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16. Abstract

More than 38,000 motorcyclists have died in **single vehicle motorcycle crashes** between 1975 and 1999. Motorcyclist fatalities in single vehicle crashes decreased each year from 1990 to 1996, reaching a historic low of 937 in 1996 and again in 1997. In 1998 and again in 1999 the fatalities increased to 1,042 (11.2%) in 1998 and to 1,140 (9.4%) in 1999. The overall increase in motorcyclist fatalities from 1997 to 1999 was 203 (21.7%).

Motorcyclist fatalities in single vehicle crashes account for about 45 percent of all motorcyclist fatalities. With such a high percentage of motorcyclist fatalities in single vehicle motorcycle crashes, this report was written to provide insight into the possible causes for these fatalities.

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1. EXECUTIVE SUMMARY

In 1999, motorcyclist fatalities in single vehicle crashes accounted for almost half (46 percent) of the fatalities from all fatal motorcycle crashes. With such a high percentage of motorcyclist fatalities in single vehicle crashes, this report was written to provide insight into the possible causes for these fatalities. The analysis was based on 1990-1999 data from the Fatality Analysis Reporting System (FARS), a census of all fatal motor vehicle crashes.

More than 38,000 motorcyclists died in **single vehicle motorcycle crashes** between 1975 and 1999. Motorcyclist fatalities in single vehicle crashes decreased each year from 1990 to 1996, reaching a low of 937 in 1996 and again in 1997. However, in 1998 and again in 1999 the fatalities in single vehicle motorcycle crashes increased to 1,042 (11.2%) in 1998 and to 1,140 (9.4%) in 1999. The overall increase in motorcyclist fatalities from single vehicle crashes from 1997 to 1999 was 203 (21.7%).

This report does not analyze all variables within the FARS database and other data sources. Also, this analysis does not examine injury data from the General Estimates System (GES), which reports injuries resulting from motor vehicle crashes. Further analyses need to be undertaken by examining other variables within FARS and GES that may provide additional information describing other factors associated with motorcycle crashes. The National Highway Traffic Safety Administration (NHTSA) plans to conduct these analyses and report the findings.

1.1 Purpose

The purpose of this report is to:

- Use FARS data to analyze fatal **single vehicle motorcycle crashes**;
- Identify possible causes for motorcyclist fatalities.

The analytical approach involved several steps. First, a review of the data source was conducted to determine the appropriate data elements to be examined within FARS. The data elements were then analyzed either individually or combined. The analysis was used in identifying possible elements within the crash information for motorcyclist fatalities in single vehicle crashes.

1.2 Conclusions

Findings from FARS data provide insight into possible reasons for motorcyclist fatalities in **single vehicle motorcycle crashes** and could aid in the design of crash prevention programs:

- More riders age 40 and over are getting killed;
- More motorcyclist fatalities are occurring on rural roads;
- High BAC levels are a major problem among motorcycle operators;
- Half of the fatalities are related to negotiating a curve prior to the crash;
- Over 80 percent of the fatalities occur off roadway;
- Undivided roadways account for a majority of the fatalities;
- Almost two thirds of the fatalities were associated with speeding as an operator contributing factor in the crash;
- Almost 60 percent of motorcyclist fatalities occur at night;
- Collision with a fixed object is a significant factor in over half of the fatalities;
- Braking and steering maneuvers possibly contribute for almost 25 percent of the fatalities;
- Helmet use among fatally injured motorcyclists below 50 percent; and,
- Almost one third of the fatally injured operators did not have a proper license.

2. INTRODUCTION

More than 38,000 motorcyclists died in **single vehicle motorcycle crashes** between 1975 and 1999. This report examines motorcyclist fatalities in single vehicle crashes from 1990-1999 in order to understand possible causes for the fatalities in these crashes.

In 1999, motorcycles made up less than 2 percent of all registered vehicles in the United States and accounted for only 0.4 percent of all vehicle miles traveled (VMT). However, in the same year, motorcyclists accounted for 5.5 percent of total traffic fatalities, and in 1999, 5.9 percent of total traffic fatalities. Per 100,000 registered vehicles, fatality rate for motorcyclists (59.53) in 1999 was 3.6 times the fatality rate for passenger car occupants (16.41). Per vehicle mile traveled in 1999, motorcyclists (23.4) were about 18 times as likely as passenger car occupants (1.3) to die in motor vehicle traffic crashes.

The purpose of this report is to:

- Examine data from NHTSA's FARS fatal motor vehicle crash database;
- Analyze data within specific problem areas by looking for possible causes; and,
- Identify areas that may explain the possible reasons for motorcyclist fatalities in single vehicle crashes.

In order to better understand the reasons for motorcyclist fatalities in single vehicle crashes, FARS data can be analyzed by various cross tabulations of more than 100 data elements. These analyses among the different variables provide better understanding into the specific problem areas related to motorcyclist fatalities. This analysis and report is based on FARS data elements cross-tabulated either individually or combined.

The following sections describe the data used in the analysis, provide the methodology to analyze crash data, highlight the findings, and summarize the implications for crash prevention programs.

3. ANALYTICAL APPROACH

The analytical approach for the report involved the following steps:

- Reviewing the FARS data source to determine the data elements of interest in the crash and how these data elements could be combined;
- Formulating hypotheses about possible factors in fatal **single vehicle motorcycle crashes**; and,
- Summarizing data that focus on possible causes for motorcyclist fatalities in single vehicle motorcycle crashes.

3.1 Fatality Analysis Reporting System (FARS)

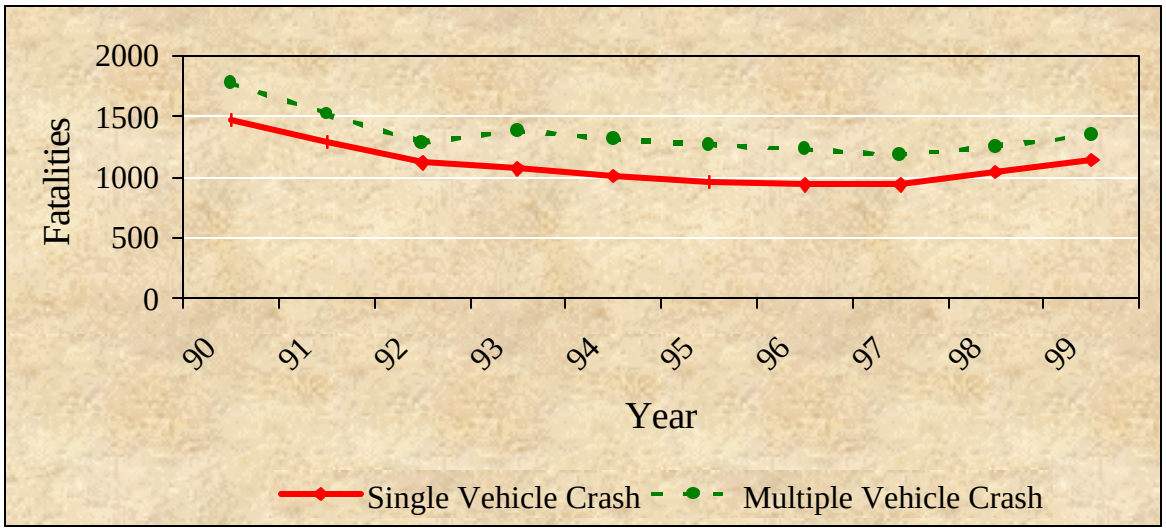
A review of FARS data shows motorcyclist fatalities from **single vehicle motorcycle crashes** in 1990 were 1,469 or 45 percent of all motorcyclist fatalities. In 1999, there were 1,140 motorcyclist fatalities in single vehicle crashes, 46 percent of all motorcyclist fatalities. Table 1 shows motorcyclist fatalities from 1990 to 1999 by year and crash type. The percentage of motorcyclist fatalities in single vehicle crashes has not shown any significant change between 1990 and 1999. Motorcyclist fatalities from single vehicle crashes have decreased each year from 1990 to 1996, reaching an all time low of 937 in 1996 and 1997. In 1998, motorcyclist fatalities from single vehicle crashes increased to 1,042 (11.2%). Again in 1999, the fatalities increased to 1,140 (9.4%). The total increase in motorcyclist fatalities from single vehicle crashes between 1997 and 1999 was 203 (21.7%).

Table 1: Motorcyclist Fatalities by Year and Type of Crash

Year	Type of Crash				Total
	Single Vehicle Crash		Multiple Vehicle Crash		
	Number	Percent	Number	Percent	
1990	1,469	45	1,775	55	3,244
1991	1,285	46	1,521	54	2,806
1992	1,114	47	1,281	53	2,395
1993	1,069	44	1,380	56	2,449
1994	1,010	44	1,310	56	2,320
1995	960	43	1,267	57	2,227
1996	937	43	1,224	57	2,161
1997	937	44	1,179	56	2,116
1998	1,042	45	1,252	55	2,294
1999	1,140	46	1,343	54	2,483

Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

Chart 1: Motorcyclist Fatalities by Year and Type of Crash



Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

3.2 Fatal Motorcycle Crash Facts

The motorcycle related data from the Fatality Analysis Reporting System, *Recent Trends in Fatal Motorcycle Crashes (DOT HS 809 271),* and *Traffic Safety Facts 1999: Motorcycles* provided the following information that served as a basis for formulating the hypotheses shown on page 8:

- In 1999, 41 percent of all motorcyclists involved in fatal crashes were speeding, approximately twice the rate for drivers of passenger cars or light trucks;

- In 1999, the percentage of alcohol involvement was more than 50 percent higher for motorcyclists than for drivers of passenger vehicles;

- Almost half (42 percent) of the motorcycle operators who died in single-vehicle crashes in 1999 were intoxicated. Three-fifths (61 percent) of those killed in single vehicle crashes on weekend nights were intoxicated;

- Motorcycle operators killed in traffic crashes at night were nearly 4 times as likely to be intoxicated as those killed during the day (43 percent and 12 percent respectively);

- Intoxication rates for drivers in fatal crashes in 1999 were highest for motorcycle operators (28 percent), compared to drivers of passenger cars (17 percent), light trucks (20 percent) and large trucks (1 percent);

- Motorcycles are more likely to be involved in a fatal collision with a fixed object than are other vehicles. In 1999, 27 percent of motorcycles involved in fatal

crashes collided with a fixed object, compared to 17 percent for passenger cars, 11 percent for light trucks, and 3 percent for large trucks;

- Nearly one out of six motorcycle operators (15 percent) involved in fatal crashes in 1999 was operating the vehicle with an invalid motorcycle only license (license suspended, revoked, expired, canceled or denied) at the time of the collision, while fewer (11 percent) drivers of passenger vehicles in fatal crashes had an invalid license;

- Motorcycle operators involved in fatal traffic crashes were more than 1.5 times as likely as passenger vehicle drivers to have a previous license suspension or revocation (20 percent and 13 percent respectively);

- There have been more 40 and over age motorcyclist fatalities in recent years; and,

- In 1999 and 1998, more motorcyclists were killed on rural roads than urban roads, reversing the trend from 1990 to 1997;

Based on the FARS data, review of the FARS data elements, *Recent Trends in Fatal Motorcycle Crashes*, and *Traffic Safety Facts 1999: Motorcycle*, the following hypotheses were formulated for testing in further analysis of fatal single vehicle motorcycle crashes:

- Alcohol involvement among operators is a major factor;

- Motorcycles are more likely to be colliding with a fixed object;

- Motorcycles are more likely to be involved when negotiating a curve;

- More crashes are now occurring on rural roadways;

- More motorcyclist fatalities occur off roadway; and,

- Speeding is a factor.

