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Assesment of Motorcycle Safety in Alabama

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ASSESMENT OF MOTORCYCLE SAFETY IN ALABAMA

By

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CIVIL ENGINEERING

ABSTRACT

Federal statistics confirm that over 5,000 accidents occurred nationwide in 2008 involving motorcycles. Examination of national traffic safety trends shows that even though motorcycle crashes declined in the early 90's, they have continued to rise steadily from 1998 to date. A federal survey indicates that a motorcycle driver's chances of being involved in a crash are thirty seven times higher compared to a car driver for the same number of miles traveled. Thus motorcycle safety is an area of traffic safety that requires additional attention.

Preliminary review of motorcycle crash records in the state of Alabama shows that the number of crashes increased threefold over the past decade. This trend is alarming, and calls for research studies to investigate the types and causes of such accidents and determine appropriate countermeasures to reduce them. To address this need the project performed an analysis of crash records over the past 10 years in order to create a casualty profile for motorcyclists in the state of Alabama, in general, and Jefferson County, in particular. The objective of the analysis was to develop a better understanding of the types, locations and contributing factors related to motorcycle crashes in Alabama. The Critical Analysis Reporting Environment (CARE) database was used for the crash record analysis. CARE, UA provides the capability of locating crashes and summarizing a number of variables that describe crash characteristics and contributing factors, such as facility type, injury severity, damage severity, helmet use,

driver condition, age, etc. Frequency analysis and cross-tabulation techniques were employed to extract and organize the data obtained from CARE. This thesis reports summary statistics and conclusions from the crash analysis.

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LIST OF ABBREVIATIONS

CARE	Critical Analysis Reporting Environment
CAPS	Center for Advanced Public Safety
NHTSA	National Highway Traffic Safety Authority
FARS	Fatality Analysis Reporting System
AL DMV	Alabama Department of Motor Vehicles
CATS	Customer Automated Tracking System
MIC	Motorcycle Industry Council
FHWA	Federal Highway Administration
ACEM	Association of European Motorcycle Manufacturers
PTW	Powered Two Wheeler
OECD	Economic Co-operation and Development

1. INTRODUCTION

1.1. Problem Statement

In 2008, 5,290 motorcyclists were killed in the US—an increase of 2 percent over the 5,174 motorcyclists killed in 2007. Moreover, 96,000 motorcyclists were injured during 2008(1). In 2008, motorcyclists accounted for 14 percent of total traffic fatalities, 17 percent of all occupant fatalities, and 4 percent of all occupants injured. The National Highway Traffic Safety Authority (NHTSA) reports that per vehicle mile traveled in 2007, motorcyclists were about 37 times more likely than passenger car occupants to die in a motor vehicle traffic crash and 9 times more likely to be injured.

The Federal Highway Administration (FHWA) recognizes that motorcycle riders face more risks of crashing and being injured than passengers in four-wheeled vehicles. Two-wheeled motorcycles are more difficult to operate and more unstable than four-wheeled cars and trucks. Some roadway design and maintenance features add additional risks. Other vehicle drivers may not expect to see motorcycles on the road, may not watch for them, and may not know how to accommodate them in traffic. When Motorcycles gets involved in crash, they provide almost no protection to their riders (2).

In the state of Alabama, the use of motorcycles has grown steadily over the last decade, and so are accidents related to motorcycles. In 2008, 127,166 motorcycle registrations were reported in the state of Alabama, an increase of 36% compared to 2005. During the same time period, fatalities involving motorcycle users in Alabama increased from 62 in 2005 to 99 in 2008, or

nearly 60%. In other words, the motorcyclist fatalities per 100,000 motorcycle registrations increased from 66.33 in 2005 to 77.85 in 2008, an alarming trend. To put things in to perspective, the total number fatalities per 100 million vehicle miles driven in Alabama for all modes combined dropped from 1.92 (in 2005) to 1.63 in 2008. In 2008, 76% of all motorcycle collisions resulted in injury or death.

These statistics clearly demonstrate that severe motorcycle accidents are overrepresented in the state of Alabama, compared to other traffic accidents and thus attention should be given to the conditions that contribute to motorcycle crashes and potential improvements that hold promise toward reducing the number and severity of motorcycle crashes in Alabama.

1.2. Goals and Objectives

The study investigates the primary reasons of motorcycle crashes in Alabama by analyzing traffic safety records over the last decade. First, a database of all crashes that occurred in Alabama from 1999-2008 and involved motorcycle users was extracted from available records. Then, the database was analyzed using statistical techniques in order to better understand how environmental, demographic, and behavioral factors contribute to motorcycle accident occurrence across the state of Alabama, and in Jefferson County, in particular.

The objectives of the study are to:

- Showcase the extent of the motorcycle safety problem in the state of Alabama and Jefferson County

- Identify primary contributing factors to motorcycle crashes in Alabama and draft a casualty profile for motorcycle users in Alabama, and
- Propose interventions with a potential to improve motorcycle safety in the future.

The report is organized in seven chapters as follows:

- Chapter *1* introduces the research problem considered in this study and outlines the study's goals and objectives.
- Chapter *2* provides a detailed literature review of past research related to safety.
- Chapter *3* describes the study methodology and introduces basic concepts related to crash database used in this study.
- Chapter *4* presents the details of the data analysis for the State of Alabama and summary results.
- Chapter *5* summarizes the data analysis and results for Jefferson County, and
- Chapter *6* summarizes the main conclusions derived from the study and provides recommendations for future research.

2. LITERATURE REVIEW

2.1. Review of US Motorcycle Crashes Historical Trends

The following paragraphs provide a summary of motorcycle crash trends based on historical data provided by NHTSA in its Traffic Safety Facts report for 2008(3). As shown in Table 2-1 the number of motorcyclist fatalities increase steadily from 1998 on and in 2008, 5,290 motorcyclists were killed and 96,000 motorcyclists injured across the nation.

An estimated 148,000 motorcyclists have died in traffic crashes since the enactment of the Highway Safety and National Traffic and Motor Vehicle Safety Act of 1966. Motorcycles made up nearly 3 percent of all registered vehicles in the United States in 2007 and accounted for only 0.4 percent of all vehicle miles traveled.

Per vehicle mile traveled in 2007, motorcyclists were about 37 times more likely than passenger car occupants to die in motor vehicle traffic crash and 9 times more likely to be injured (4). Table 2-2 provides a comparison of occupant fatality rates by vehicle type over a ten-year period. It can be observed that while a significant decrease in fatality rates occurred for passenger cars and light trucks over the 10 year period, a dramatic increase of motorcycle fatality rates took place over the same reference period.

Per registered vehicle, the fatality rate for motorcyclists in 2007 was 6 times the fatality rate for passenger car occupants. The injury rate for motorcyclists was 0.7 times more than the injury rate for passenger car occupants. In 2008, motorcyclists accounted for 14 percent of total traffic fatalities, 17 percent of all occupant fatalities, and 4 percent of all occupants injured.

