Nobody Told Me That Motorcycles Are So Dangerous

A paper on understanding the danger of motorcycling in the USA

June 3, 2018

National Motorcycle Institute (NMI)
is a 501(c)(3) Educational Public Charity

MotorcycleInstitute.org

Make An Informed Choice

We use science to understand and manage the danger of motorcycling.

Introduction

Motorcycle Crash Fatalities are at disturbing levels. Most people would agree that driving or riding upon a motorcycle on public roadways is dangerous. But the level of danger is much higher than most people realize. Unfortunately, none of the well-known countermeasures that have been attempted over the past 40 years, including rider training, motorcycle license endorsements, and personal protective equipment have reduced the danger to an acceptable level.

One countermeasure that does work is encouraging people to opt out of motorcycling. People who are merely curious about motorcycling, whether a driver, a passenger, or a caregiver (parents, spouse, etc.), should be made aware of the danger and the intense level of effort needed to become a serious motorcycle driver. For anyone concerned about the danger of motorcycling, the best answer is to not take up motorcycling. To assist the curious in making an informed decision, we have analyzed the data from federal databases including the Fatality Analysis Reporting System (FARS) and offer the conclusions freely.

Please share the information contained in this document with anyone in a position to counsel a person who has become curious about motorcycling. The data contained here will support an explanation about being uncomfortable with their loved one's choice to pursue motorcycling on public roadways.

We are careful and precise with our terms when analyzing the danger of motorcycling on public roadways. And, to smooth out random fluctuations, we use 5-year averaging. There are three important data sets necessary to use when analyzing the danger:

1. Crash Fatalities per Population, to measure the danger of motorcycling to society.

2. Crash Fatalities by Person and Motorcycle Type, to determine who is most likely to be killed, and the type of motorcycle typically involved.

3. Driver Fatalities per Driver (Vehicle) Miles Traveled, to compare the danger of driving motorcycles to driving other vehicles.

1. Crash Fatalities per Population

We use Crash Fatalities per Population to model what we call the "Societal Danger of Motorcycling." The Motorcycle Crash Fatality per Population chart provides a way to gain a perspective on the changes to societal danger of motorcycling over time. Currently there are about 15 motorcycle crash fatalities per million population annually. This is an alarming doubling of the motorcycle crash fatality rate of 20 years ago (a +100% increase). By comparison, passenger vehicle fatalities have decreased 35% over the same time frame.

Chart 1: USA **Motorcycle** Crash Fatalities per Population
Five Year Rolling Average (Everybody*)