3.3 Analytical Tools

Review of FARS data indicates further in-depth analysis is required using either the data elements individually or by combining the data elements to look for possible causes of motorcyclist fatalities in single vehicle crashes. This report focuses on the following major areas:

- Most harmful event in the crash;

- Speeding as a factor in the crash;

- Alcohol involvement among operators;
- Vehicle maneuver during the crash;
- Crash avoidance maneuver during the crash;
- Helmet use among motorcyclists;
- Age of the motorcyclist;
- Engine size of motorcycle involved in the fatal crash;
- Land use (rural/urban) in the crash;
- Roadway type in the crash;
- Relation to roadway during the crash; and,
- Time of day (day/night) of the crash.

4. FINDINGS

Detailed results are presented based on several of the FARS data elements used in the analysis of fatal **single vehicle motorcycle crashes**. Some of the findings indicate possible causes for motorcyclist fatalities in singe vehicle crashes. These are some of the areas that need attention and focus in developing safety programs and assist in designing crash prevention programs.

4.1 Motorcyclist Fatalities by Year and Person Type

Table 2 shows the number and percent of motorcyclist fatalities by year and person type from 1990 to 1999. The numbers indicate that operators account for over 90 percent of the fatalities while passengers account for less than 10 percent of the fatalities. Review of the data shows no significant changes in the percentage of operator fatalities between 1990 and 1999.

Table 2: Motorcyclist Fatalities by Year and Person Type

Year	Person Type				Total
	Operator (Driver)		Passenger		
	Number	Percent	Number	Percent	
1990	1,321	90	148	10	1,469
1991	1,157	90	128	10	1,285
1992	1,017	91	97	9	1,114
1993	974	91	95	9	1,069
1994	912	90	98	10	1,010
1995	870	91	90	9	960
1996	853	91	84	9	937
1997	879	94	58	6	937
1998	956	92	86	8	1,042
1999	1,051	92	89	8	1,140

Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

4.2 Motorcyclist Fatalities by Year and Sex

Table 3 shows the number and percent of motorcyclist fatalities by year and motorcyclist sex from 1990 to 1999. The data show that between 1990 and 1999 over 90 percent of the motorcyclists killed were males and less than 10 percent were females. Review of the data shows no significant changes in the number and percentage of female fatalities between 1990 and 1999.

Table 3: Motorcyclist Fatalities by Year and Sex							
Year	Motorcyclist Sex						Total
	Male		Female		Unknown		
	Number	Percent	Number	Percent	Number	Percent	
1990	1,369	93	100	7	0	0	1,469
1991	1,188	92	97	8	0	0	1,285
1992	1,039	93	75	7	0	0	1,114
1993	987	92	82	8	0	0	1,069
1994	935	93	75	7	0	0	1,010
1995	876	91	84	9	0	0	960
1996	849	91	88	9	0	0	937
1997	873	93	64	7	0	0	937
1998	955	92	87	8	0	0	1,042
1999	1,037	91	102	9	1	0	1,140
Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999							

4.3 Motorcyclist Fatalities by Year and Age Group

An increase in motorcyclist fatalities has been observed only in the 40 year old and over age group. Conversely the number of fatalities in the under-20 and 20-29 year old age groups declined considerably between 1990 and 1999. Fatalities in the 30-39 year old age group remained proportionally the same over this time period. But the 40-49 and over-49 year old age groups showed an increase between 1990 and 1999. The percentage of fatalities in the 40-49 year old age group increased from 9 percent in 1990 to 24 percent, a factor of 2.7. The over-49 year old age group fatality percentage for the same years increased from 5 in 1990 to 15 in 1999, a factor of 3. Table 4 shows the number and percent of motorcyclist fatalities by age groups for the last 10 years.

However, examining Table 4 shows there are still proportionally more fatalities in the 20-29 year old age group than in the under-20, 30-39, 40-49, and over-49 year old age groups from 1990 to 1999. This indicates that the 20-29 year old age group is still the leading at risk age group in terms of the number of motorcyclist fatalities. However, the number of fatalities in the 30-39 and 40-49 year old age groups are fast approaching the number of fatalities in the 20-29 year old age group.

The number of fatalities in the 40-49 year old age group has increased from 138 in 1990 to 271 in 1999, an increase of 96 percent. Similarly, the number of fatalities in the over-49 year old age group has increased from 67 in 1990 to 176 in 1999, an increase of 163 percent. In fact, the number of fatalities in the 40 and over year old age group has increased from 205 in 1990 to 447 in 1999, an increase of 118 percent. The number of fatalities in the 40-49 and over-49 year old age groups has increased each year since 1995. The fatalities in the 40 and over year old age group have doubled, from 219 in 1995 to 447 in 1999, an increase of 104 percent.

Table 4: Motorcyclist Fatalities by Year and Age Group													
Year	Motorcyclist Age Group												Total
	< 20		20-29		30-39		40-49		> 49		Unknown		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
1990	198	13	679	46	387	26	138	9	67	5	0	0	1,469
1991	168	13	565	44	358	28	133	10	60	5	1	0	1,285
1992	138	12	466	42	316	28	131	12	63	6	0	0	1,114
1993	99	9	435	41	307	29	153	14	74	7	1	0	1,069
1994	100	10	420	42	249	25	160	16	80	8	1	0	1,010
1995	73	8	404	42	264	28	142	15	77	8	0	0	960
1996	77	8	333	36	270	29	177	19	80	9	0	0	937
1997	50	5	317	34	267	28	180	19	123	13	0	0	937
1998	77	7	321	31	297	29	225	22	122	12	0	0	1,042
1999	61	5	340	30	292	26	271	24	176	15	0	0	1,140
Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999													

4.4 Motorcyclist Fatalities by Year and Land Use

Motorcyclist fatalities on rural roadways increased from 49 percent in 1990 to 58 percent in 1999, an increase of 9 percentage points. Between 1991 and 1999 the majority of single vehicle motorcyclist fatalities occurred on rural roads, in contrast to fatalities among all motorcyclists (Table 5). Motorcyclist fatalities on rural roads have increased each year since 1996, from 501 in 1996 to 657 in 1999, an increase of 31 percent.

Table 5: Motorcyclist Fatalities by Year and Land Use							
Year	Land Use						Total
	Rural		Urban		Unknown		
	Number	Percent	Number	Percent	Number	Percent	
1990	726	49	742	51	1	0	1,469
1991	687	53	594	46	4	0	1,285
1992	591	53	514	46	9	1	1,114
1993	551	52	510	48	8	1	1,069
1994	531	53	478	47	1	0	1,010
1995	513	53	444	46	3	0	960
1996	501	53	436	47	0	0	937
1997	518	55	419	45	0	0	937
1998	592	57	445	43	5	0	1,042
1999	657	58	475	42	8	1	1,140
Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999							

4.5 Motorcyclist Fatalities by Year and Engine Displacement in Cubic Centimeters (cc)

The percentage of motorcyclist fatalities in the 1,001-1,500 cc displacement engine size increased from 22 percent in 1990 to 33 percent in 1999, an increase of 11 percentage points, the only group by engine size to show an increase between 1990 and 1999. The largest number of motorcyclist fatalities still occurs in the 501-1,000 cc engine group. However, the fatality count among motorcyclists in the 1,001-1,500 cc group is approaching the 501-1,000 cc levels. Motorcyclist fatalities in the 500 cc and less engine group declined from 17 percent in 1990 to 6 percent in 1999. Similarly, fatalities in the 501-1,000 cc engine size have declined from 49 percent to 40 percent during the same time period. Starting in 1996, a very small number of all motorcyclist fatalities are reported involving motorcycles with engine displacements greater than 1,500 cc. These findings may reflect market trends in the new motorcycles being sold. Table 6 shows number and percent of fatalities from 1990 to 1999 by engine displacement.

Table 6: Motorcyclist Fatalities by Year and Engine Displacement (cc)

Year	Engine Size: Displacement in Cubic Centimeters (cc)										Total
	Up to 500		501-1,000		1,001-1,500		> 1,500		Unknown		
	No.	%	No.	%	No.	%	No.	%	No.	%	
1990	247	17	725	49	329	22	0	0	168	11	1,469
1991	194	15	667	52	316	25	0	0	108	8	1,285
1992	173	16	507	46	312	28	0	0	122	11	1,114
1993	143	13	514	48	308	29	0	0	104	10	1,069
1994	132	13	468	46	289	29	0	0	121	12	1,010
1995	122	13	462	48	285	30	0	0	91	9	960
1996	86	9	451	48	307	33	2	0	91	10	937
1997	72	8	446	48	331	35	6	1	82	9	937
1998	83	8	484	46	364	35	8	1	103	10	1,042
1999	73	6	455	40	372	33	12	1	228	20	1,140

Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

4.6 Motorcyclist Fatalities by Year and Helmet Use

Helmet use in fatal **single vehicle motorcycle crashes** among fatally injured motorcyclists has shown a slow but steady increase from 39 percent in 1990 to 49 percent in 1999, a 10-percentage point increase. At the same time, just under half (48 percent) of all fatally injured motorcyclists in 1999 did not wear a helmet while riding a motorcycle compared to 54 percent in 1990. Table 7 shows the number and percent of fatally injured motorcyclists by helmet use from 1990 to 1999. Motorcyclists who died without a helmet have increased sharply, from 424 in 1997 to 544 in 1999, an increase of 28 percent.

Helmet use among fatally injured motorcyclists in all crashes (single and multiple vehicle) was higher (DOT HS 809 271) when compared to helmet use among fatally injured motorcyclists in single vehicle crashes.

Table 7: Motorcyclist Fatalities by Year and Helmet Use

Year	Helmet Use						Total
	Not Used		Used		Unknown		
	Number	Percent	Number	Percent	Number	Percent	
1990	788	54	579	39	102	7	1,469
1991	690	54	519	40	76	6	1,285
1992	513	46	542	49	59	5	1,114
1993	484	45	525	49	60	6	1,069
1994	474	47	494	49	42	4	1,010
1995	450	47	477	50	33	3	960
1996	436	47	470	50	31	3	937
1997	424	45	481	51	32	3	937
1998	497	48	503	48	42	4	1,042
1999	544	48	555	49	41	4	1,140

Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

4.7 Motorcyclist Fatalities by Year and Speeding Factor

The percent of fatally injured motorcyclists where speeding was recorded as a driver contributing factor remains about 55 percent and has not changed significantly. Further analysis of the data in the following sections reveals some important information relating to speeding. Table 8 shows the fatalities by year and speeding factor.

Table 8: Motorcyclist Fatalities by Year and Speeding Factor							
Year	Speeding Factor						Total
	Speeding		Not Speeding		Unknown		
	Number	Percent	Number	Percent	Number	Percent	
1990	856	58	595	41	18	1	1,469
1991	809	63	466	36	10	1	1,285
1992	649	58	457	41	8	1	1,114
1993	624	58	429	40	16	1	1,069
1994	588	58	401	40	21	2	1,010
1995	535	56	398	41	27	3	960
1996	548	58	372	40	17	2	937
1997	525	56	393	42	19	2	937
1998	566	54	465	45	11	1	1,042
1999	634	56	487	43	19	2	1,140
Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999							

4.8 Motorcyclist Fatalities by Year and Relation to Roadway

The definitions of on roadway and off roadway terms used throughout this report are based on the following:

Off Roadway – A crash occurring on the shoulder, median, roadside, outside right-of-way, off roadway – location unknown, in a parking lane, gore and separator. A gore is an area of land where two roadways diverge or converge.

On Roadway – A crash occurring on the roadway.

Review of data from Table 9 shows that over 80 percent of the motorcyclist fatalities are off roadway. Further analysis of the data in the following sections reveals some important information relating to fatalities off roadway.