Table 2-1 Motorcyclists Killed and Injured, and Fatality and Injury Rates, 1998–2008(3)

Year	Fatalities	Registered Vehicles	Fatality Rate*	Vehicle Miles Traveled (millions)	Fatality Rate**
1998	2,294	3,879,450	59.13	10,283	22.31
1999	2,483	4,152,433	59.80	10,584	23.46
2000	2,897	4,346,068	66.66	10,469	27.67
2001	3,197	4,903,056	65.20	9,639	33.17
2002	3,270	5,004,156	65.35	9,552	34.23
2003	3,714	5,370,035	69.16	9,577	38.78
2004	4,028	5,767,934	69.83	10,122	39.79
2005	4,576	6,227,146	73.48	10,454	43.77
2006	4,837	6,678,958	72.42	12,049	40.14
2007	5,174	7,138,476	72.48	13,612	38.01
2008	5,290	–	–	–	–
Year	**Injured**	**Registered Vehicles**	**Injury Rate***	**Vehicle Miles Traveled (millions)**	**Injury Rate****
1998	49,000	3,879,450	1,262	10,283	476
1999	50,000	4,152,433	1,204	10,584	472
2000	58,000	4,346,068	1,328	10,469	551
2001	60,000	4,903,056	1,229	9,639	625
2002	65,000	5,004,156	1,293	9,552	677
2003	67,000	5,370,035	1,250	9,577	701
2004	76,000	5,767,934	1,324	10,122	755
2005	87,000	6,227,146	1,402	10,454	835
2006	88,000	6,678,958	1,312	12,049	727
2007	103,000	7,138,476	1,443	13,612	757
2008	96,000	–	–	–	–

*Rate per 100,000 registered vehicles; **Rate per 100 million vehicle miles traveled
– = not available.
Source: Vehicle miles traveled and registered vehicles—Federal Highway Administration Fatalities—Fatality Analysis Reporting System (FARS), NHTSA Injured—General Estimates System (GES), NHTSA

Table 2-2 Occupant Fatality Rates by Vehicle Type, 1997 and 2007

Year	Fatality Rate	Motorcycles	Passenger Cars	Light Trucks
1997	Per 100,000 Registered Vehicles	55.3	17.81	15.23
	Per 100 Million Vehicle Miles Traveled	20.99	1.45	1.24
2007	Per 100,000 Registered Vehicles	72.48	12.06	12.34
	Per 100 Million Vehicle Miles Traveled	38.01	1.03	1.06
% Change (1997–2007)	Per 100,000 Registered Vehicles	31.07	-32.28	-19
	Per 100 Million Vehicle Miles Traveled	81.09	-28.76	-14.79

Note: 2008 registered vehicles and vehicle miles data not available.

Figure 2-1 shows the geographic distribution of 2008 fatal crashes by state. States that reported the highest number of crashes include California (537 fatal motorcycle crashes in 2008), Florida (523), and Texas (480).

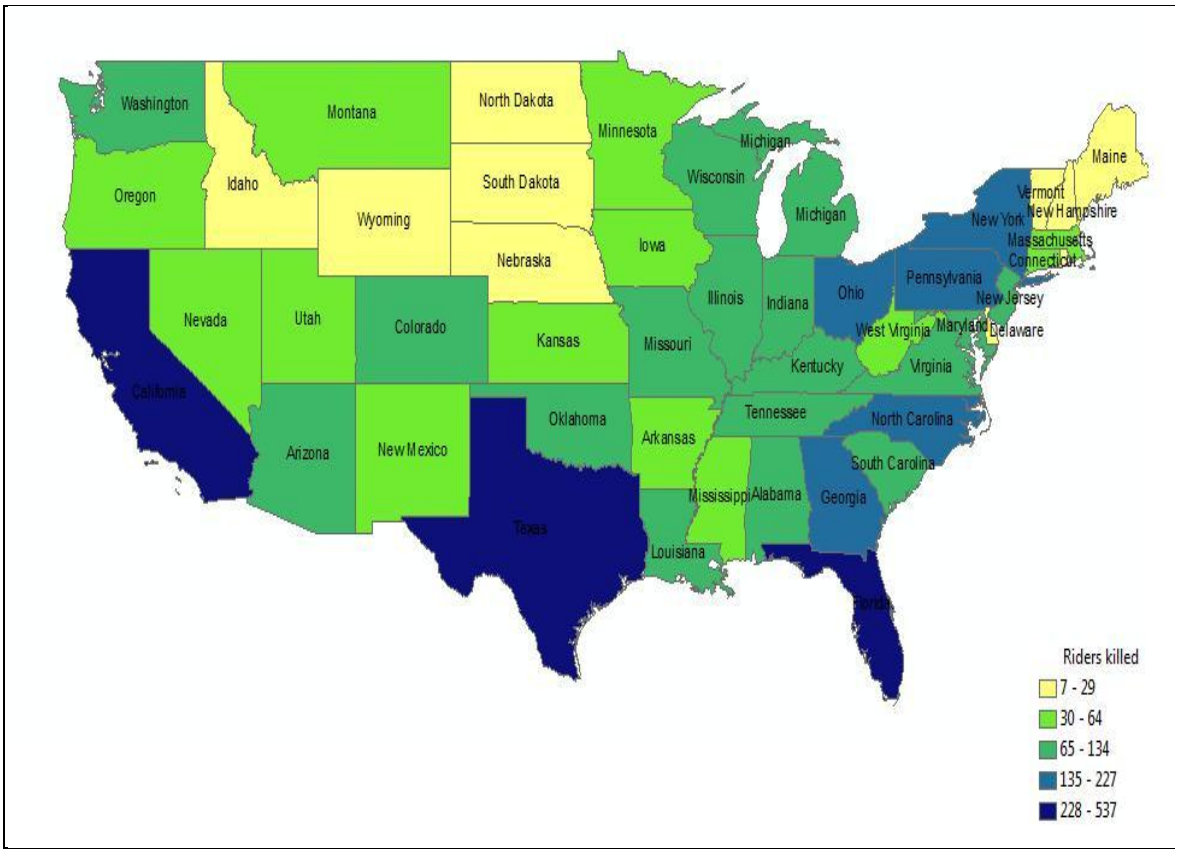

Figure 2-1 Geographic Distribution of 2008 Fatal Crashes by State (5)

2.1.1. Conditions Present during Fatal Motorcycle Crashes

In 2008, 2,554 (47%) motorcycles involved in fatal crashes collided with another type of motor vehicle in transport. In two-vehicle crashes, 77 percent of the motorcycles involved were struck in the front. Only 7 percent were struck in the rear.(1)

Motorcycles are more likely to be involved in a fatal collision with a fixed object than are other vehicles. In 2008, 25 percent of the motorcycles involved in fatal crashes

collided with fixed objects, compared to 19 percent for passenger cars, 14 percent for light trucks, and 4 percent for large trucks.(1)

In 2008, there were 2,387 two-vehicle fatal crashes involving a motorcycle and another type of vehicle. In 41 percent (985) of these crashes the other vehicle was turning left while the motorcycle was going straight, passing, or overtaking the vehicle. Both vehicles were going straight in 666 crashes (28%). As far as age is concerned, motorcyclists over 40 years of age are overrepresented in fatal crashes with 2,687 fatalities in 2008, compared to 1,614 and 987 deaths for motorcyclists younger than 30, and between 30 - 39 years of age, respectively.

It is important to note that 35 percent of all motorcycle riders involved in fatal crashes were speeding compared to 23 percent for passenger car drivers, 19 percent for light-truck drivers, and 8 percent for large-truck drivers. Other contributing factors include alcohol and licensing.

In 2008, 30 percent of all fatally injured motorcycle riders had blood alcohol concentration (BAC) levels of .08 g/dL or higher. An additional 7 percent had lower alcohol levels (BAC .01 to .07 g/dL). The percentage with BAC .08 g/dL or above was highest for fatally injured motorcycle riders among two age groups, 40–44 (41%) and 45–49 (41%) followed by the 35–39 (36%) age group. In fatal crashes motorcyclists with BAC levels of 0.08g/dL or higher are over represented.

As far as licensing is concerned, one out of four motorcycle riders (25%) involved in fatal crashes in 2008 were riding their vehicles with invalid licenses at the time of the collision, while only 12 percent of drivers of passenger vehicles in fatal crashes did not have valid licenses.

Last but not least, NHTSA estimates that helmets saved the lives of 1,829 motorcyclists in 2008. The reported helmet use rates for fatally injured motorcyclists in 2008 were 59 percent for riders and 49 percent for passengers indicating that there is still a lot of room for potential improvement. Figure 2-2 shows helmet use in 2008 fatal crashes by state. According to NHTSA helmets are 9 percent effective in preventing all kinds of injuries and 35 percent effective in preventing a fatality (6).