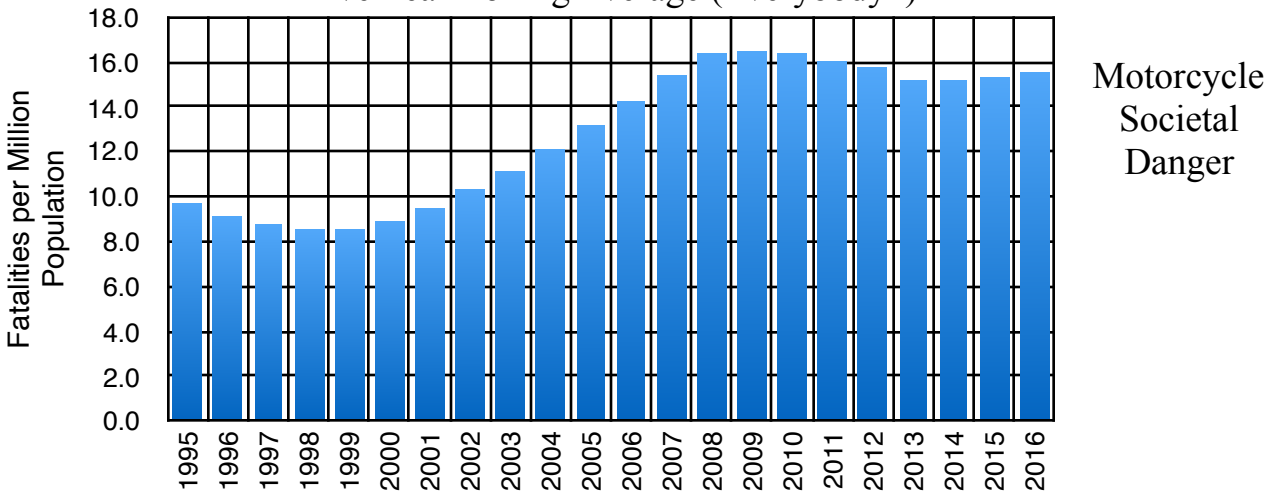
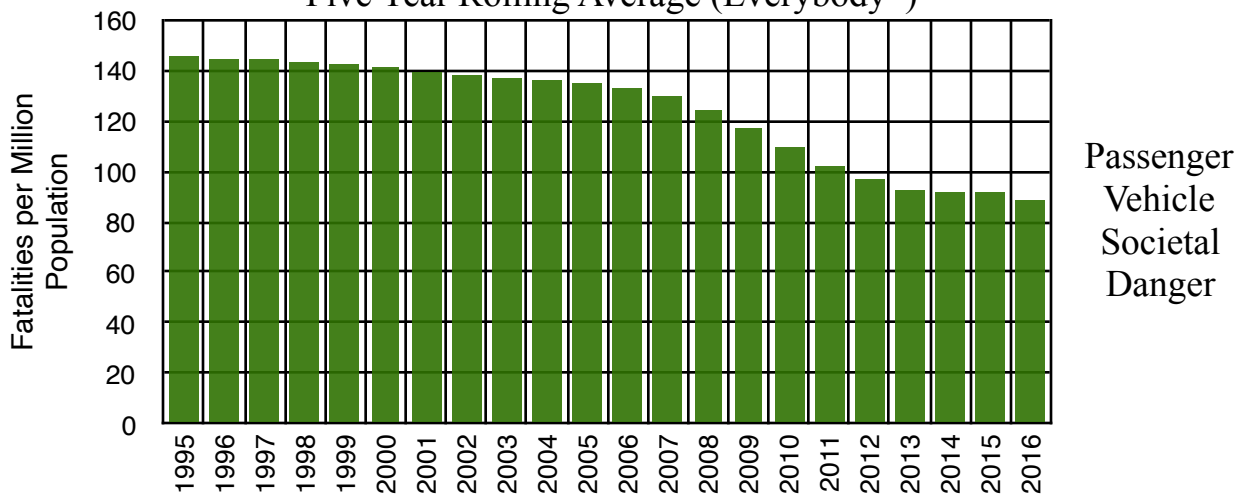


Chart 2: USA **Passenger Vehicle** Crash Fatalities per Population
Five Year Rolling Average (Everybody*)



*Everybody fatally injured in the crash including motorcyclists and non-motorcyclists. Everybody is part of the population.

Sources: Fatalities: NHTSA Fatality Analysis Reporting System (FARS) using the FARS File released September 2016.
Population: US Census Bureau 2017 website

Pre-1995 data not useful for comparison due to change in Passenger Vehicle Definition. See Footnotes.

2. Motorcycle Crash Fatalities by Person and Motorcycle Type

Table 1 "*Motorcycle Crash Fatalities by Person and Motorcycle Type*" provides insight into who receives fatal injuries in motorcycle crashes. The driver of the motorcycle is the fatally injured person more than 94% of the time! The table also shows that the two-wheeled street motorcycle is the dominant type of motorcycle involved in fatal crashes (93%). From the table you can easily see that just one of the twelve categories, "Drivers of Two-Wheeled Street Motorcycles," accounts for almost all the motorcycle crash fatalities.

Table 1: Average Annual USA Motorcyclist Fatalities
by Person* and Motorcycle Type

Five Year Annual Average **2012-2016**	**4,907** Motorcyclist Fatalities per Year	
Motorcycle Type	Driver	Passenger**
Motorcycle (Two-Wheeled Street, Type 80)	4,286	283
Moped (Motorized Bicycle, Type 81)	143	6
Three-wheel Motorcycle Or Moped (Not All-Terrain Vehicle, Type 82)	20	4
Off-road Motorcycle (Type 83)	42	1
Other Motored Cycle Type (Mini-bikes, Motor Scooters, Pocket Motorcycles, Pocket Bikes, Type 88)	94	4
Unknown Motored Cycle Type (Type 89)	20	1
**An average of 3 motorcyclist fatalities per year were not identified as the Driver or Passenger		

Sources: NHTSA Fatality Analysis Reporting System (FARS) using the FARS File released September 2016.