Table 9: Motorcyclist Fatalities by Year and Relation to Roadway							
Year	Relation to Roadway						Total
	On Roadway		Off Roadway		Unknown		
	Number	Percent	Number	Percent	Number	Percent	
1990	216	15	1,230	84	23	2	1,469
1991	205	16	1,048	82	32	2	1,285
1992	168	15	936	84	10	1	1,114
1993	156	15	912	85	1	0	1,069
1994	189	19	817	81	4	0	1,010
1995	172	18	782	81	6	1	960
1996	159	17	776	83	2	0	937
1997	165	18	769	82	3	0	937
1998	171	16	866	83	5	0	1,042
1999	199	17	938	82	3	0	1,140
Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999							

4.9 Motorcyclist Fatalities by Year and Crash Avoidance Maneuver

The crash avoidance maneuver is an element coded in the crash if the driver of the vehicle took any steps to avoid the crash. This data element was added to the FARS database in 1991. Almost one-fifth (22 percent) of the motorcyclist fatalities in 1999 were related to either the braking or steering maneuvers. Table 10 shows the number and percent of motorcyclist fatalities by year and crash avoidance maneuver over the 9-year period from 1991 to 1999. The number of motorcyclist fatalities related to braking and steering maneuvers has increased from 16 percent in 1991 to 22 percent in 1999, an increase of 6 percentage points. The fatalities related to the braking maneuver has not changed with 13 percent of the fatalities in 1991 and 1999 whereas the fatalities relating to steering maneuver have increased from 3 percent in 1991 to 9 percent in 1999, an increase of 6 percentage points (or 200 percent). However, almost half of the fatal crashes did not report any crash avoidance maneuver during the crash investigation (either not reported by police or information reported is inconclusive). Similarly, about 30 percent of the fatalities were attributed to no maneuver in the crash.

Table 10: Motorcyclist Fatalities by Year and Crash Avoidance Maneuver											
Year	Crash Avoidance Maneuver										Total
	No Maneuver		Braking		Steering		Other		Not Reported		
	No.	%	No.	%	No.	%	No.	%	No.	%	
1991	370	29	169	13	41	3	13	1	692	54	1,285
1992	418	38	109	10	38	3	13	1	536	48	1,114
1993	384	36	114	11	41	4	13	1	517	48	1,069
1994	310	31	152	15	48	5	12	1	488	48	1,010
1995	352	37	122	13	48	5	18	2	410	43	960
1996	319	34	147	16	61	7	8	1	402	43	937
1997	303	32	136	15	61	7	7	1	430	46	937
1998	297	29	140	13	75	7	13	1	517	50	1,042
1999	340	30	152	13	98	9	10	1	540	47	1,140
Source: National Center for Statistics and Analysis, NHTSA, FARS 1991-1999											

4.10 Motorcyclist Fatalities by Year and Most Harmful Event

The most harmful event applies to the vehicle. It is an event during a crash for a particular vehicle that is judged to have produced the greatest personal injury. The definitions of non-collision, collision with object not fixed, and collision with fixed object terms used throughout this report are based on the following:

Non-collision - a crash in which the harmful event does not involve a collision with a fixed object, non-fixed object, or a motor vehicle. This includes overturn, fire/explosion, falls from a vehicle, and injuries in a vehicle.

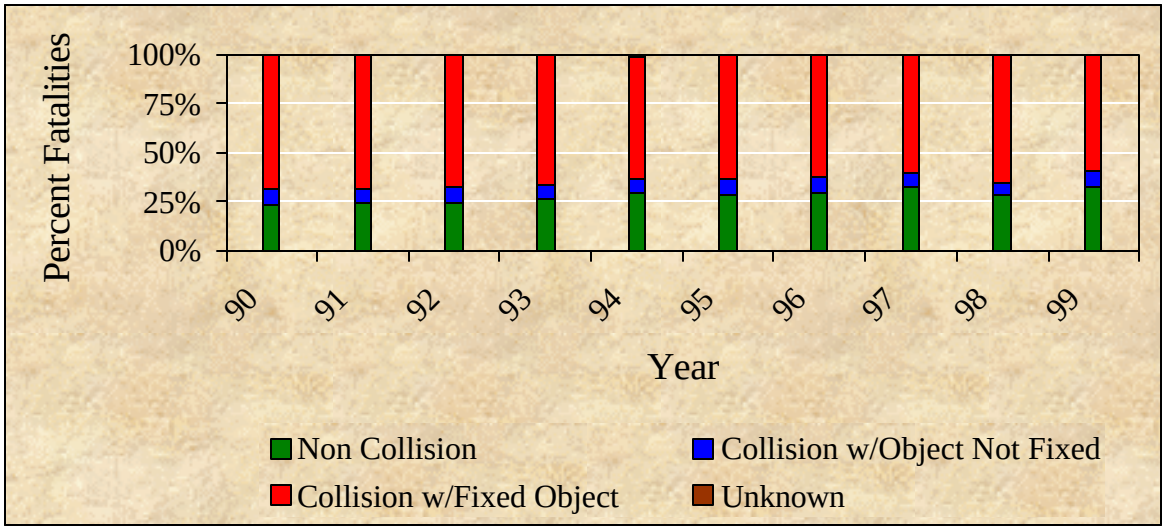
Collision with object not fixed - objects that are movable or moving but are not motor vehicles. This includes pedestrians, pedalcyclists, animals, and /or trains.

Collision with fixed object - the collision of the vehicle with stationary structures or substantial vegetation attached to the terrain, like a bridge rail, guardrail, utility pole, culvert, concrete traffic barrier, fire hydrant and / or shrubbery.

Table 11 shows the number and percent of motorcyclist fatalities by year and most harmful event. About 30 percent of the fatalities were related to non-collision in the crash. Almost two thirds of the motorcyclist fatalities were associated where collision with fixed object was recorded as the most harmful event. The percentage of motorcyclist fatalities colliding with a fixed object as the most harmful event has decreased from 69 percent in 1990 to 59 percent in 1999, a reduction of 10 percentage points. This variable in the crash has been further combined with other variables in the crash to obtain the relationship between the two crash variables. Further analysis of these data relating to a collision with a fixed object is presented in the following sections.

Table 11: Motorcyclist Fatalities by Year and Most Harmful Event									
Year	Most Harmful Event								Total
	Non Collision		Collision with Object Not Fixed		Collision with a Fixed Object		Unknown		
	No.	%	No.	%	No.	%	No.	%	
1990	337	23	116	8	1,016	69	0	0	1,469
1991	314	24	94	7	877	68	0	0	1,285
1992	269	24	84	8	761	68	0	0	1,114
1993	275	26	79	7	715	67	0	0	1,069
1994	300	30	69	7	632	63	9	1	1,010
1995	271	28	80	8	608	63	1	0	960
1996	276	29	74	8	586	63	1	0	937
1997	300	32	64	7	572	61	1	0	937
1998	291	28	61	6	687	66	3	0	1,042
1999	363	32	96	8	677	59	4	0	1,140
Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999									

Chart 2: Motorcyclist Fatalities by Year and Most Harmful Event



Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

4.11 Motorcyclist Fatalities by Year and Vehicle Maneuver

The vehicle maneuver is the driver's action, or intended action, prior to commencement of an un-stabilizing event, as indicated on the crash report. Other vehicle maneuvers include going straight, starting in lane, stopping in lane, passing, parked, avoid animal, left turn, U-turn, changing lanes and others. Table 12 shows the number and percent of motorcyclist fatalities by year and vehicle maneuver. Review of the data shows half of

the motorcyclist fatalities occurred when the vehicle was negotiating a curve. The other vehicle maneuver actions as an individual data element did not show significant number of fatalities to be analyzed further. The number of motorcyclist fatalities when negotiating a curve has increased from 430 in 1997 to 570 in 1999, an increase of 33 percent after reducing between 1990 and 1996. Further analysis of the data is provided in the following sections relating to vehicle maneuver when negotiating a curve.

Table 12: Motorcyclist Fatalities by Year and Vehicle Maneuver

Year	Vehicle Maneuver						Total
	Negotiate Curve		All Others		Unknown		
	Number	Percent	Number	Percent	Number	Percent	
1990	710	48	752	51	7	0	1,469
1991	627	49	652	51	6	0	1,285
1992	567	51	540	48	7	1	1,114
1993	525	49	535	50	9	1	1,069
1994	488	48	516	51	6	1	1,010
1995	472	49	478	50	10	1	960
1996	451	48	478	51	8	1	937
1997	430	46	505	54	2	0	937
1998	507	49	528	51	7	1	1,042
1999	570	50	565	50	5	0	1,140

Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

4.12 Motorcyclist Fatalities by Year and Time of Day

The definitions of day and night terms used throughout this report are based on the following:

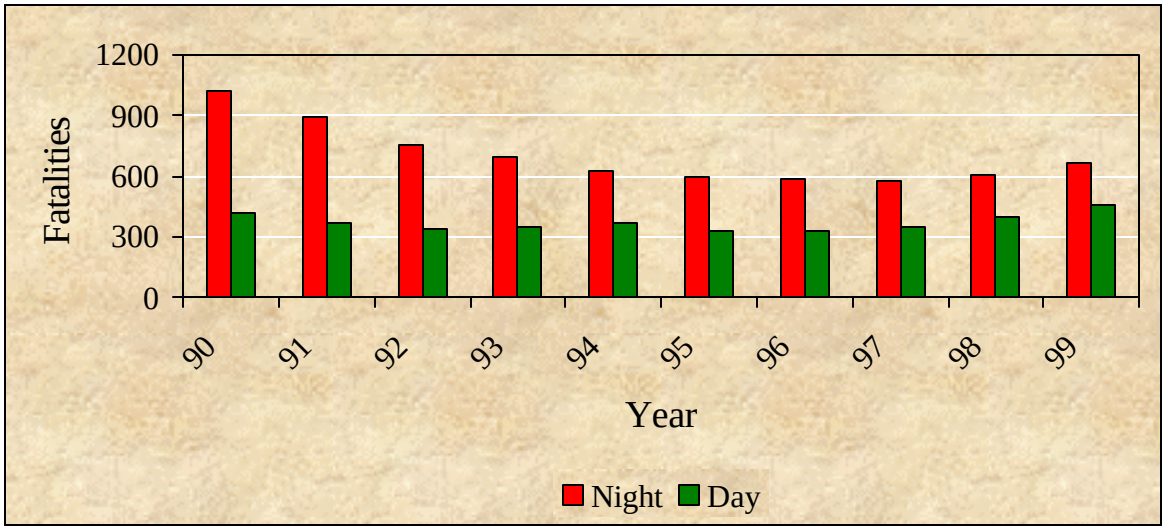
Day – 6:00 AM to 5:59 PM.

Night – 6:00 PM to 5:59 AM.

Table 13 shows the number and percentage of motorcyclists killed by year and time of day. Review of the data shows number of motorcyclists killed during the night accounted for more than half of the fatalities. However, the percentage of motorcyclists killed during the daytime has increased steadily from 28 percent in 1990 to 40 percent in 1999, an increase of 12 percentage points. In fact, the number of motorcyclist fatalities during the daytime has increased each year from 1995 to 1999. The number of motorcyclist fatalities occurring during the daytime has increased from 324 in 1995 to 457 in 1999, an increase of 41 percent. Similarly, the number of motorcyclist fatalities during the daytime has increased from 347 in 1997 to 457 in 1999, an increase of 32 percent. This may indicate the increasing use of motorcycles during the daytime hours in recent years.