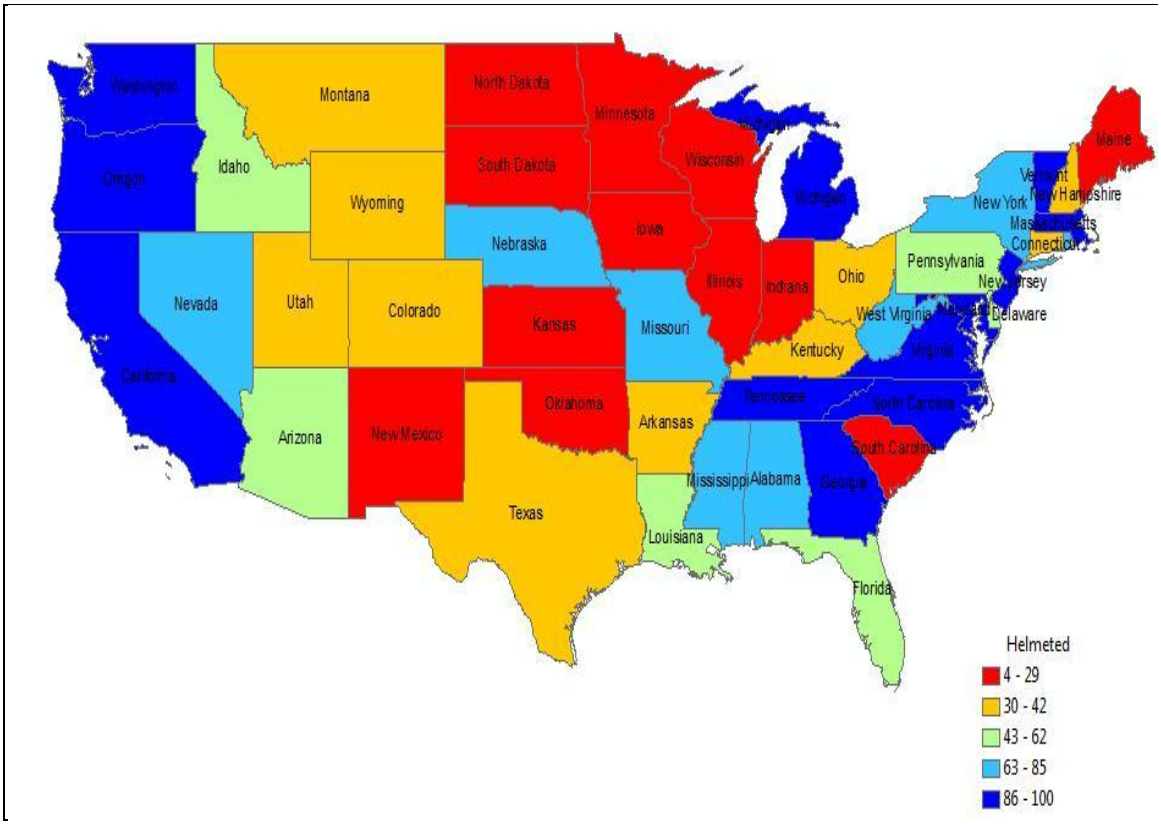

Figure 2-2 Percent of Motorcycle Users Wearing Helmet when Fatally Injured (5)

2.2. Motorcyclist Crash Causation Studies

Even though traffic safety is a hot research topic and several studies reported on crash statistics involving motorcyclists and the association between motorcycle safety

and helmet use, there are only three motorcycle crash causation studies reported in the literature. These include the U.S. 1981 Hurt Report, the European Motorcycle Accidents in Depth Study (MAIDS), and a study from Thailand.

2.2.1. The Hurt Study

A scientific study conducted by the University of Southern California in late nineteen seventies on motorcycle accident causal factors and countermeasures is considered as a pioneering research effort. The study was initiated by NHTSA and investigated over 900 accidents in the Los Angeles area performing an in depth analysis of 3,600 police reports during the twenty-four-month period of 1976–77(4). Each accident was studied individually with approximately 1,000 data elements, collected for each of the 900 accident scenes, including measuring and photographing vehicle damage, skid marks, scrape marks, people marks on road, and interviewing survivors. Hundreds of accident-involved riders donated their helmet to the research, which allowed team members to disassemble measure, photograph and record the accident damage as part of the study.

The findings of this comprehensive study were summarized in the well known Hurt Report published in 1981 and included a list of 55 findings as well as several recommendations for law enforcement agencies and legislation. Some notable findings in the Hurt report (7) (quoted below) were:

- 75% of accidents were found to involve a motorcycle and a passenger vehicle, while the remaining 25% of accidents were single motorcycle accidents.

- "In the single vehicle accidents, motorcycle rider error was present as the accident precipitating factor in about two-thirds of the cases, with the typical error being a slide-out and fall due to over braking or running wide on a curve due to excess speed or under-cornering."
- "Almost half of the fatal accidents show alcohol involvement" and "injury severity increases with speed, alcohol involvement and motorcycle displacement."
- In the multiple vehicle accidents, the driver of the other vehicle violated the motorcycle right-of-way and caused the accident in two-thirds of those accidents.
- The report's additional findings show that the wearing of appropriate gear, specifically, helmets and durable garment, mitigates crash injuries substantially.
- "Vehicle failure accounted for less than 3% of these motorcycle accidents, and most of those were single vehicle accidents where control was lost due to a puncture flat"
- "Weather is not a factor in 98% of motorcycle accidents."
- "The failure of motorists to detect and recognize motorcycles in traffic is the predominating cause of motorcycle accidents. Conspicuity of the motorcycle is a critical factor in the multiple vehicle accidents, and accident involvement is significantly reduced by the use of motorcycle headlamps-on in daylight and the wearing of high visibility yellow, orange or bright red jackets."

The Hurt report significantly advanced the state of knowledge of the causes of motorcycle accidents, in particular pointing out the widespread problem of car drivers failing to see an approaching motorcycle and precipitating a crash by violating the motorcyclist's right-of-way. The study also provided data clearly showing that helmets

significantly reduce deaths and brain injuries without any increased risk of accident involvement or neck injury.

2.2.2. The Motorcycle Accidents in Depth Study (MAIDS)

The most recent large-scale study of motorcycle accidents is the Motorcycle Accidents in Depth Study (MAIDS) (5) that was carried out in five European countries in 1999-2000, using the rigorous Organization for Economic CoOperation and Development (OECD) standards.

Starting in September, 1999, over 2000 variables were coded in each of 921 accidents, and exposure data was collected on an additional 923 cases, collected at five locations in France, Germany, Netherlands, Spain and Italy. The investigation was carried out under the auspices of the Association of European Motorcycle Manufacturers (ACEM) with the support of the European Commission. The focus was on all powered two wheelers (PTW), motorcycles, scooters and mopeds.

The main findings of the report are quoted below (8):

- There were 103 cases involving a fatality of either the rider or the passenger.
- 54.3% of the PTW accidents took place at an intersection.
- Passenger cars were the most frequent collision partner (60%).
- A PTW was more likely to collide with a passenger car in an urban area than in a rural area. (64.1% v. 46.7%).
- Due to the absence of comparable exposure data, it was not possible to determine if any month, day of the week or time of the day a risk factor.

The MAIDS report tends to support most of the Hurt Report findings, for example that "69% of the other vehicle drivers attempted no collision avoidance maneuver," suggesting they did not see the motorcycle. And further that, "The data indicates that in 68.7% of all cases, the helmet was capable of preventing or reducing the head injury sustained by the rider.

2.2.3. The Bangkok, Thailand Study

A comprehensive study was done in Thailand using nearly identical research methods to the Hurt study in Thailand, where data was collected on 1,082 accident-involved riders in 1999-2000 (9) in Bangkok and Upcountry. The objectives of the study were to identify causes and characteristics of motorcycle crashes; determine motorcycle crash related injuries and contact surfaces causing these injuries, identify risk factors, and recommend countermeasures to reduce crash frequency and severity.

In the Bangkok study, 723 in-depth on-scene investigations of motorcycle crashes (including mopeds) took place. Trained investigators gathered detailed exposure at the location of each crash such as skid marks, photos of the damaged motorcycle and helmet and contacted 2,100 interviews to obtain additional information. From all the collected details speeds, pre crash motions, collision contacts injury causations and helmet performances were studied.

