, the NSC linked that information to the crash report data and determined that 35% of motorcycles in crashes were cruisers, 34% were super sport, 14% were touring, and 9% were sport bikes. Correlating those figures to operator behavior and crash outcomes allows safety planners to develop and focus countermeasures to have the desired effect.

Emergency Department and Hospital Inpatient Discharge Records

FARS contains only crashes that result in a fatal injury, while other national and state crash databases rely on a five-point injury scale (K=fatal injury, A=incapacitating injury, B=non-incapacitating injury, C=possible injury, O=no injury) to determine the severity of the crash. That five-point scale is completed by the law enforcement officer at the scene of the crash, not a trained medical professional so it may not be accurate as to the level of injury, except for fatal injuries.

Integrating medical records into traffic safety analyses enriches the findings with clinically accurate injury codes and hospital charges. Emergency department and hospital inpatient discharge records are both needed to capture minor injuries that may be treated quickly in the emergency department and the more serious injuries that require intervention or observation after admission to the hospital. CODES was developed on the basis of linking hospital information with crash reports to quantify costs associated with different types of injuries sustained among motorcycle operators wearing a helmet and those not wearing a helmet.

Table 2 includes hospital admission numbers and charges from 2009 by mechanism and shows that motorcyclists, while only being 21% of all admissions, accrued the highest median and 75th percentile hospital charges.

Table 2 – Maryland Hospital Inpatient Admissions (2009)

Mechanism	Number	Charge (\$ in 1,000s)	Percent (%)	Hospital Charges		
Driver	3,132	60,945	45.7	3,923	5,650	14,996
Passenger	1,125	19,363	14.5	4,075	6,110	15,403
Motorcyclist	835	27,455	20.6	4,835	9,999	27,207
Pedalcyclist	105	2,225	1.7	4,062	7,526	22,240
Pedestrian	736	18,171	13.6	4,588	9,083	25,455
Unspecified	247	5,110	3.8	4,281	7,066	18,201
Total	6,180	133,269	100.0	4,104	6,396	17,713

Summary

Motorcycle safety is a complex issue that cannot be understood through one analysis or one database or by answering one question. It requires data integration, multi-tiered research studies, collaboration between partners in the safety, engineering, enforcement, EMS, and

research fields, and an understanding of the multiple social and behavioral aspects of the riding population. Maryland has incorporated such research into its Motorcycle Safety Coalition and has implemented data-driven problem identification and program evaluation methodologies. Crash report data are the critical foundation to any traffic safety study; however motorcycle projects should be enhanced by medical databases, such as EMS, hospital, and death records, as well as traffic citation, operator training, licensing and vehicle registration information.

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