Table 13: Motorcyclist Fatalities by Year and Time of Day							
Year	Time of Day						Total
	Night		Day		Unknown		
	Number	Percent	Number	Percent	Number	Percent	
1990	1,021	70	415	28	33	2	1,469
1991	891	69	371	29	23	2	1,285
1992	750	67	340	31	24	2	1,114
1993	697	65	350	33	22	2	1,069
1994	626	62	363	36	21	2	1,010
1995	600	63	324	34	36	4	960
1996	587	63	330	35	20	2	937
1997	572	61	347	37	18	2	937
1998	602	58	402	39	38	4	1,042
1999	662	58	457	40	21	2	1,140
Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999							

Chart 3: Motorcyclist Fatalities by Year and Time of Day



Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

4.13 Motorcyclist Fatalities by Year and Roadway Type

Almost three-fourths of the motorcyclist fatalities in **single vehicle crashes** occurs on undivided roadways, another 15 percent are on roadways that have a median with no median barrier. Data from 1990 to 1999 indicate that there are not many changes in the percentage of fatalities occurring on different types of roadways. Table 14 shows the number and percentage of fatalities by year and on different roadways. The number of

fatalities on undivided roadways has increased from 666 in 1996 to 847 in 1999, an increase of 27 percent.

Table 14: Motorcyclist Fatalities by Year and Roadway Type

Year	Roadway Type										Total
	Not Divided		Median-No Barrier		Median w/Barrier		One Way Traffic		Unknown		
	No.	%	No.	%	No.	%	No.	%	No.	%	
1990	1,066	73	200	14	100	7	47	3	56	4	1,469
1991	935	73	178	14	98	8	31	2	43	3	1,285
1992	857	77	129	12	78	7	23	2	27	2	1,114
1993	811	76	126	12	74	7	39	4	19	2	1,069
1994	750	74	135	13	89	9	22	2	14	1	1,010
1995	718	75	131	14	77	8	14	1	20	2	960
1996	666	71	150	16	91	10	12	1	18	2	937
1997	684	73	163	17	70	7	9	1	11	1	937
1998	775	74	135	13	103	10	11	1	18	2	1,042
1999	847	74	179	16	79	7	24	2	11	1	1,140

Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

4.14 Motorcycle Operator Fatalities by Year and License Status and License Compliance

The definitions of properly and improperly licensed terms, used throughout this report, are based on the following:

Properly Licensed – a valid driver license with a motorcycle endorsement, a motorcycle-only license, learner's permit, and a temporary license or no license required for operating a motorcycle type vehicle like mopeds.

Improperly Licensed – not licensed, not licensed to operate a motorcycle, or a license that is suspended, revoked, expired, canceled, or denied.

From 1990 to 1999, a steadily increasing percent of fatally injured motorcycle operators were properly licensed. This number hit an all time high of 68 percent in 1999, compared to 52 percent in 1990. Still almost one-third (31 percent) of the operators killed in 1999 were riding a motorcycle with an improper license. Table 15 shows the number and percentage of operators killed by year and their license status for the past ten years. The number of motorcycle operator fatalities with a proper license increased from 520 in 1996 to 715 in 1999, an increase of 38 percent.

Proper licensing among fatally injured motorcycle operators from all crashes (single and multiple vehicle) was higher (DOT HS 809 271) when compared to proper licensing among fatally injured motorcycle operators in single vehicle crashes.

Table 15: Motorcycle Operator Fatalities by Year and License Status and License Compliance

Year	License Status with License Compliance						Total
	Properly Licensed		Improperly Licensed		Unknown		
	Number	Percent	Number	Percent	Number	Percent	
1990	692	52	608	46	21	2	1,321
1991	627	54	524	45	6	1	1,157
1992	559	55	439	43	19	2	1,017
1993	563	58	401	41	10	1	974
1994	536	59	373	41	3	0	912
1995	520	60	337	39	13	1	870
1996	520	61	321	38	12	1	853
1997	557	63	319	36	3	0	879
1998	624	65	321	34	11	1	956
1999	715	68	328	31	8	1	1,051

Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

4.15 Fatally Injured Motorcycle Operators by Year and Driver Blood Alcohol Concentration (BAC)

The National Highway Traffic Safety Administration defines a fatal traffic crash as being alcohol-related if either a driver or a non-occupant (e.g., a pedestrian) had a blood alcohol concentration (BAC) of 0.01 grams per deciliter (g/dl) or greater in a police reported traffic crash. Persons with a BAC of 0.08 g/dl or greater involved in fatal crashes are considered to be intoxicated. This is the legal limit of intoxication in many states. BAC values have been assigned to drivers involved in fatal crashes when alcohol test results are unknown. A complete description of the statistical procedures used for unknown alcohol test results in FARS can be found in a technical report available from the National Center for Statistics and Analysis (Reference No. 2)

Alcohol involvement among fatally injured motorcycle operators has been declining over the last ten years. The percent of fatally injured operators who had been drinking in 1999 was 53 percent, compared with 69 percent in 1990. But a majority of the fatally injured operators were intoxicated with a BAC $\geq$ 0.10. In 1999, there were 555 fatally injured operators who had been drinking (BAC $\geq$ 0.01), of which 442 (80 percent) operators killed were intoxicated (BAC $\geq$ 0.10). These numbers indicate that even though the alcohol involvement among operators is declining, there is still an underlying problem because of the high proportion with BACs $\geq$ 0.10. Table 16 shows the number and

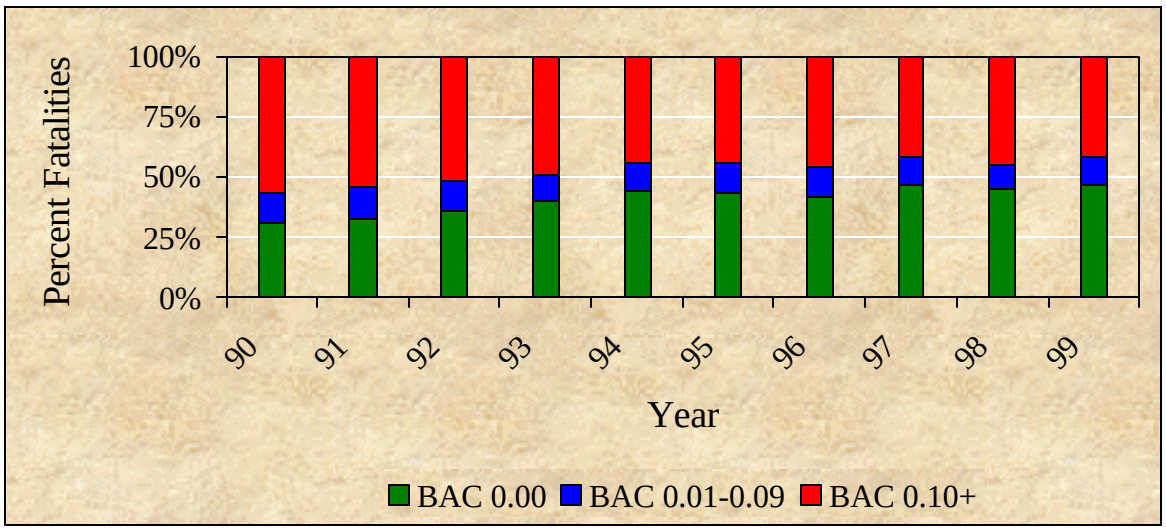
percent of fatally injured operators by their BAC from 1990 to 1999. In 1999, 39 percent (442/1,140) of all motorcyclist fatalities in single vehicle crashes were intoxicated operators. In fact, there were more fatally injured operators with alcohol than fatally injured operators without alcohol in each of the years between 1990 and 1999.

Table 16: Fatally Injured Motorcycle Operators by Year and Operator BAC

Year	BAC 0.00		BAC 0.01-0.09		BAC ³ 0.10		BAC ³ 0.01		Total
	No.	%	No.	%	No.	%	No.	%	
1990	407	31	166	13	748	57	914	69	1,321
1991	379	33	145	13	633	55	778	67	1,157
1992	362	36	124	12	531	52	655	64	1,017
1993	386	40	108	11	480	49	588	60	974
1994	405	44	105	12	402	44	507	56	912
1995	377	43	110	13	383	44	493	57	870
1996	360	42	104	12	390	46	493	58	853
1997	409	47	104	12	366	42	470	53	879
1998	435	45	92	10	429	45	521	55	956
1999	496	47	113	11	442	42	555	53	1,051

Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

Chart 4: Fatally Injured Motorcycle Operators by Year and Operator BAC



Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

4.16 Fatally Injured Motorcycle Operators with Alcohol Involvement (BAC ³ 0.01) by Year and Time of Day

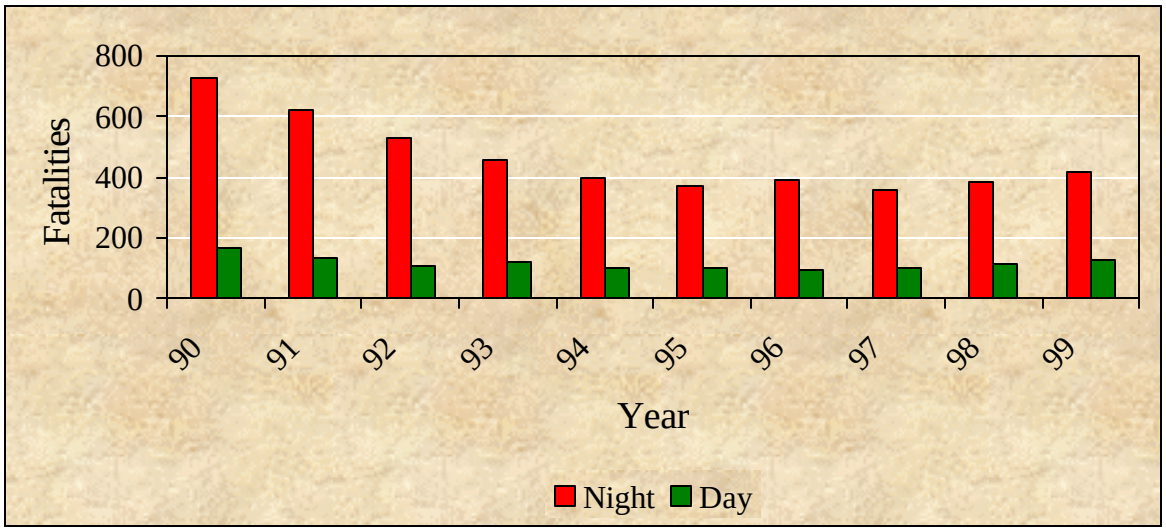
Table 17 shows the number and percentage of fatally injured motorcycle operators with alcohol involvement (BAC ≥ 0.01) by year and time of day. Fatally injured motorcycle operators with alcohol involvement (BAC ≥ 0.01) account for more than half of all operator fatalities in single vehicle crashes (Table 16). The data show the number of fatally injured operators with alcohol involvement during nighttime hours was over three times the number of fatally injured operators with alcohol involvement during the daytime. In fact, over one third (416/1,140 – 36 percent) of all motorcyclist fatalities in single vehicle crashes in 1999 were operators with BAC ≥ 0.01 killed at night. The numbers indicate high use of alcohol among fatally injured operators at night.