Some key findings from the analysis are as follows:

- The most frequent crash type was motorcycle rear-ending another vehicle.
- Rider error was the most frequent primary cause in both single and multiple vehicle crashes and contributed to 50% of crashes involving motorcycles.

- Another crucial factor was alcohol that was present in 40% motorcycle crashes.
- Roadway design and maintenance contributed to 12.5% of crashes studied.
- Absence of training was linked to high frequency of rider errors.

These findings are overall consistent with the ones reported from earlier studies in the US and Europe.

2.2.4. Recent Initiatives

Since 1981, when the famed Hurt Study issued its findings on the causes of motorcycle accidents, a lot has changed. Almost 11 million street bikes have been sold in the U.S. Not only has the size of the rider population grown to 6.6 million, but so has the average motorcycle displacement. In 1990, just 40% of motorcycles were larger than 749 cc; that percentage has since doubled. Even more significant is the average age of riders. In 1985, the typical rider was 27 years old while today the average age is 41(10).

Thus in 2005 that the federal government decided to fund a new motorcycle crash causation study to update the findings of the Hurt Report issued nearly 3 decades ago. A federal transportation reauthorization bill (a.k.a. SAFETEA-LU) included $2.8 million for this research, with the requirement that federal funds be matched from a nongovernmental source. At that time, the motorcycle industry was on board to come up with the matching funds -- at least until the study's first cost estimate came in. The contract was awarded to the Oklahoma Transportation Center (OTC) that was charged with the task to conduct an in-depth motorcycle crash causation study that employed the OECD methodology used in earlier work.

The OECD describes two complementary procedures to be performed for acquiring the data needed to understand the causes of motorcycle crashes. The first of these is the traditional in-depth crash investigation that focuses on the sequence of events leading up to the crash, and on the motorcycle, rider, and environmental characteristics that may have been relevant to the crash. The second procedure, known as the case-control procedure, complements the first. It requires the acquisition of matched control data to allow for a determination of the extent to which rider and driver characteristics, and pre-crash factors observed in the crash vehicles, are present in similarly-at-risk control vehicles. Such a dual approach offers specific advantages to the understanding of crashes and the development of countermeasures. The in-depth study of the crash by itself allows for analysis of the events antecedent to the crash, some of which, if removed or altered, could result in a change in subsequent events that would have led to a non-crash, or reduced crash severity outcome (11).

The objective of the study is to focus on the relevant aspects of motorcycle crashes susceptible to countermeasures that can prevent motorcycle crashes from occurring or lessen the harm resulting from such crashes. Risk factors being considered in this effort include rider and driver characteristics (such as training, age, gender, driver condition, etc), vehicle characteristics, and roadway geometrics and traffic characteristics. The study is on-going and scheduled for completion in August 2010.

2.3. Motorcycle Laws in USA

In the US different states have different laws pertaining to the safety of motorcycle riders. The laws refer to the use of protective devices (such as helmets, eye protection), operation of motorcycle (e.g. using of headlights in daytime, two abreast in

same lane), motorcycle equipment (such as passengers seat and footrest for the passenger, side mirrors, and turn signals), and other requirements such as restriction on passengers age, periodic safety inspection, insurance requirements etc. Figure 2-3 summarizes motorcycle laws by state based on data provided by the American Motorcyclist Association (AMA) (12).

Except from the states of Illinois, and Iowa helmet use is mandatory in all other states for all motorcycle users (19 states, including Alabama) or users under a certain age (varying from 15 to 21 years of age). Thirty seven states have laws requiring eye protection, and four states have laws for minimum age requirement to be carried on motorcycles. While other laws vary from state-to-state all 50 states require a motorcycle operator's license.

Remember that while other laws vary from state-to-state, all 50 states require a motorcycle operator's license.

The AMA assumes no responsibility for the accuracy of information included in this guide. Every effort has been made to ensure the information is correct at the time of publication.

LEGEND:

x required by law
* no reference in administrative code or statutes
# available for all eligible applicants
• prohibited to use or possess
> required if carrying a passenger
1 - reflectorization required
2 - must have in possession
3 - required for novice riders
4 - required under age 18
5 - required under age 19
6 - required under age 21
7 - under age 15; or operating under a learner's permit; or operating less than one year with license/endorsement; or as a passenger of an operator required to wear protective headgear
8 - required for passengers
9 - required for instructional permit holders
10 - not required over 21 with successful completion of rider training or $10,000 medical insurance
11 required under age 16
12 - required for first-time applicants
13 - may waive skills test for successful completion of rider ed
14 - may waive knowledge test for successful completion of rider ed
15 - required unless equipped with windscreen
16 - required unless equipped with windscreen which is 15" or higher above handlebars
17 - required at speeds over 35 mph
18 - modulating headlight permitted
19 - required for vehicles manufactured after 1/1/56
20 - required for vehicles manufactured after 4/1/77
21 - required for vehicles manufactured during or after 1978
22 - required for vehicles manufactured during or after 1980
23 - not applicable if manufactured prior to 1975
24 - prohibits passengers under age 5
25 - prohibits passengers under age 7
26 - single earphone only
27 - to be used for communication purposes only
28 - required by inspection regulations
29 - random
30 - annual emissions, some areas
31 - upon title transfer
32 - not required over 21 with a minimum of $10,000 in medical insurance
33 - not required to wear a helmet over 18 with proof of Insurance.
34 - Required if manufactured after 1968
35 - Required if manufactured after 1974
36 - Required if manufactured after 1973
37 - Required if manufactured after 1985
38 - Not required over 21 with successful completion of rider training or two full years riding experience.
39 – prohibits passengers under age 8

	Safety Helmet	State Funded Rider Ed	Eye Protection	Daytime Use of Headlight	Passenger Seat / Footrests	Two Abreast in Same Lane	Passenger Age Restrictions	Helmet Speakers	Mirror Left (L) Right (R)	Periodic Safety Inspection	Turn Signals
Alabama	x	#		18	>/>	YES			x		
Alaska	x-4,8		x-16	x-18	>/>	YES			x (L,R)	x-29	
Arizona	x-4	#-13	x-15	18	>/>	YES			x	x-30	
Arkansas	x-6		x	x-18	>/>	*	39		x		
California	x	#-6,13		x-18,21	>/>	*		26	x	x-29	x
Colorado	X-4,8*	#-13	x	18	>/>	YES			x	x-29	
Connecticut	x-4,9	#-4,13	x-15	x-18,22	>/>	YES			x	x-29	
Delaware	x-1,2,5,9	#-4,13,14	x	18	>/>	*			x	x	
Florida	x-32	#-6,12,13,14	x	x-18	>/>	YES			x		x
Georgia	x	#-13,14	x-15	x-18	>/>	YES		27	x		
Hawaii	x-1,4	#-13	x-15		>/>	YES	25		x	x	
Idaho	x-4	#-6,13		18	>/>	*			x		
Illinois		#-4,13,14	x-15	x-18	>/>	*		27	x		
Indiana	x-4,9	#-13	x-4	x-18,19	>/>	YES			X-19		
Iowa		#-4,13		x-18,20	>/>	YES			x		
Kansas	x-4	#-13,14	x-15	x-21	>/>	YES			x (L)	x-29	x-36
Kentucky	x-3,6,9	#-13	x		>/>	*			x	x-30	
Louisiana	x	#-13	x-15	18	>/>	YES	24		x (L)	x	x
Maine	x-4	#-12,13,14		x	>/>	YES			x	x	x-35
Maryland	x	#-4,13,14	x-15	18	>/>	YES		26	x (L,R)	x-31	x
Massachusetts	x	#-13	x-9,15	18	>/>	YES		•	x	x	x
Michigan	x	#-4,13	x-15,17	18	>/>	YES			x	x-29	
Minnesota	x-4,9	#-4,13	x	x-18	>/>	YES		26	x	x-29	
Mississippi	x					*				x	
Missouri	x	#-13		18		*				x	
Montana	x-4	#-13		x-18	>/>	YES			x		
Nebraska	x	#-13,14		18	>/>	YES					
Nevada	x	#-13,14	x-15	18	>/>	YES			x (L,R)		x-36
New Hampshire	x-4	#-13	x-15	18	>/>	YES			x	x	
New Jersey	x-1	#-13	x-9,15	18	>/>	*			x	x	
New Mexico	x-1,4	#-4,13,14	x-15	18	>/>	*			x	x-29	x
New York	x-1	#-13	x	x-18	>/>	YES		26	x	x	x-37
North Carolina	x	#-13		x-18	>/>	YES			x	x	
North Dakota	x-1,4	#-11		18	>/>	YES			x		
Ohio	x-3,4	#-4,13	x-15	18	>/>	YES			x	x-29	x-34
Oklahoma	x-4		x-15	x-18	>/>	*			x (L,R)		
Oregon	x	#-6,13,14		x-18	>/>	YES			x	x-29	x
Pennsylvania	x-38	#-13,14	x	x-18, 36	>/>	YES		27	x-20,28	x	
Rhode Island	x-3,6,8	#-12,13,14	x		>/>	YES		•	x	x	
South Carolina	x-1,6	#	x-6,15	x-18	>/>	YES			x		
South Dakota	x-4	#-13,14	x-15	18	>/>	YES			x		x
Tennessee	x	#-13,14	x-15	x-18	>/>	YES			x		
Texas	x-6,10	#-4,13		x-23,18	>/	*			x	x	
Utah	x-4	#-13		18	>/>	YES			x	x	
Vermont	x-1	#-13	x-15	18	>/>	NO			x	x	x
Virginia	x	#-13	x-15	18	>/>	NO		27	x	x	
Washington	x	#-4,13,14	x-15	x-18	>/>	YES	24		x (L,R)	x-29	
West Virginia	x	#-13,14	x	x	>/>	*			x	x	x
Wisconsin	x-4,9	#-4,13	x-16	x-18	>/>	YES			x	x-29	x
Wyoming	x-4	#-13		x-18	>/>	YES			x		
District of Columbia	x-1		x-15	18	>/>				x	x	
Puerto Rico	x		x	x	>/>				x	x	
Canada	x										