*Motorcyclists are drivers and passengers, i.e. the occupants, riding on Motorcycles-in-Transport. The 5-year Motorcycle Crash Fatalities (when everybody fatally injured in crashes is counted) average is 5,006 fatalities per year. An average of 99 of these fatalities per year were non-motorcyclists. This leaves a 5-year average of 4,907 fatally injured motorcyclists per year, as noted at the top of Table 1. An average of 3 fatally injured motorcyclists per year were not identified as either the Driver or a Passenger, thus reported "Unknown Occupant."

FARS BODY TYPE DEFINITIONS:

80 (Motorcycle) is used when a motor vehicle having a seat or saddle for the use of its operator is a two-wheeled open (e.g., no enclosed body) vehicle propelled by an engine/motor. Motorcycles equipped with a side car also use this code.

81 (Moped [motorized bicycle]) is used when the vehicle is a speed-limited motor-driven cycle capable of moving either by pedaling or by an engine/motor.

82 (Three-Wheeled Motorcycle or Moped) is used when the vehicle is a three-wheeled open vehicle propelled by an engine/motor or a three-wheeled motorized bicycle capable of moving either by pedaling or by an engine/motor.

83 (Off-road Motorcycle [2-wheel]) is used when the vehicle is a two-wheeled open vehicle propelled by an engine/motor designed or built for off road use only.

88 (Other Motored Cycle [mini-bike, motor scooter, pocket motorcycles "pocket bikes"])
is used when the vehicle in question does not qualify for attributes motorcycle, moped, three- wheeled motorcycle or moped.

89 (Unknown Motored Cycle Type) is used when it is known that the vehicle is a motored cycle, but no further data is available.

3. Driver Fatalities per Driver-Miles-Traveled

To correctly measure the danger of driving a motorcycle, we use Driver Fatalities per Driver-Miles-Traveled. In Table 2, we measure only drivers, which will allow a direct comparison between drivers of different types of vehicles. And we use Vehicle Miles Traveled (VMT) to quantify exposure to danger for drivers, to account for fewer miles traveled by motorcycles than by passenger vehicles. VMT for all vehicles is well documented, and is currently equal to "Driver-Miles-Traveled." Based on current driver fatalities per VMT, a person in the USA is 38 times more likely to be fatally injured driving a motorcycle than when driving a passenger vehicle, mile for mile!

Table 2: USA Driver Fatalities per Driver-Miles-Traveled (=VMT*)

	Motorcycle Driver Fatalities (MDF)	**Motorcycle Million Miles**	**Motorcycle Driver Fatalities per 100 Million Miles**
2012	4,652	21,298	21.8
2013	4,423	20,366	21.7
2014	4,318	19,970	21.6
2015	4,735	19,606	24.2
2016	4,950	20,445	24.2
Total	23,078	101,685	*22.7*
	Passenger Vehicle Driver Fatalities (PVDF)	**All light Duty Vehicles Million Miles**	**Passenger Vehicle Driver Fatalities per 100 Million Miles**
2012	15,842	2,664,445	0.595
2013	15,494	2,677,730	0.579
2014	15,431	2,710,556	0.569
2015	16,560	2,779,693	0.596
2016	17,480	2,849,718	0.613
Total	80,807	13,682,142	*0.591*
	Motorcycle Driver Fatalities per 100 Million Miles	**Passenger Vehicle Driver Fatalities per 100 Million Miles**	**Relative Danger**
2012	21.8	0.595	36.7
2013	21.7	0.579	37.5
2014	21.6	0.569	38.0
2015	24.2	0.596	40.5
2016	24.2	0.613	39.5
Average	*22.7*	*0.590*	*38.5*