Table 17: Fatally Injured Motorcycle Operators with Alcohol Involvement (BAC ³ 0.01) by Year and Time of Day

Year	Time of Day						Total
	Night		Day		Unknown		
	Number	Percent	Number	Percent	Number	Percent	
1990	725	79	163	18	26	3	914
1991	623	80	136	17	19	2	778
1992	527	80	109	17	19	3	655
1993	457	78	117	20	15	3	588
1994	395	78	97	19	14	3	507
1995	370	75	97	20	25	5	493
1996	387	78	91	18	15	3	493
1997	359	76	102	22	9	2	470
1998	384	74	111	21	26	5	521
1999	416	75	125	23	14	3	555

Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

Chart 5: Fatally Injured Motorcycle Operators with Alcohol Involvement (BAC ≥ 0.01) by Year and Time of Day



Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

4.17 Motorcyclist Fatalities Off Roadway by Year and Speeding Factor

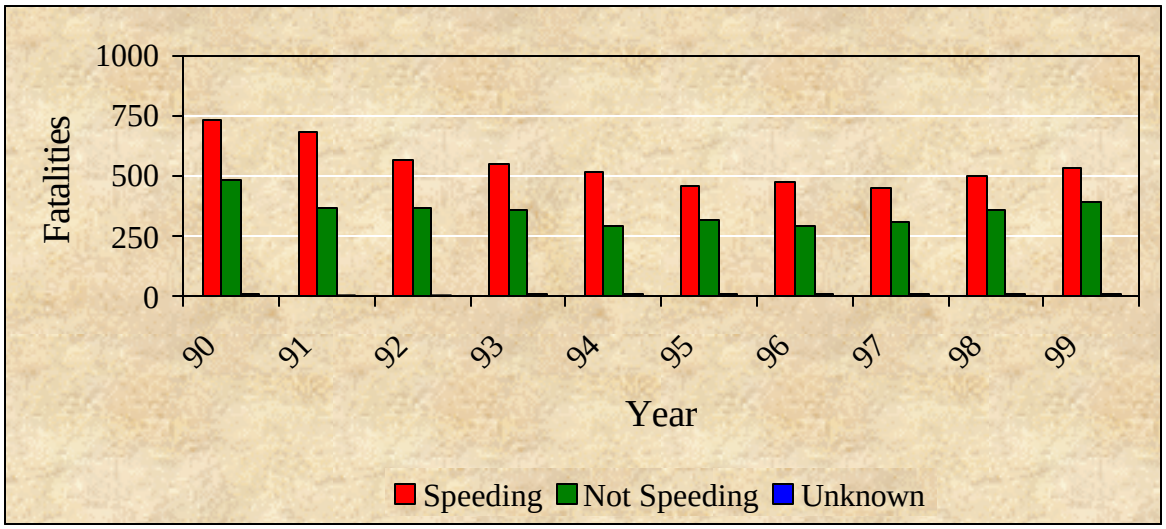
Review of data from Table 18 shows more than half of all crashes in which motorcyclist fatalities occurred off roadway was related to speeding. The percentage of fatalities did not change significantly between 1990 and 1999. In 1999, 57 percent of crashes in which motorcyclist fatalities occurred off roadway were related to speeding.

Table 18: Motorcyclist Fatalities Off Roadway by Year and Speeding Factor

Year	Speeding Factor						Total
	Speeding		Not Speeding		Unknown		
	Number	Percent	Number	Percent	Number	Percent	
1990	735	60	484	39	11	1	1,230
1991	680	65	364	35	4	0	1,048
1992	563	60	369	39	4	0	936
1993	546	60	359	39	7	1	912
1994	514	63	293	36	10	1	817
1995	455	58	314	40	13	2	782
1996	475	61	293	38	8	1	776
1997	451	59	305	40	13	2	769
1998	499	58	360	42	7	1	866
1999	535	57	394	42	9	1	938

Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

Chart 6: Motorcyclist Fatalities Off Roadway by Year and Speeding Factor



Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

4.18 Motorcyclist Fatalities by Time of Day and Relation to Roadway

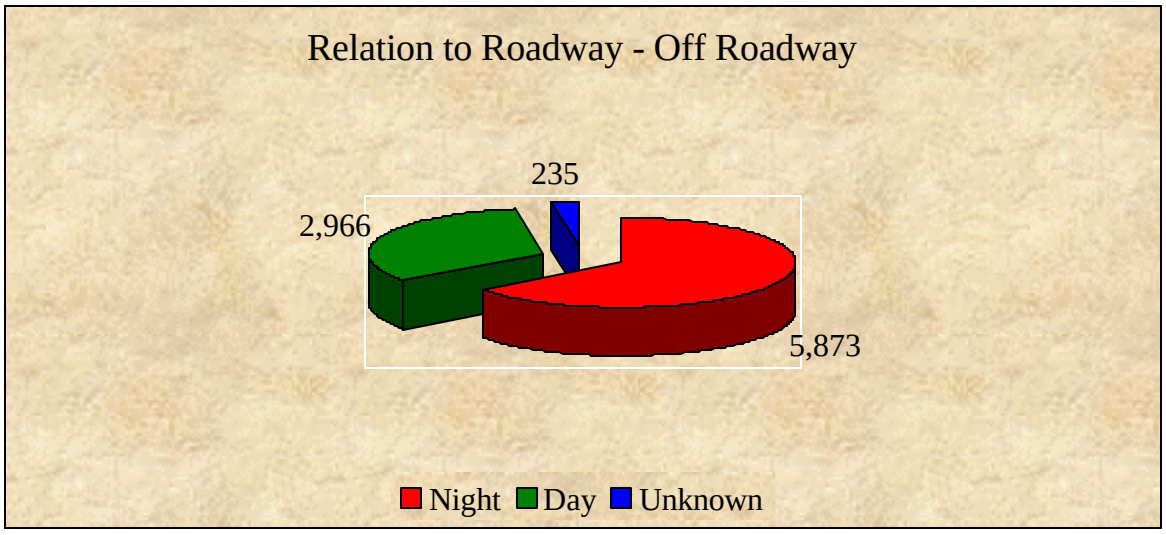
Table 19 shows the number and percent of motorcyclist fatalities by time of day and relation to roadway aggregated over a ten-year period. The data show almost two-thirds (65 percent) of motorcyclist fatalities in crashes off roadway occurred during nighttime hours. In fact, over half (54 percent) of all motorcyclist fatalities occurred in crashes off roadway during the nighttime hours (5,873/10,963). The data also show that almost two thirds (65 percent) of all motorcyclist fatalities occurred during nighttime hours (7,008/10,963).

Table 19: Motorcyclist Fatalities Off Roadway by Time of Day (1990-1999)

Time of Day	Relation to Roadway						Total
	On Roadway		Off Roadway		Unknown		
	Number	Percent	Number	Percent	Number	Percent	
Night	1,071	60	5,873	65	64	72	7,008
Day	710	39	2,966	33	23	26	3,699
Unknown	19	1	235	3	2	2	256
Total	1,800	100	9,074	100	89	100	10,963

Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

Chart 7: Motorcyclist Fatalities by Time of Day and Relation to Roadway (1990-1999)

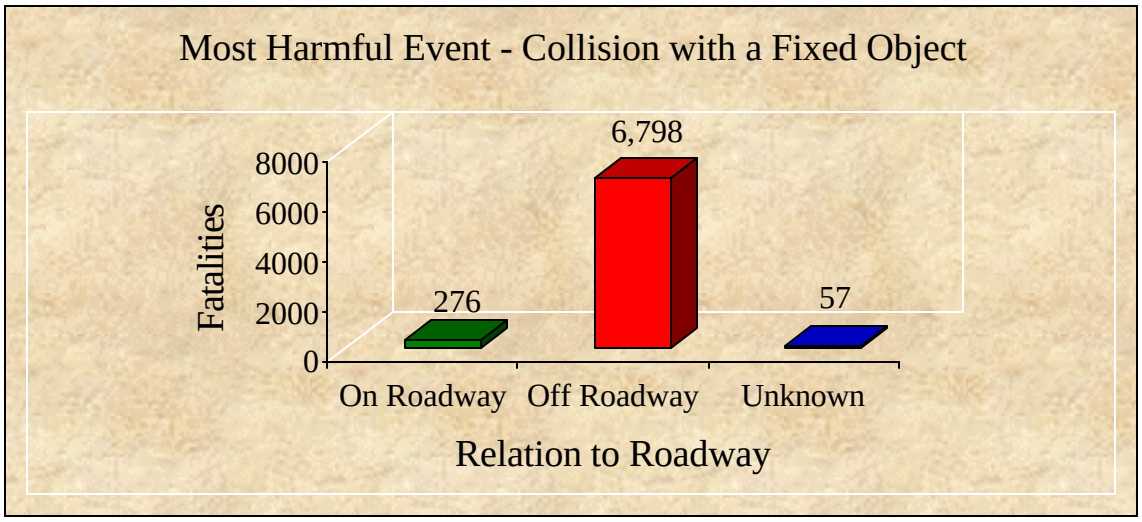


Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

4.19 Motorcyclist Fatalities Where Most Harmful Event was Collision with a Fixed Object and Relation to Roadway

Chart 8 shows the number of motorcyclist fatalities where a collision with a fixed object was recorded as the most harmful event for the vehicle by relation to the roadway, aggregated over 10 years. A review of the data reveals that 95 percent (6,798/7,131) of the off roadway motorcyclist fatalities occurred as a result of a collision with a fixed object as the most harmful event recorded for the vehicle. Further analysis of the data in the following sections reveals some important information relating to fatalities by most harmful event.

Chart 8: Motorcyclist Fatalities Where Most Harmful Event was Collision with a Fixed Object and Relation to Roadway (1990-1999)

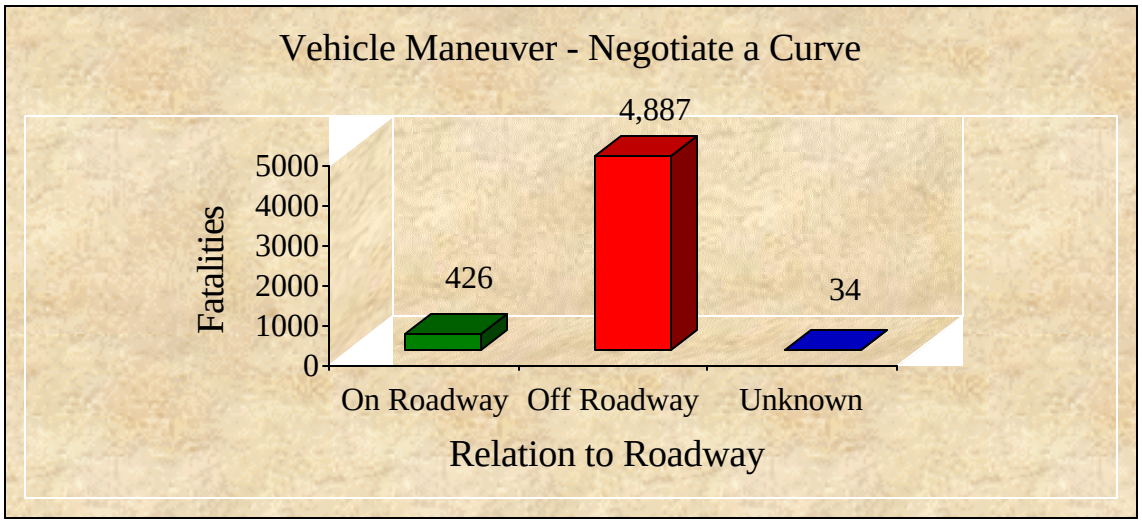


Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

4.20 Motorcyclist Fatalities Where Vehicle Maneuver was to Negotiate a Curve and Relation to Roadway

The vehicle maneuver is the driver's action, or intended action, prior to commencement of an un-stabilizing event, as indicated on the crash report – in this case negotiating a curve. Chart 9 shows the number of motorcyclist fatalities where negotiating a curve was recorded as the vehicle maneuver for the vehicle by relation to the roadway, aggregated over 10 years. Review of the data shows over 90 percent (4,887/5,347) of motorcyclist fatalities occur off roadway when negotiating a curve. Further data analysis in the following sections reveals some important information relating to fatalities when the vehicle maneuver is recorded as negotiating a curve in the crash report.