Figure 2-3 Motorcycle Laws by State (Revised 08-05-2009) (12)

While the use of helmet in Alabama is mandatory and state funded rider education is available for all eligible applicants, there are no passenger age restrictions, nor requirements for eye protection, safety inspections or the use turn signals. Compulsory Liability state insurance (Minimum Limits, 20/40/10) is required and passenger seat and footrest are required if carrying a passenger. Alabama code (Title 32: Section 32-5A-242) states that motorcycles are entitled to full use of a lane and no motor vehicle shall be driven in such a manner as to deprive any motorcycle of the full use of a lane. This subsection shall not apply to motorcycles operated two abreast in a single lane. Moreover, the operator of a motorcycle shall not overtake and pass in the same lane occupied by the vehicle being overtaken. The law also prohibits anyone from operating a motorcycle between lanes of traffic or between adjacent lines or rows of vehicles.

3. STUDY METHODOLOGY

3.1. Approach

This study performed an analysis of crash records over a 10-year span (i.e., from 1998 to 2007) in order to create a casualty profile for motorcyclists in the state of Alabama, in general, and Jefferson County, in particular. The overall aim of the analysis was to develop a better understanding of the types, locations, and contributing factors related to motorcycle crashes in Alabama.

The Critical Analysis Reporting Environment (CARE 9.1.1.5) database was used for the crash record analysis. CARE provides the capability of locating crashes and summarizing a number of variables that describe crash characteristics and contributing factors, such as facility type, injury severity, damage severity, helmet use, driver condition, age, etc. Frequency analysis and cross-tabulation techniques were employed to extract and organize the 10-year data obtained from CARE. The frequency analysis produces a simple count of the number of occurrences for each code of the specified variable(s), with percentages and cumulative percentages. Cross tabulations are used to summarize two different variables simultaneously with a count and percentage in each cell.

A number of parameters were considered in the analysis including demographics (such as age, gender, race); infrastructure related characteristics (including highway classification, roadway characteristics, crash location, type of environment, i.e., rural versus urban, signalization etc); and environmental and human conditions (such as day of week, month, alcohol involvement etc).

A brief description of the CARE database is provided next.

3.2. Critical Analysis Reporting Environment (CARE)

3.2.1. Overview

The Critical Analysis Reporting Environment (CARE) is a world class crash analysis system that has been implemented in Alabama and twelve other states. Its main analytical engine is in the public domain and is maintained by the Center for Advanced Public Safety (CAPS) in the Department of Computer Science at the University of Alabama.

CARE uses advanced statistical and analytical techniques to generate valuable information directly from the data. Capabilities exist to develop charts and tables and also export the data into other external files. CARE uses its own proprietary database structures that are optimized to support its analysis and information-mining capabilities, many of which would be slower or impossible for a generalized relational database system. CARE also has special features of mapping data on Google maps. The data mapped can be mile post or non-mile posted data. Intersection Magic is a special feature of the CARE which shows the accident as a drawing.

One of CARE's greatest strength is its ability to quickly make subsets of datasets and allow analyses and comparative analyses of these subsets, without requiring users to know how to make sophisticated database queries. Queries can be modified immediately, giving users the ability to hone in on exactly what they want. In this study, a subset crashes that involved motorcycles was obtained from the database of all crash records reported during the analysis period in Alabama, and was used for the analysis of statewide motorcycle crashes reported in Chapter 4. Later, a subset of those motorcycle

crashes occurring in Jefferson County was extracted, and used to document the motorcycle crash experience in Jefferson County in the period 1999-2008 (Chapter 5).

3.2.2. CARE Capabilities Summary

CARE has many functions and capabilities that can be obtained by merely selecting options from menus and following the stepwise procedures. In addition, most of the results are returned virtually instantaneously. Generally these capabilities exist for both the desktop and the web version of CARE. A summary of CARE capabilities (13):

- Filter Selection. A filter is a specification that enables analyses to be directed at only a specific subset of the data. When selected, a filter will be stay in effect for the remainder of the CARE session or until changed by the user. Certain filters are predefined in that many of the subsets of interest are known. For example, in traffic accidents, filters are generally predefined for all crashes caused by or related to: alcohol, bicycle, driver, EMS (injury and fatal), fatal, motorcycle, pedestrian, roadway defects, railroad, school bus, truck, vehicle defects, age, and political subdivisions (counties and cities).
- Filter Combination. Combinations of predefined filters can be created and made current on demand with standard Boolean ‘AND’ and ‘OR’ operations (e.g., the user might specify that only alcohol-related, motorcycle-fatality crashes will be analyzed). The option exists to obtain more sophisticated combinations with two filter lists within an intuitive user interface.
- User-defined filters. In addition to using filters from those already created, the user can create additional filters. This is accomplished by using an intuitive interface that walks the user through the selection of any combination of variables and values from the

database. Thus, a filter defining any subset may be defined. Examples could include certain age groups, BAC levels, or driver visibility. Once a user-created subset is defined, it has the same status as any other predefined subset. Thus, it may be combined with any of the other filters to produce more specifically defined subsets.

- Frequency distributions can be obtained for any or all variables for any subset. Variables (such as time of day, day of the week, weather, driver age, etc.) are listed on a selection menu. Tabular frequency distributions are accompanied by a menu for obtaining bar charts to visualize any of them.
- Cross-tabulations can be obtained for fully-labeled cross-tabulations of sets of any two variables for any subset of the data.
- Area Criticality Technique (ACT). This list is prioritized worst-first by rate as calculated using some demographic (such as city population). Typically, this is composed of a list of cities (stratified within population groupings) that are prioritized according to crashes per city population, where crashes can be for any subset specified.
- Information Mining (IMPACT). This module performs true automated information discovery by systematically finding all over-representations between any two subsets. Graphical and tabular outputs are arranged in order of worst-first order for each variable. This is one of the most powerful tools within CARE in that it finds and prioritizes over-representations without user intervention or even any knowledge of the underlying database.
- Reports. There are options for producing several different reports that can be automatically generated.