Sources: NHTSA Fatality Analysis Reporting System (FARS) and FHWA Table VM-1.
*See Footnotes

Conclusions

The motorcycle crash fatalities per population (Societal Danger) has varied over time. It was lowest in the 1997-1998 time frame, but today the rate is at disturbing levels. Therefore, it is within reason that the current rate of 15 fatalities per million population could be reduced to below 8. For the USA, that would mean reducing the current motorcyclist fatality count from about 5,000 persons annually to about 2,500. It appears that the primary cause for the societal danger rising or falling is the level of participation in motorcycling. This is unlike the motorcycle driver fatality rate which has been a relatively constant 22 per million VMT regardless of mitigation tactics such as training, licensing, or mandatory protective gear.

If, on average, the danger of driving a motorcycle per mile is relatively constant, whenever more people have taken up motorcycling, the societal danger has increased. When these three data-sets contained in this article are examined state-by-state, a serious and uncomfortable trend becomes clear. Every state has shown a dramatic increase in motorcycle crash fatalities whenever beginner motorcycle “safety” training has become popular. There are no exceptions. We must conclude that there is a strong inappropriate connection between the promotion of motorcyclist “safety” training and promotion of the sport.

The data helps us better understand what’s happening. Table 1, Motorcycle Crash Fatalities by Person and Motorcycle Type depicts who gets injured in crashes. Clearly, motorcycle drivers of two-wheeled street motorcycles are the dominant persons fatally injured in all types of motorcycle crashes. This table provides insight into how motorcycle endorsements relate to involvement in fatal crashes. The table provides an answer to the question posed by state program employees and motorcycle enthusiasts, "Do unlicensed motorcycle drivers contribute significantly to the high motorcyclist fatality counts?" and the answer is no, they don't. There is not room in this article for another table, however, we can state that 80% of fatally injured motorcycle drivers were properly endorsed and had valid status at the time of the crash. If we include drivers who once had a motorcycle endorsement, but had the license suspended or revoked, the result is 90%. If we narrow the inspection to just two wheeled street motorcycles, the percentage increases further. Clearly, the current motorcycle driver endorsement has little effect on the relative motorcycle driver danger.

The data makes it self-evident that participating carelessly in a dangerous activity will increase the danger. What is NOT self-evident, although true and factual, is that: “Even when being careful, motorcycle drivers continue to experience great danger relative to driving their cars.”

Our models indicate that the Motorcycle Driver Fatalities per Driver-Miles-Traveled (Driver Danger) rate does not vary significantly from year to year. Fluctuations in this rate are caused by the random fluctuations in the measurement of VMT. If we accept that the Driver Danger rate no longer varies, regardless of intervention tactics such as training and endorsements, it would be appropriate to focus resources on tactics that would reduce the number of motorcycle crashes. This could include better public awareness programs to educate the public on the extreme danger of motorcycling and opt-out counseling for training and endorsement programs. Once the danger

of motorcycling becomes more widely known, it will be in the best interest of a state program to focus on danger mitigation techniques that result in a provable reduction in Societal Danger, as measured by Motorcycle Crash Fatalities per Population. It is an urgent matter that the general public learns that motorcycling on public roadways is 38 times more dangerous than driving a car, mile for mile. Do not limit the target audience to just motorcyclists for this information. We also recommend that Departments of Motor Vehicles and state sponsored motorcycle training programs inform students and motorcycle endorsement applicants of the realistic level of danger they will face on public roadways. And we recommend reimbursing training sites for students who opt out before completing training and getting an endorsement.

For those who have promoted that motorcycles can be safe and enjoyable, we realize that motorcycle danger is an uncomfortable and discouraging subject to address. But the data calls for a paradigm shift, not unlike the shifting of the paradigm of the earth being flat to the paradigm of the earth being spherical. The “flat earth” paradigm could explain individual observations, but could not explain other observations. Understanding the true situation in motorcycling requires an appropriate paradigm. For those who are genuinely interested in reducing motorcycle crash fatalities we suggest using this new paradigm, focusing on societal danger, when applying resources and efforts.