Chart 9: Motorcyclist Fatalities Where Vehicle Maneuver was Negotiate a Curve and Relation to Roadway (1990-1999)

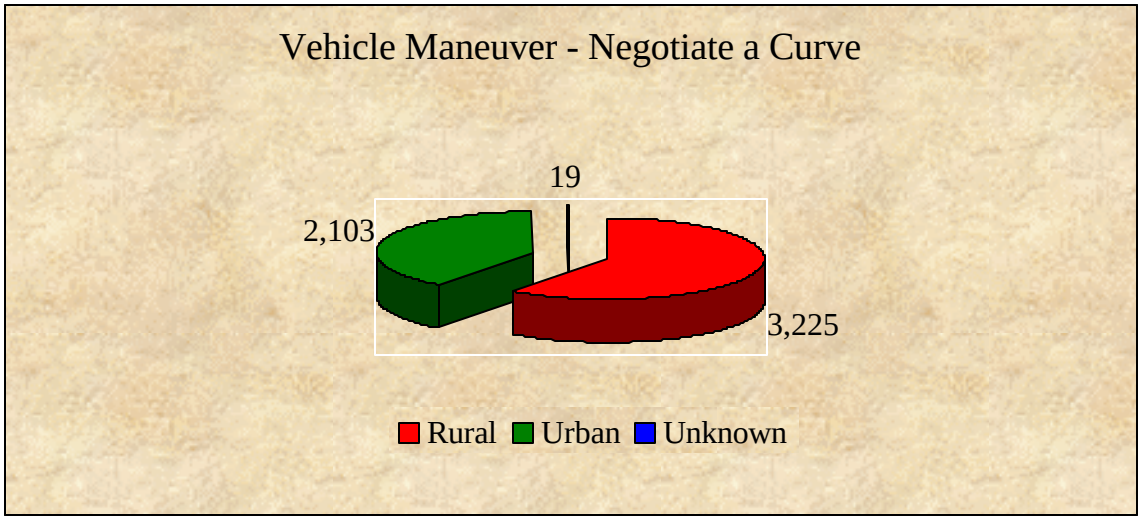


Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

4.21 Motorcyclist Fatalities While Negotiating a Curve and Land Use

Chart 10 shows the number of motorcyclist fatalities when negotiating a curve by land use, aggregated over a ten-year period. A review of the data shows that 60 percent (3,225/5,347) of motorcyclist fatalities occur on rural roads when negotiating a curve. Further data analysis in the following sections reveals some important information relating to fatalities when the vehicle maneuver is recorded as negotiating a curve in the crash report.

Chart 10: Motorcyclist Fatalities Where Vehicle Maneuver was Negotiate a Curve and Land Use (1990-1999)



Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

4.22 Fatally Injured Motorcycle Operators by Time of Day and Operator BAC

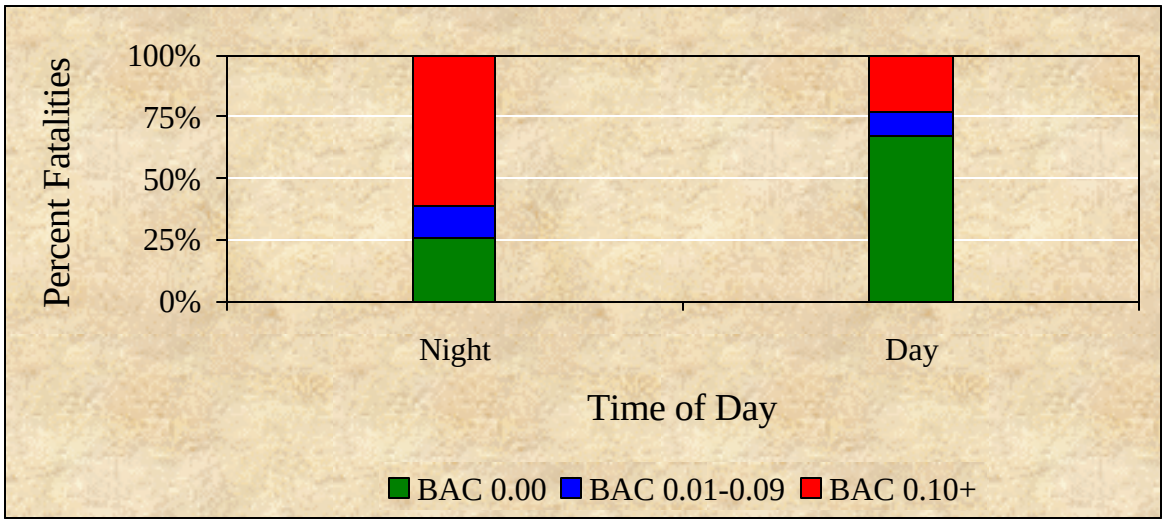
Table 20 shows the number and percent of fatally injured motorcycle operators by time of day and operator BAC, aggregated over ten years. Review of the data shows 74 percent (797+3,847=4,644/6,309) of the fatally injured motorcycle operators during the night involved alcohol (BAC ≥ 0.01) compared to 33 percent (341+808=1,149/3,438) during the day. In fact, there were more operators killed with alcohol involvement (BAC ≥ 0.01) during nighttime hours than operators without alcohol involvement (BAC 0.00). There were 2.8 times more operators killed at night with alcohol involvement (BAC ≥ 0.01) than without alcohol involvement (BAC 0.00). Of the operators killed with alcohol involvement (BAC ≥ 0.01) at night (797+3,847=4,644), 83 percent (3,847/4,644) were intoxicated with a BAC ≥ 0.10. Forty-six percent (4,644/9,990) of all operators killed had some alcohol involvement (BAC ≥ 0.01) and were killed at night. Sixty percent of all operators killed in single vehicle crashes had BAC ≥ 0.01 (5,975/9,990).

Table 20: Fatally Injured Motorcycle Operators by Time of Day and Operator BAC (1990-1999)

Time of Day	BAC 0.00		BAC 0.01-0.09		BAC ³ 0.10		Total
	Number	Percent	Number	Percent	Number	Percent	
Night	1,665	26	797	13	3,847	61	6,309
Day	2,289	67	341	10	808	23	3,438
Unknown	62	26	33	13	148	61	243
Total	4,016	40	1,171	12	4,804	48	9,990

Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

Chart 11: Fatally Injured Motorcycle Operators by Time of Day and Operator BAC (1990-1999)



Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

4.23 Fatally Injured Motorcycle Operators by Time of Day (Hour) and Operator BAC

Table 21 shows the number and percent of operator fatalities by time of day (each 3-hour period) and their BAC, aggregated over ten years. The highest number of fatalities during any three-hour period occurred between 6 PM and 9 PM (1,907). The highest percentage of operators killed with some alcohol involvement (85 percent) occurred between midnight and 3 AM. The ratio of operators killed with alcohol involvement (BAC ≥ 0.01) to operators killed without alcohol involvement (BAC 0.00) was 5.9 during the midnight to 3 AM period. A similar ratio during the 3 AM to 6 AM period was 4.7. The percentage of operators killed with some alcohol involvement during the 3 AM to 6 AM period was a close second with 82 percent. Review of the data shows the percentage of fatally injured operators with some or any alcohol varies from 60 percent to 85 percent between 6 PM and 6 AM. These numbers indicate risks associated with alcohol use and motorcycle riding at night. The numbers also indicate deadly consequences in **single vehicle motorcycle crashes** from the combination of alcohol and motorcycle riding at night.

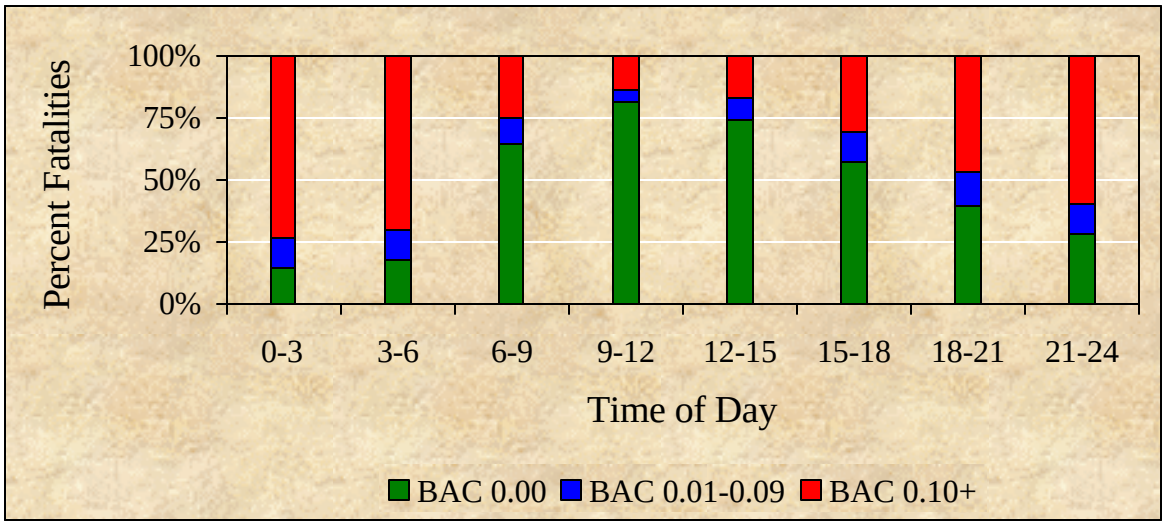
Among fatally injured operators with a BAC ≥ 0.01 (1,621) between midnight and 3 AM, 86 percent (1,390) were intoxicated with a BAC ≥ 0.10. Similarly, 85 percent of the fatally injured operators with a BAC ≥ 0.01 between 3 AM and 6 AM were intoxicated with a BAC ≥ 0.10. Similar high intoxication percentages were also prevalent between 6 PM to 9 PM and 9 PM to midnight. In fact, over one third (902+1,099+1,390=3,391/9,990) of all fatally injured operators between 6 PM and 3 AM were intoxicated operators with a BAC ≥ 0.10. These were also the hours with high percentage of fatally injured operators with some alcohol involvement (BAC ≥ 0.01).

Table 21: Fatally Injured Motorcycle Operators by Time of Day (Hour) and Operator BAC (1990-1999)

Time of Day	BAC 0.00		BAC 0.01-0.09		BAC ³ 0.10		Total
	No.	%	No.	%	No.	%	
Midnight to 3 AM (0-3)	274	14	231	12	1,390	73	1,895
3 AM to 6 AM (3-6)	113	17	78	12	456	70	647
6 AM to 9 AM (6-9)	199	64	33	11	78	25	311
9 AM to Noon (9-12)	434	82	24	5	73	14	531
Noon to 3 PM (12-15)	741	74	91	9	165	17	997
3 PM to 6 PM (15-18)	915	57	192	12	492	31	1,599
6 PM to 9 PM (18-21)	748	39	257	13	902	47	1,907
9 PM to Midnight (21-24)	529	28	231	12	1,099	59	1,860
Unknown	62	26	33	13	148	61	243
Total	4,016	40	1,171	12	4,804	48	9,990

Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

Chart 12: Fatally Injured Motorcycle Operators by Time of Day (Hour) and Operator BAC (1990-1999)



Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

4.24 Fatally Injured Motorcycle Operators by Speeding Factor and Time of Day

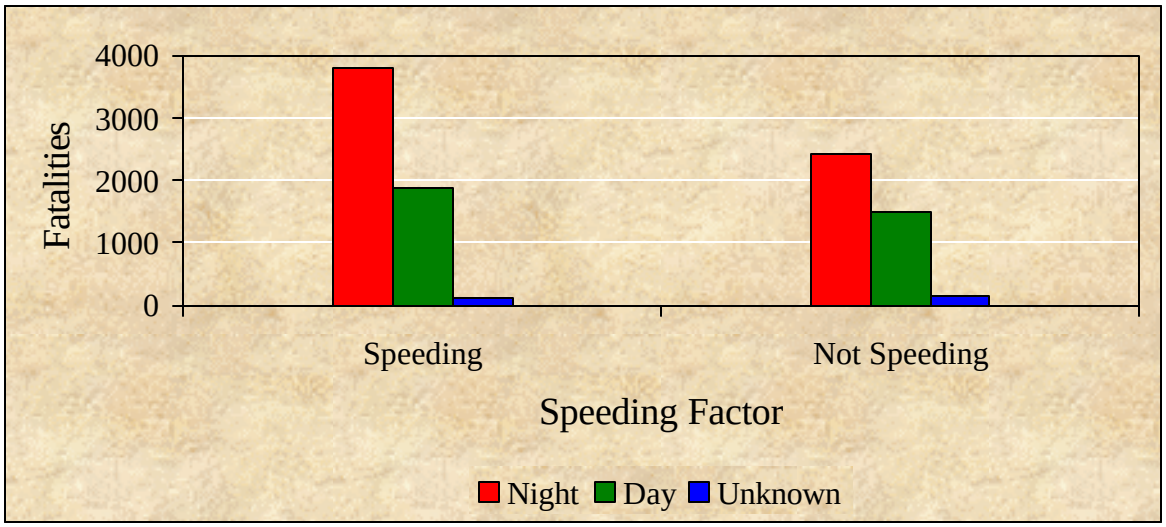
Almost two-thirds (3,799/5,795 or 66 percent) of the operator fatalities where speeding was recorded as a driver related factor occurred at night. Table 22 shows the number and percentage of operator fatalities by speeding factor and time of day, aggregated over ten years. There were twice the number of operator fatalities while speeding during the night compared to the day. In fact, more than half (3,799/6,309 - 60 percent) of all operator fatalities during the night were attributed to speeding as a driver related factor. Similarly, more than half of all fatally injured operators during the day were attributed to speeding as a driver related factor. Overall 58 percent of operator fatalities were associated with speeding as a driver related factor.