- Locations. This module (available in the desktop version only) finds high accident locations (intersections, non-mile posted segments, or mile posted segments) for any subset. The interactive nature of this task enables any number of accidents specified to define a "high-accident location." Users can dynamically redefine mile posted locations to be sure that all relevant accidents are included for a location. Further processing can continue when the appropriate locations are generated to produce frequency distributions, crosstabs, ACT, IMPACT, Profiling and/or case numbers for any location (or set of locations) found.

4. STATEWIDE MOTORCYCLE CRASH DATA ANALYSIS AND RESULTS

The following paragraphs present the motorcycle crash data analysis findings for the state of Alabama. A total of 14,775 motorcycle crashes were considered over the 10 year study period. The analysis focused on a number of variables including the following:

- Demographics (Age, Gender, Race, License State, License Type, and Citations)
- Infrastructure (Geographic Location, Area Type, Road Type, Crash Location, Traffic Control, Distance from Residence)
- Environmental Conditions (Time of Day, Day of Week, Month of Year), and
- Human Factors (Condition of Motorcyclist; Intoxication; Maneuver during Crash)

4.1. Motorcycle Crash Trends in Alabama

Figure 4-1 shows the reported motorcycle crashes in the state of Alabama from 1999 to 2008. It can be seen that the number of motorcycle accidents has been increasing steadily in the last decade and more than doubled during the study period (from 854 in 1999 to 2,044 in 2008).

Table 4-1 and Figure 4-2 provide information on the severity of reported crashes. The data show that there is no significant difference in the distribution of motorcycles among the categories considered over the years (i.e., fatal 3.4-5.2%, personal injury=64.6-67.5%, and

property damage only= 28.8-31%). It also worth noting that, contrary to passenger car and truck-related crashes where nearly 70% of the crashes are property damage only, the vast majority of motorcycle crashes involve a fatality or personal injury (over 70%). This is due to the increased

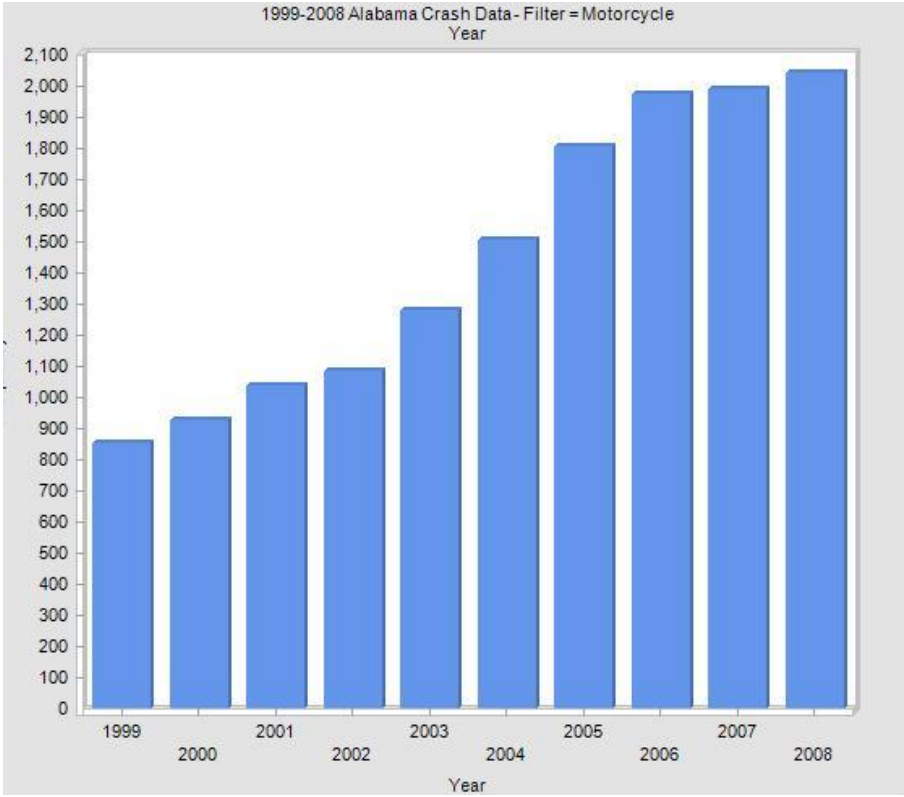

Figure 4-1 Motorcycle Crashes Trends in the State of Alabama (1999-2008)

Table 4-1 Motorcycle Crashes Severity Trends in the State of Alabama (1999-2008)

Year	Motorcycle Crashes Fatalities	Motorcycle Crashes Injuries	Motorcycle Crashes Property Damage-Only	Number of Motorcycles Crashes
1999	33	633	213	879
2000	43	698	208	949
2001	43	778	243	1,064
2002	45	808	236	1,089
2003	52	977	263	1,292
2004	75	1,082	366	1,523
2005	61	1,347	440	1,848
2006	105	1,428	460	1,993
2007	84	1,426	522	2,032
2008	98	1,495	513	2,106
Total:	639	10,672	3,464	14,775

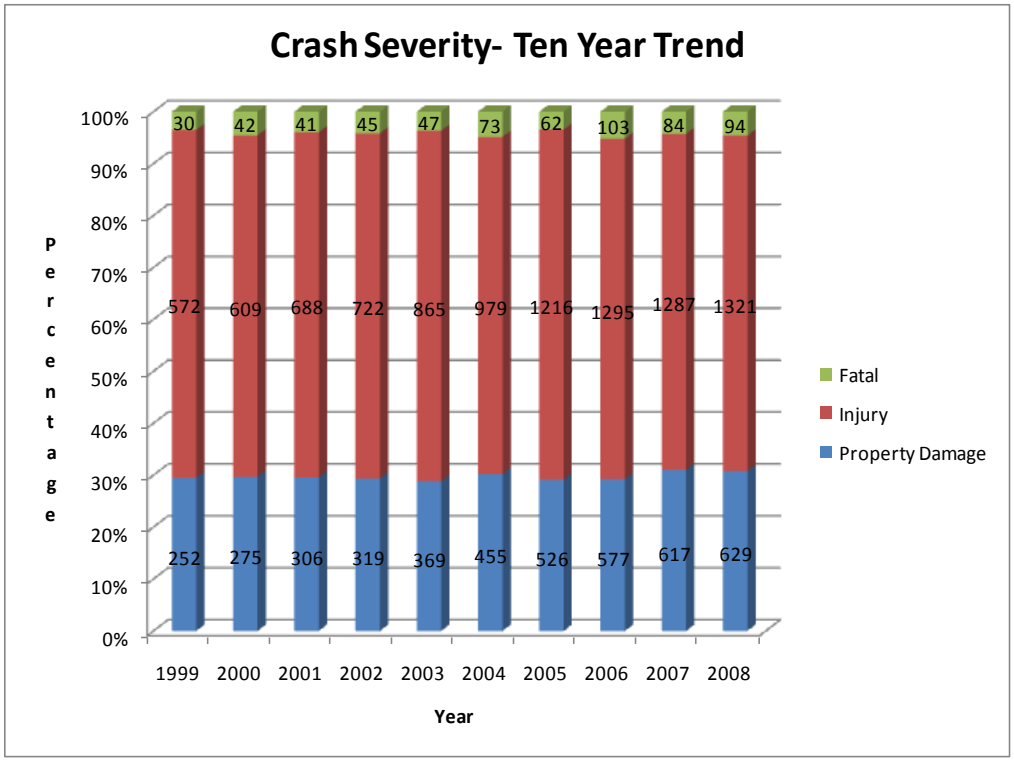

Figure 4-2 Motorcycle Crashes Types in the State of Alabama (1999-2008)

Vulnerability of the motorcyclist in a collision with an object or another vehicle, as compared to driver or passenger of any other motorized mode.

4.2. Demographics-Related Factors

4.2.1. Age

Figure 4-3 depicts the distribution of all Alabama crashes over the 10-year study period by age group. It can be observed that motorcyclists who are 16 to 30 years of age are involved in 38% of all motorcycle crashes reported. The 20-25 years old age group is leading the way, followed by the 26 to 30 year olds. No age was reported in 499 crash records.