The New Motorcycle Danger Paradigm:
- Motorcycles are dangerous and can be enjoyable.
- Motorcycle drivers can get hurt or killed even when they are doing everything “right.”
- Motorcycle drivers are similar to all other human drivers.

Our tagline is, "Make An Informed Choice." When possible, please share the information and ideas contained here with your colleagues and friends. Most importantly, share this information with the mothers and fathers, spouses, significant others, and loved ones of those who are curious about motorcycles. This will lead to a reduction of motorcycle crash fatalities and injuries on our public roadways. This will also lead to much less pain and suffering by people whose loved ones are killed and injured in motorcycle crashes.

We strongly urge you to study the data, not only for the USA, but for your individual state. The three danger measurements we have described are a good place to start. Additional data is available at motorcycleinstitute.org, with greater detail about how we gather and analyze data. National Motorcycle Institute (NMI) is a 501(c)(3) Non-profit Educational Charity committed to reducing the fatalities and injuries of motorcycle drivers and passengers, and the suffering of the family and friends of those injured and killed. We use science to understand and manage the dangers of motorcycling. We are intentionally separate from the motorcycle industry.

Data Sources

Slide Presentation: "FARS Rosetta Stone - Understanding the FARS limitations to the data and help for translating terms"

Fatalities: NHTSA Fatality Analysis Reporting System (FARS) using the FARS File released September 2016

VMT, Vehicle Miles Traveled: Federal Highway Administration

Population: US Census Bureau

Footnotes:

Five-year averaging: We use five-year averaging to provide enough data points to smooth out random fluctuations. This will make comparisons to individual US States more reasonable. The 1995 five-year average is 1991+1992+1993+1994+1995 divided by 5. The five year average is then "rolled" forward to obtain the next year's average. Also, five year averages are commonly used by other organizations, such as NHTSA. Our intent is that by using five year averages, the checking and comparing data in this document will be more accessible for the reader.

Start with 1991 (and 1995 5-year average) Data: We start with the 1995 five year average because the FARS definition for "Passenger Vehicle" was changed to its current definition in 1991. The 1991 data is a part of the 1995 five-year average. Using earlier years will not be useful for comparisons. Also, vehicle, roadway, and data collection technologies vastly change over time periods greater than 25 years, which again limit the usefulness of many longterm comparisons. See FARS Manual and FARS Analytical User Manual for details.

Relative Occupant Danger: Drivers are occupants. This requires that, scientifically, the relative occupant danger must be similar to relative driver danger. You can obtain occupant-miles-traveled (also called "Person-Miles-Traveled" by FHWA) by multiplying VMT by the occupancy rate. Then you may obtain the occupant per vehicle-mile fatality rates for vehicle body types. Sometimes a relative per vehicle rate is given, such as the 2014 NHTSA 27 times more Motorcycle Occupants killed per VEHICLE-mile. The reason the relative occupant per occupant-mile ratio is greater than the occupant per vehicle-mile ratio simply is because cars have more seats, and thus more occupancy, than motorcycles.

Definitions and terms

Vehicle-In-transport: A vehicle being driven on a public road. Example: a motorcycle being driven on the street, not parked or being carried on a trailer.

Crash: A crash is any mishap that involves one or more vehicles-in-transport on roadways commonly used by the public. A Motorcycle Crash is a crash involving one or more Motorcycles-In-Transport on a roadway commonly used by the public.

Everybody Counted in Crashes: "Everybody" fatally injured in the crash is counted, whether riding, or not riding, on or in a vehicle-in-transport. Examples of those fatally injured in a motorcycle crash but not riding on a motorcycle-in-transport are pedestrians, road workers, pedal-cyclists, and passenger-vehicle occupants. Everybody is a part of the "Population." This is why dividing the total fatality count in the crash by the population is a correct pairing of data to obtain a "proper rate." Also, the reporting of who was killed in a crash has a high veracity in the data.

Driver: The occupant operating or controlling the Vehicle-In-Transport. "Motorcyclists" include both drivers and passengers, also known as occupants, riding on Motorcycles-In-Transport. The Motorcycle Driver is the person operating the Motorcycle-In-Transport. A Motorcyclist can be either a driver or a passenger.