Table 22: Motorcycle Operator Fatalities by Speeding Factor and Time of Day (1990-1999)

Time of Day	Speeding Factor						Total
	Speeding		Not Speeding		Unknown		
	Number	Percent	Number	Percent	Number	Percent	
Night	3,799	60	2,431	39	79	1	6,309
Day	1,891	55	1,481	43	66	2	3,438
Unknown	105	43	131	54	7	3	243
Total	5,795	58	4,043	40	152	2	9,990

Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

Chart 13: Motorcycle Operator Fatalities by Speeding Factor and Time of Day (1990-1999)

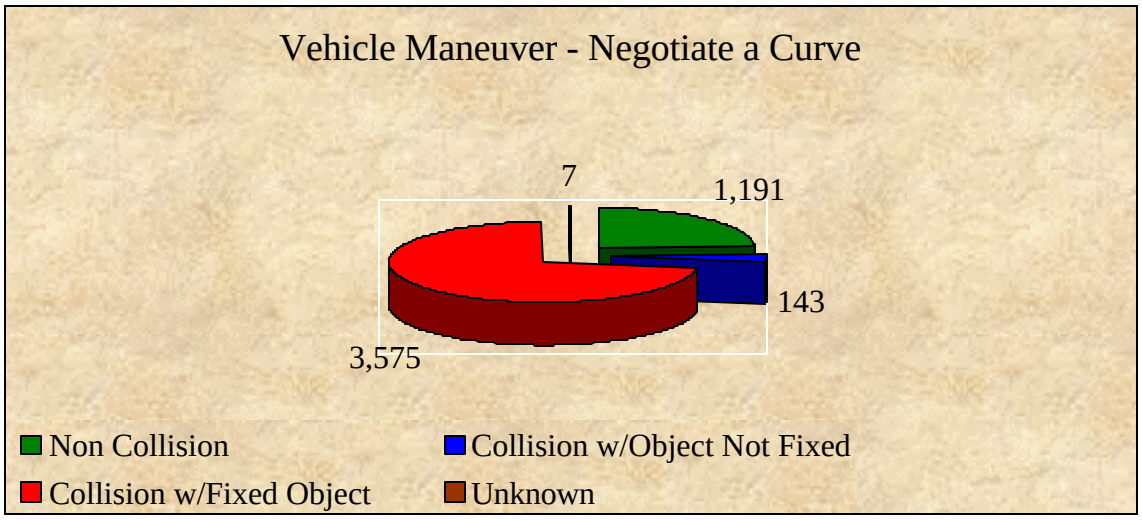


Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

4.25 Motorcycle Operator Fatalities When Vehicle Maneuver was Negotiate a Curve by Most Harmful Event

Chart 14 shows the number of motorcycle operator fatalities when the vehicle maneuver was negotiating a curve by the most harmful event for the vehicle aggregated over ten years. A review of the data shows that almost three-fourths (3,575/4,916 – 73 percent) of the operator fatalities while negotiating a curve were associated where the most harmful event was a collision with a fixed object. These high percentage of fatalities related to collision with a fixed object may be due to the tendency to go off the road when riding a motorcycle and negotiating a curve either due to speeding or other factors in the crash.

Chart 14: Motorcycle Operator Fatalities When Vehicle Maneuver was Negotiate a Curve by Most Harmful Event (1990-1999)

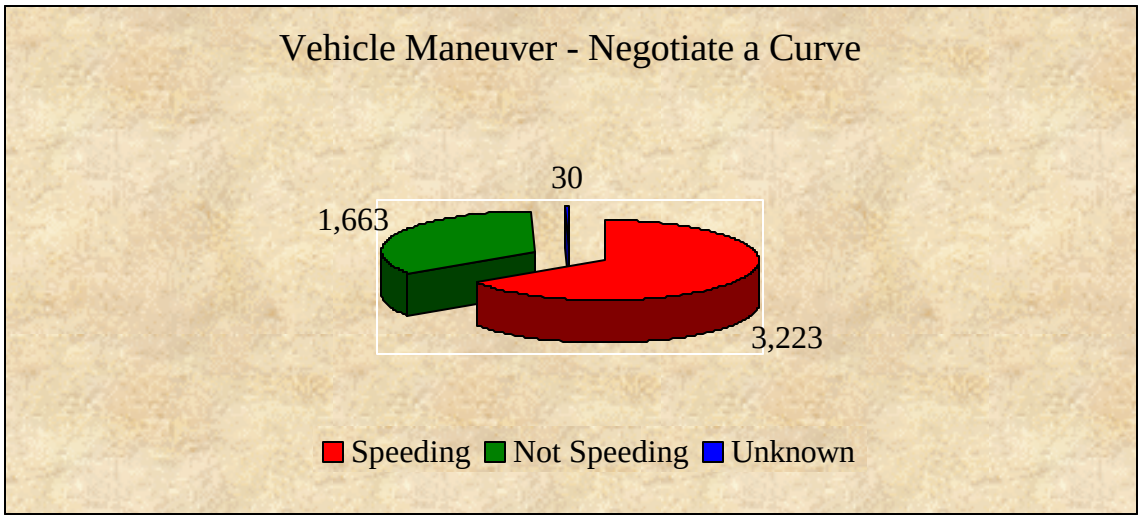


Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

4.26 Motorcycle Operator Fatalities When Vehicle Maneuver was Negotiate a Curve by Speeding Factor

Chart 15 shows the number of motorcycle operator fatalities when the vehicle maneuver was negotiating a curve by the speeding factor aggregated over ten years. A review of the data shows that in almost two-thirds (3,223/4,916 – 66 percent) of the operator fatalities while negotiating a curve, speeding was recorded as a driver-contributing factor in the crash. There were twice as many operator fatalities while speeding compared to when not speeding. These high percentage fatalities related to speeding may be due to the tendency to go off the road and collide with a fixed object when riding a motorcycle and negotiating a curve.

Chart 15: Motorcycle Operator Fatalities When Vehicle Maneuver was Negotiate a Curve by Speeding Factor (1990-1999)

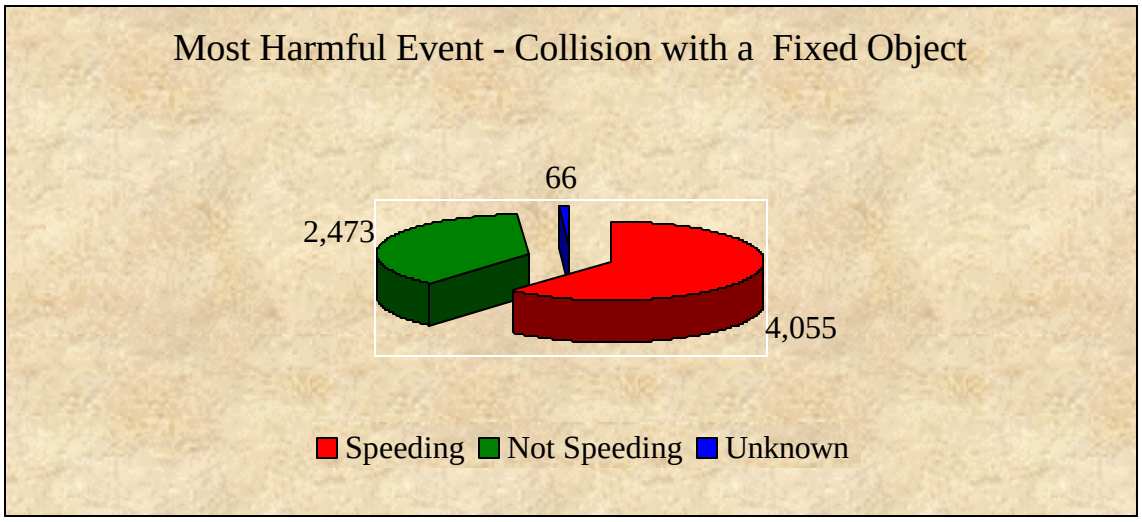


Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

4.27 Motorcycle Operator Fatalities When Most Harmful Event was Collision with a Fixed Object by Speeding Factor

Chart 16 shows the number of motorcycle operator fatalities when the most harmful event was collision with a fixed object by the speeding factor aggregated over ten years. A review of the data shows that almost two-thirds (4,055/6,594 – 61 percent) of the operator fatalities while speeding were associated to collision with a fixed object in the crash. There were 1.6 times as many operator fatalities while speeding compared to when not speeding. These high percentage fatalities related to speeding may be due to the tendency to go off the road and collide with a fixed object when riding a motorcycle.

Chart 16: Motorcycle Operator Fatalities When Most Harmful Event was Collision with a Fixed Object by Speeding Factor (1990-1999)



Source: National Center for Statistics and Analysis, NHTSA, FARS 1990-1999

5. CONCLUSIONS

The analysis described in this report could aid in the design of countermeasure programs to reduce **single vehicle motorcycle crashes**. Most of the fatalities in single vehicle crashes were associated with collision with a fixed object, speeding, off roadway, undivided roads, rural roads, nighttime riding, and high alcohol use among operators. Safety messages based upon these data should be included as part of any motorcycle safety initiative or public information effort by NHTSA and its partners.

This report does not analyze all variables within the FARS database and other data sources. Also, this analysis does not examine injury data from the General Estimates System (GES), which reports injuries resulting from motor vehicle crashes. Further analyses need to be undertaken by examining other variables within FARS and GES that may provide additional information describing other factors associated with single vehicle motorcycle crashes. The National Highway Traffic Safety Administration (NHTSA) plans to conduct these analyses and report the findings.

5.1 Motorcyclist Fatalities by Person Type and Sex

In view of the fact that 90 percent of all fatally injured motorcyclists are operators rather than passengers, it is imperative that safety programs, education, training and enforcement be addressed towards motorcycle operators. Also, since more than 90 percent of the fatally injured motorcyclists are males, safety messages should be directed mostly towards a male audience.

5.2 Motorcyclist Age

Results from 1990-1999 FARS data show that there is an increase in the number of motorcyclist fatalities in the 40 and over age group. Review of US Census Bureau data from 1990-1999 (*Recent Trends in Fatal Motorcycle Crashes – DOT HS 809 271)* indicates an increase in the 40 and over age population. If these patterns continue, there is the likelihood that there will continue to be an increase in the number of 40 and over age motorcyclists involved in single vehicle fatal crashes.