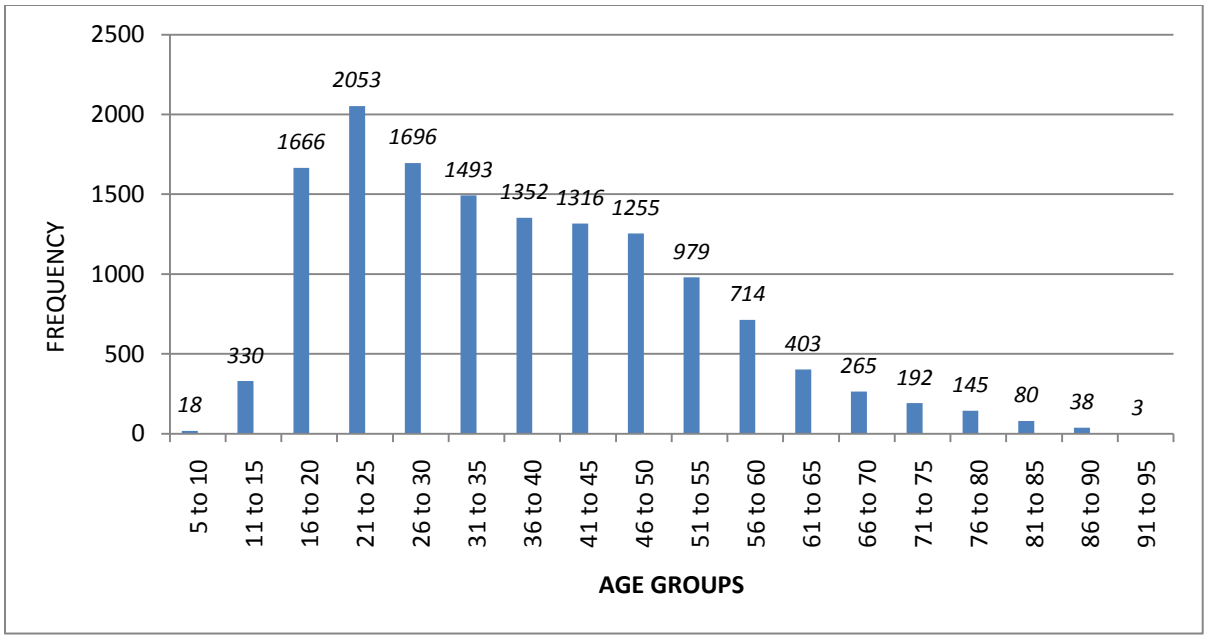

Figure 4-3 Distribution of Motorcycle Crashes by Age in the State of Alabama (1999-2008)

4.2.2. Gender

There are 14,775 motorcycle crashes recorded in the study subset, out of which male riders contributed to 11,635 (or 78.7%), and females contributed to 2,468 (or 16.7%). No record of gender was available for the remaining 397 crashes. One, however, should also consider the fact that nationwide data from 2008 show that only 12.6% of motorcycle drivers are women. No specific data on motorcycle registrations by sex over the ten year study period were available for the state of Alabama.

4.2.3. Race

Figure 4-4 displays the distribution of motorcycle crashes by race. It can be seen that Caucasians are involved in 10,792 accidents (or 74.4% of total), and African American riders in 3,183 accidents (or nearly 22%).

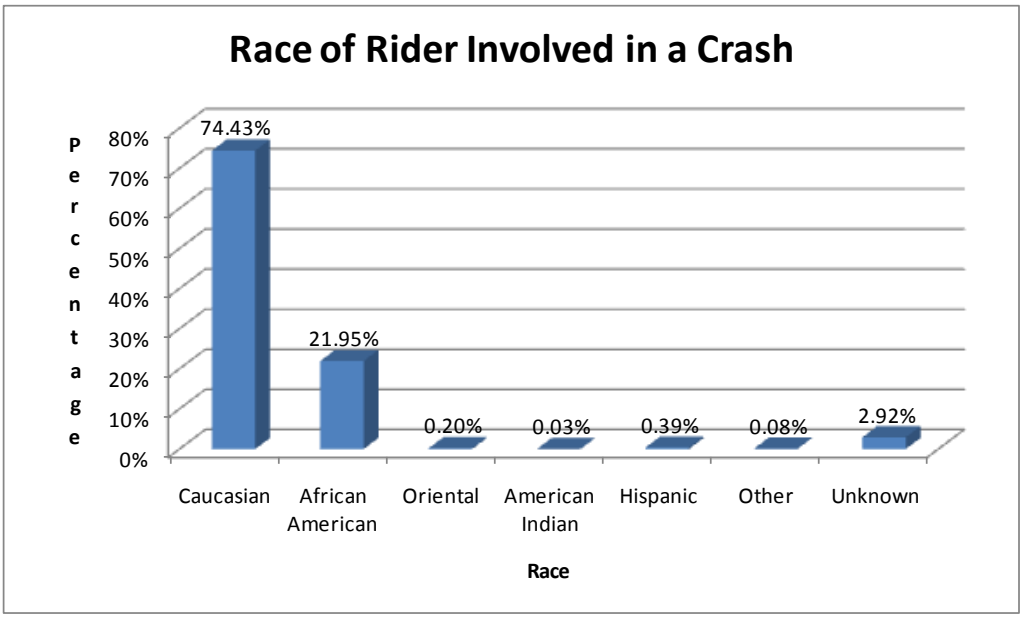

Figure 4-4 Distribution of Motorcycle Crashes by Race in the State of Alabama (1999-2008)

4.2.4. License State of Motorcyclist

Review of crash records for the period 1999-2008 indicates that 83.8% of motorcyclists involved in crashes possessed an Alabama license. Out-of-state motorcyclists involved in crashes in Alabama where registered with the states of Georgia, Florida, Mississippi, Tennessee, and Louisiana.

4.2.5. License Type

There are different types of licenses on which one can ride a motorcycle. In Alabama, you must be at least 14 years old to apply for a motorcycle license with an "M Class" designation. For 14 and 15 year olds, this license carries a "B" restriction for use on a motor-driven cycle. When one turns 16, the "B" restriction is removed when the rider returns to the driver's license office.

Table 4-2 shows the frequency of motorcycle accidents by corresponding license type. The "Not applicable" category refers to a second rider. DM D Operators are involved in 44% of the reported crashes and holders of D Operators License in 34%.

Table 4-2 Motorcycle Crashes and License Type in the State of Alabama (1999-2008)

Type of License	Number of Crashes
A Comb Vehicle Wt Gt. 26k or Tow Gt. 10k	282
B Sing Vehicle Wt Gt. 26k or Tow Lt 10k	70
C Sing Vehicle Wt Lt 26k or Tow Lt 10k	239
D Operators License	4,873
M Motorcycle	113
AM A Comb W Gt. 26k T Gt. 10 and Mot	677
BM B Single W Gt. 26k T Lt 10 and Mot	164
CM C Single W Lt 10k T Lt 10 and Mot	157
DM D Operators and Mot	6,376
Not Applicable	1,549
Unknown	416

4.2.6. Citation Record

Review of the motorcyclists' citation record history can provide some useful information on behavioral patterns of motorcyclists that may lead to crashes. Analysis of CARE motorcycle crashes in Alabama shows that in ninety five percent of cases there was no previous citation noted. When earlier records of citations existed, those mostly involved citations related to intoxication (driving under the influence (DUI) of alcohol) or to license (expired or no license). Figure 4-5 provides information on the types of citations recorded on motorcyclists involved in crashes in Alabama over the study period.