Passenger: A person being carried in or upon a Vehicle-In-Transport, who is not operating or controlling the vehicle. A Motorcyclist can be either a driver or a passenger.

Occupant: Anyone being carried in or upon a Vehicle-In-Transport. An Unknown Occupant fatality is a fatally injured person who could not be identified as the driver or the passenger, but was a fatally injured occupant in the crash. A Motorcyclist is an occupant of a Motorcycle-In-Transport.

Two-Wheeled Motorcycles and Sidecars: FARS definition Element Body Type 80 includes two-wheeled motorcycles with sidecars. In FARS counts, the small number of fatalities resulting from two-wheeled motorcycles with sidecars attached is included in Two-Wheeled counts and not Three-Wheeled Motorcycle (Body Type 82) counts.

Motorcycle Configuration: Whether or not a motorcycle has two front wheels, two rear wheels, or a side-car attached, has great influence on the danger. To understand the danger, we recommend using more precision than what is available with the term "3-wheeled." For beginners we recommend motorcycles that have two front wheels.

VMT: Vehicle Miles Traveled, Driver Miles Traveled, Occupant Miles Traveled - Currently, there is one driver per vehicle. This means that "Driver Miles Traveled" is equal to "Vehicle Miles Traveled." Next, to obtain "Occupant Miles Traveled," one multiplies VMT by the occupancy rate, which is always equal to or greater than 1. Thus, "Occupant Miles Traveled" is always equal to or greater than "Vehicle Miles Traveled" and "Driver Miles Traveled." In other words, there are more occupants than vehicles-in-transport or drivers. This is why dividing the driver fatality count in the crash by the VMT is a correct pairing (units) of data to obtain a "proper driver danger rate."

Once the Driver Danger rate is obtained for different vehicles, then relative danger ratios can be compared. Relative Driver Danger Ratios are a very good approximation for the Relative Occupant Danger Ratios since drivers are the majority of occupants, and the relative danger of all occupants of a particular vehicle are similar. This means that it is also over 38 times more dangerous to be an occupant of a motorcycle than to be an occupant of a passenger vehicle, mile for mile.

Currently it is accurate to set Driver Miles Traveled equal to Vehicle Miles Traveled. As autonomous (or driverless) vehicles become more prevalent, the Driver Miles Traveled will become not equal to Vehicle Miles Traveled. For motorcycles, Occupant Miles Traveled can be approximated by Vehicle Miles Traveled. For passenger vehicles, it has not, is not, and in the future will not be accurate to set Occupant Miles Traveled equal to Vehicle Miles Traveled.

Due to changes in the way VMT has been calculated in the past, current VMT cannot be compared to VMT from previous decades. Both the FHWA and NHTSA have posted warnings to not use registrations or VMT for historical comparisons. After reviewing the materials available, we have confidence in using VMT beginning with 2011.

The validity of VMT can be checked by counting cars and motorcycles on public roads. Start by just counting the passenger vehicles between motorcycles. The average motorcycle miles traveled to passenger vehicle miles traveled ratio is about 1 motorcycle to 150 passenger vehicles.

Verifying that motorcycles are only about one out of every 150 vehicles on the road helps quantify the danger of motorcycling. One out of 150 is much less than 1% of vehicles on the road, but motorcycle fatalities represent more than 20% of all driver fatalities.

Note that Relative Driver Danger can be verified as equal to Relative Occupant Danger through observations of the number of passengers riding in the vehicles of interest. The ratio of occupants to drivers is equal to the occupancy rate. Current occupancy rates published by NHTSA for motorcycles is about 1.08, and current occupancy rates for passenger vehicles is about 1.5.

Further Information and Reading: Please visit **MotorcycleInstitute.org**

National Motorcycle Institute's (NMI's) mission is to reduce motorcycle crash fatalities while being an effective, transparent and professionally run 501(c)(3) public charity. We are a resource for the general public and governmental agencies, and we are purposefully independent of the motorcycling industry.