5.3 Motorcycle Operator Fatalities by Operator BAC

Although the percentage of alcohol impaired fatally injured operators has decreased from 69 percent in 1990 to 53 percent in 1999, alcohol use is still a major factor in single vehicle crashes. This is especially true at night. In fact, three-fourths of all operator fatalities involving some or any alcohol occur at night. The number of fatally injured operators with some alcohol involvement (BAC $\geq$ 0.01) at night is over three times the fatally injured operators with some alcohol during the day. This poses a great risk for all motorcycle operators, particularly when riding a motorcycle at night. The high rate of fatally injured intoxicated operators with a BAC $\geq$ 0.10 also adds to the overall problem of alcohol use among operators in **single vehicle motorcycle crashes**. Over 40 percent of all fatally injured operators in 1999 were intoxicated. These data should be utilized in

developing any motorcycle safety initiative or public information effort by NHTSA and its partners.

5.4 Motorcyclist Helmet Use

Helmet use among occupants killed has increased from 39 percent in 1990 to 49 percent 1999. Still almost half of the motorcyclists killed were not wearing a helmet. Increasing the number of states with helmet laws covering all riders, more education, and stronger enforcement of existing helmet use laws are required to reduce the risks of fatal injury.

Only 20 states, the District of Columbia and Puerto Rico require helmet use for all riders. Twenty-seven states require use for a specific segment of riders and 3 states do not require any helmet use while riding a motorcycle (reference 4). Detailed information relating to the helmet use requirements is provided in Appendix B.

5.5 Motorcycle Operator License Status by License Compliance

Almost one third (31 percent) of the motorcycle operators killed in 1999 did not have a proper license compared to 46 percent in 1990. While these numbers suggest an increase in proper licensing among motorcyclists, they also suggest increased awareness and enforcement of motorcycle licensing.

5.6 Motorcyclist Fatalities by Speeding Factor

With more than half of all motorcyclist fatalities associated with speeding as a contributing factor, safety messages relating to the risk of riding motorcycles and speeding has to be communicated along with necessary education programs. This is particularly important at night with almost two-thirds of all operator fatalities attributed to speeding as a driver related factor in the crash.

5.7 Motorcyclist Fatalities by Land Use (Urban/Rural)

The number of motorcyclist fatalities on rural roads has increased between 1990 and 1999. There has been a significant increase in motorcyclist fatalities especially between 1996 and 1999. In 1999, 57 percent of the motorcyclist fatalities were on rural roads. Hence, information, education, training and enforcement efforts need to be focused on riding motorcycles in rural areas.

5.8 Motorcyclist Fatalities by Roadway Type

Over 70 percent of all fatalities occur on undivided roadways and another 15 percent on roadways that have a median but no barrier. Public information and education efforts should focus attention on the risks involved in operating motorcycles on undivided roadways, as well as the risks associated with speeding and alcohol use on undivided roadways.

5.9 Motorcyclist Fatalities by Time of Day

Almost two-thirds (58 percent) of motorcyclist fatalities in 1999 occurred during nighttime hours. Over three-fourths of the operator fatalities during the night were alcohol related. Safety information based upon these data should be included as part of any motorcycle safety initiative or public information effort by NHTSA and its partners.

5.10 Motorcyclist Fatalities by Vehicle Maneuver

With 50 percent of motorcyclist fatalities occurring while the vehicle was negotiating a curve, it is imperative that this information be conveyed to operator education, and training programs. This is especially important because most fatalities in **single vehicle motorcycle crashes** occur:

- On rural roadways;
- With high alcohol use among operators;
- With speeding;
- Off roadway;
- On undivided roadways; and
- During the night.

5.11 Motorcyclist Fatalities by Crash Avoidance Maneuver

Almost one-fifth (22 percent) of motorcyclist fatalities in 1999 were related to either braking (13 percent) or steering maneuvers (9 percent). The crash avoidance maneuver is one of the important elements in the crash. The steering and braking maneuver indicate as being a possible factor in the motorcycle crash.

5.12 Motorcyclist Fatalities by Most Harmful Event

A collision with a fixed object as the most harmful event in conjunction with other factors in the crash plays an important role for most of the fatalities in single vehicle crashes. This becomes more significant due to the fact that most fatalities in single vehicle crashes were associated with speeding, occurring off roadway, on undivided roadways, rural roads, during nighttime hours and with high alcohol use among operators.

5.13 Motorcyclist Fatalities by Relation to Roadway

The majority (over 80 percent) of motorcyclist fatalities between 1990 and 1999 were off roadway. The relation to roadway factors along with the other factors mentioned above once again shows the risks and the deadly consequences associated with single vehicle motorcycle crashes.

6. APPENDIX A: Data Source

The following section gives information relating to the data source used in the analysis.

6.1 Fatality Analysis Reporting System (FARS)

The National Center for Statistics and Analysis (NCSA) collects and analyzes data, conducts research, and disseminates statistical information to support efforts by NHTSA and the highway safety community aimed at reducing deaths, injuries and economic losses resulting from motor vehicle crashes.

NCSA designed and developed the Fatality Analysis Reporting System (FARS) database, a national census of police-reported motor vehicle crashes resulting in fatal injuries. FARS compiles data from various sources on the location and circumstances of the crash, types of vehicles, and people involved. This system generates overall measures of highway safety, helps identify traffic safety problems, and provides a basis to evaluate the effectiveness of motor vehicle safety standards and highway safety programs.

The FARS system became operational in 1975. It contains a census of fatal motor vehicle traffic crashes within the 50 states and the District of Columbia and Puerto Rico.

A motor vehicle crash is a transport incident that involves a motor vehicle in transport, is not an aircraft incident or water craft incident, and does not include any harmful event involving a railway train in transport prior to involvement of a motor vehicle in transport.

To be included in FARS, a crash must involve a motor vehicle traveling on a traffic way customarily open to the public, and result in the death of a person (either an occupant of a vehicle or a non-motorist) within 30 days of the crash. Data elements contain specific information including the age of the person, license status of the driver, roadway type, motorcycle engine size, and land use (urban/rural). These data elements can be used in determining trends relating to fatal crashes. Thus, the FARS system provides a basis to evaluate the effectiveness of motor vehicle safety standards and highway safety programs.

NHTSA has contracted with an agency in each state to provide information on fatal crashes. Data on fatal motor vehicle traffic crashes are gathered from the state's own source documents and are coded on standard FARS forms. The analyst or analysts from the contract agency in each state obtain documents needed to complete the FARS forms, which generally include some or all of the following:

Police Accident Reports (PARS);
State vehicle registration files;
State driver-licensing files;
State Highway Department data;
Vital Statistics;
Death certificates;

Coroner/medical examiner reports;
Hospital medical records; and,
Emergency medical services reports.

The FARS file contains descriptions of each fatal crash reported. Each crash has more than 100 coded data elements that characterize the crash, the vehicles, and the people involved. The specific data elements may be modified slightly at times, in response to users' needs and highway safety emphasis areas.

All data elements are reported on one of the following forms:

The Accident Form: This form records information about the time and location of the crash, the first harmful event in the crash, whether it is a hit-and-run crash, whether a school bus was involved, and the number of vehicles and people involved. Information on the weather conditions, roadway surface conditions, geometric profiles of the highways, the geographic location of the crash including the route information as well as the presence of the traffic control devices is also recorded in this form. Roadway information such as the functional classification, route, National Highway System (NHS) relation, land use, the number of lanes, and the flow of traffic at the site of the crash is recorded on this form.

The Vehicle and Driver Form: These forms include the data for each vehicle and driver involved in the fatal crash. The data include the vehicle type, the initial and principal points of impact, the most harmful event, and the driver's license status.

The Person Form: This form contains data on each person involved in the fatal crash. The data include the age, gender, role (driver, passenger, non-motorist), the severity of the injuries sustained, and the restraint usage characteristics.

FARS data can be used to answer a myriad of questions on the safety of vehicles, drivers, pedestrians, traffic situations, roadways and environmental conditions. But the data cannot by themselves be used to calculate the rates to find trends over a period of time based on exposure data. For example, FARS data can be used in evaluating the following:

Speed limit as a factor in fatal crashes;
Fatalities by zip code, region, county, or state;
Fatal crashes by land use categories (urban or rural);
Fatalities by type of roadway;
Pedestrian fatalities by zip code, region, county or state;
Fatalities by vehicle type (passenger car or motorcycle);
Fatalities by age group; and,
Fatalities in various weather or road surface conditions.

NCSA has developed a variety of reports and fact sheets using the information from FARS. Some are produced annually. Examples of the fact sheets and reports include:

Traffic Safety Facts: An annual compilation of data on motor vehicle crashes;

Motor Vehicle Traffic Crashes as a leading cause of death in the US, 1997: A report examining the status of fatalities in motor vehicle crashes compared to the other causes of death;

Traffic Safety Facts – Motorcycles: An annual compilation of motorcycle crash data; and,

Traffic Safety Facts – Alcohol: An annual compilation of data on the effects and involvement of alcohol in motor vehicle crashes.

Additional information on traffic safety facts, FARS and other publications can be obtained from the NHTSA's website at:

www.nhtsa.dot.gov

7. APPENDIX B: Status of State Motorcycle Helmet Use Requirements

Twenty states, the District of Columbia and Puerto Rico require helmet use for all riders. Twenty-seven states require use of helmet for a specific segment of riders, usually under 18. Helmet use is not required in three states. The table below with the notes gives the details of the state helmet use requirements.

Helmet Use Required for all Riders	Helmet Use for A Specific Segment of Riders (Usually Under 18)	Helmet Use Not Required
Alabama	Alaska	Colorado
California	Arizona	Illinois
District of Columbia	Arkansas	Iowa
Georgia	Connecticut	
Maryland	Delaware (1)	
Massachusetts	Florida (2)	
Michigan	Hawaii	
Mississippi	Idaho	
Missouri	Indiana	
Nebraska	Kansas	
Nevada	Kentucky (3)	
New Jersey	Louisiana (4)	
New York	Maine (5)	
North Carolina	Minnesota	
Oregon	Montana	
Pennsylvania	New Hampshire	
Puerto Rico	New Mexico	
Tennessee	North Dakota	
Vermont	Ohio (6)	
Virginia	Oklahoma	
Washington	Rhode Island (7)	
West Virginia	South Carolina	
	South Dakota	
	Texas (8)	
	Utah	
	Wisconsin	
	Wyoming	

1. Riders under 19 must wear helmets and helmets must be in the possession of other riders, even though use is not required.

2. Required for riders under age 21 and for those without $10,000 of medical insurance that will cover injuries resulting from a motorcycle crash.
3. Required for riders under age 21, riders operating a motorcycle with an instruction permit, riders with less than one-year experience, and/or riders who do not provide proof of health insurance to county clerk. (Insurance provision repealed effective July 15, 2000.)

4. Required for riders under age 18 and those who do not have a health insurance policy with medical benefits of at least $10,000. Proof of policy must be shown to law enforcement officer upon request.

5. Required only under 15 years of age, novices, and holders of learner's permits.

6. Riders under 18 and first year novices are also required to wear helmets.

7. Riders under 21 and first operators must wear helmets.

8. Riders 20 and under and those who have not completed a rider training course or who do not have $10,000 medical insurance coverage.

8. REFERENCES

1. Department of Transportation, National Highway Traffic Safety Administration, "*Traffic Safety Facts 1999: Motorcycle*".

2. Department of Transportation, National Highway Traffic Safety Administration, "*A Method of Estimating Posterior BAC Distributions for Persons Involved in Fatal Traffic Accidents (DOT HS 807 094)*".

3. Department of Transportation, National Highway Traffic Safety Administration, "*Recent Trends in Fatal Motorcycle Crashes (DOT HS 809 271)*".

4. Department of Transportation, National Highway Traffic Safety Administration, "*State Legislative Fact Sheet, Motorcycle Helmet Use Laws, January 2001*".

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