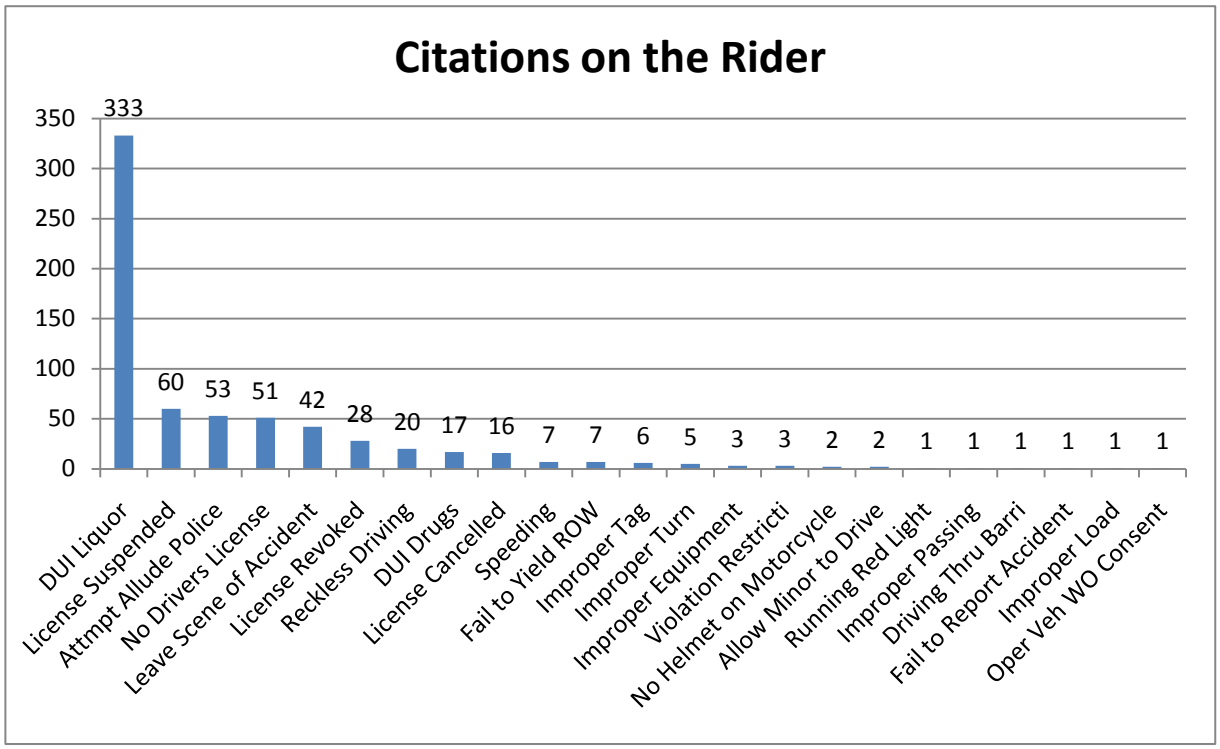

Figure 4-5 Types of Earlier Citations of Motorcyclists involved in Crashes in the State of Alabama (1999-2008)

4.3. Infrastructural Related

4.3.1. Geographical Distribution of Motorcycle Crashes

Knowledge of the geographic location of motorcycle crashes is important in indentifying areas with high concentrations of crashes where interventions may be needed. Using the automatic sampling features of ARC GIS and the motorcycle crash records available for the state of Alabama, a map was developed showing the frequency range of motorcycle crashes by county (Figure 4-6).

With more than 1,300 motorcycle crashes over the 10-year study period, Jefferson County is rated as the County with the highest motorcycle crash record followed by Mobile, Tuscaloosa, Montgomery and Madison Counties all of which reported 585 to 1,300 crashes.

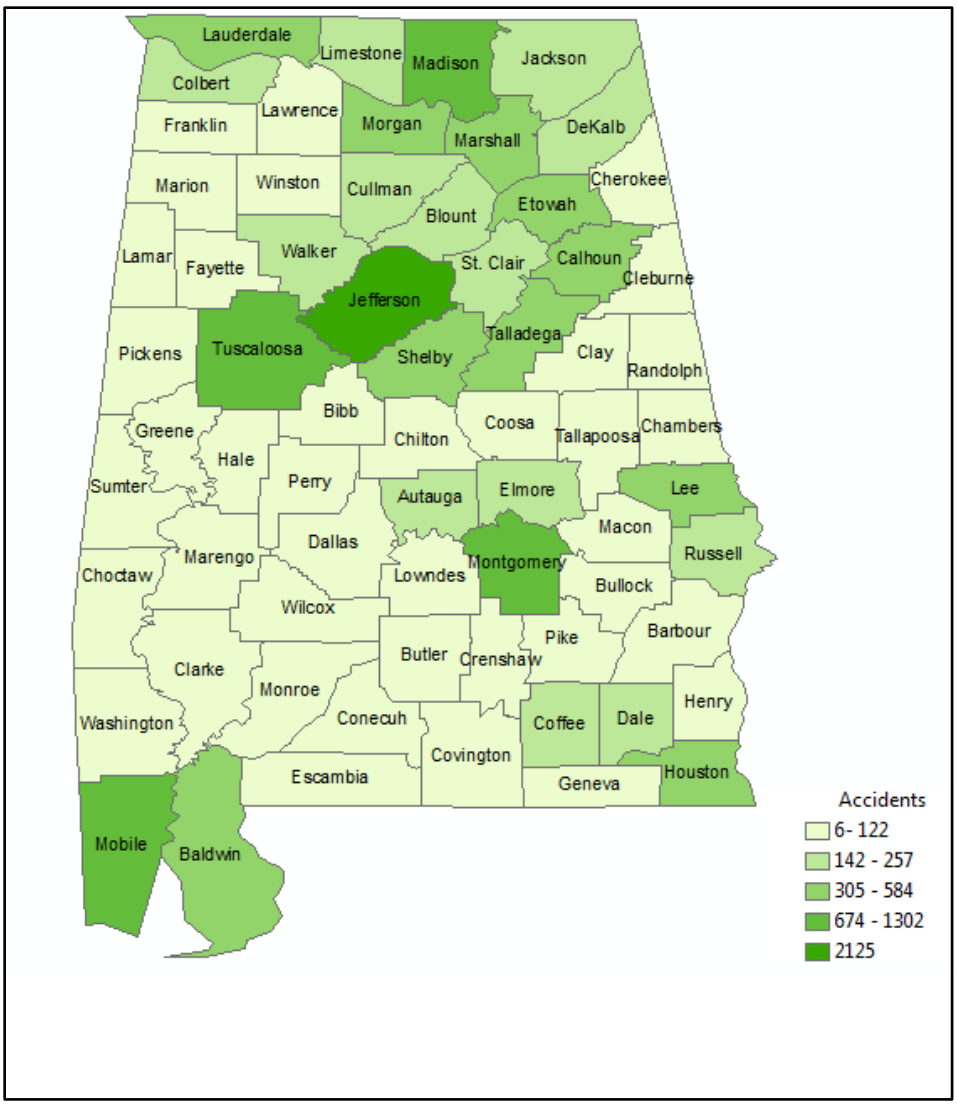

Figure 4-6 Classification of Alabama Counties based on Total Motorcycle Crashes (1999-2008)

It is expected that counties with a larger number of registered motorcyclists should likely experience a larger number of crashes as well. Thus a measure of exposure needs to be considered for a fair comparison. Using the number of motorcycle crashes available in CARE as one variable and the number of registered motorcycles by county obtained by the Alabama Department of Motor Vehicles (AL DMV) as another, Figure 4-7 was constructed showing the classification of Alabama Counties based on motorcycle crashes per number of registrations. Counties with the highest ratios of motorcycle

crashes to registrations include Mobile, Sumter, Greene, Wilcox, Lowndes, Montgomery, Bullock, Macon and Russell.

4.3.2. Development Zone

Development zone refers to whether the accident was located in urban or rural environment. The type of development (rural or urban) relates to the classification of roadway, speed, traffic mix, and emergency response to an accident, among other parameters. Analysis of the motorcycle records in the state of Alabama from 1999-2008 (Figure 4-8) indicates that that 40% of motorcycle crashes (or 5,776 accidents) occurred in rural settings where as the remaining 60% took place in urban regions.

4.3.3. Road Type

Analysis of motorcycle crash records for the state of Alabama shows that the vast majority of accidents involving motorcycles take place on municipal (28.6%) and county (27.1%) roads, Accidents on Interstate Highways account for only 5.7% of the total. Figure 4-9 provides the details.

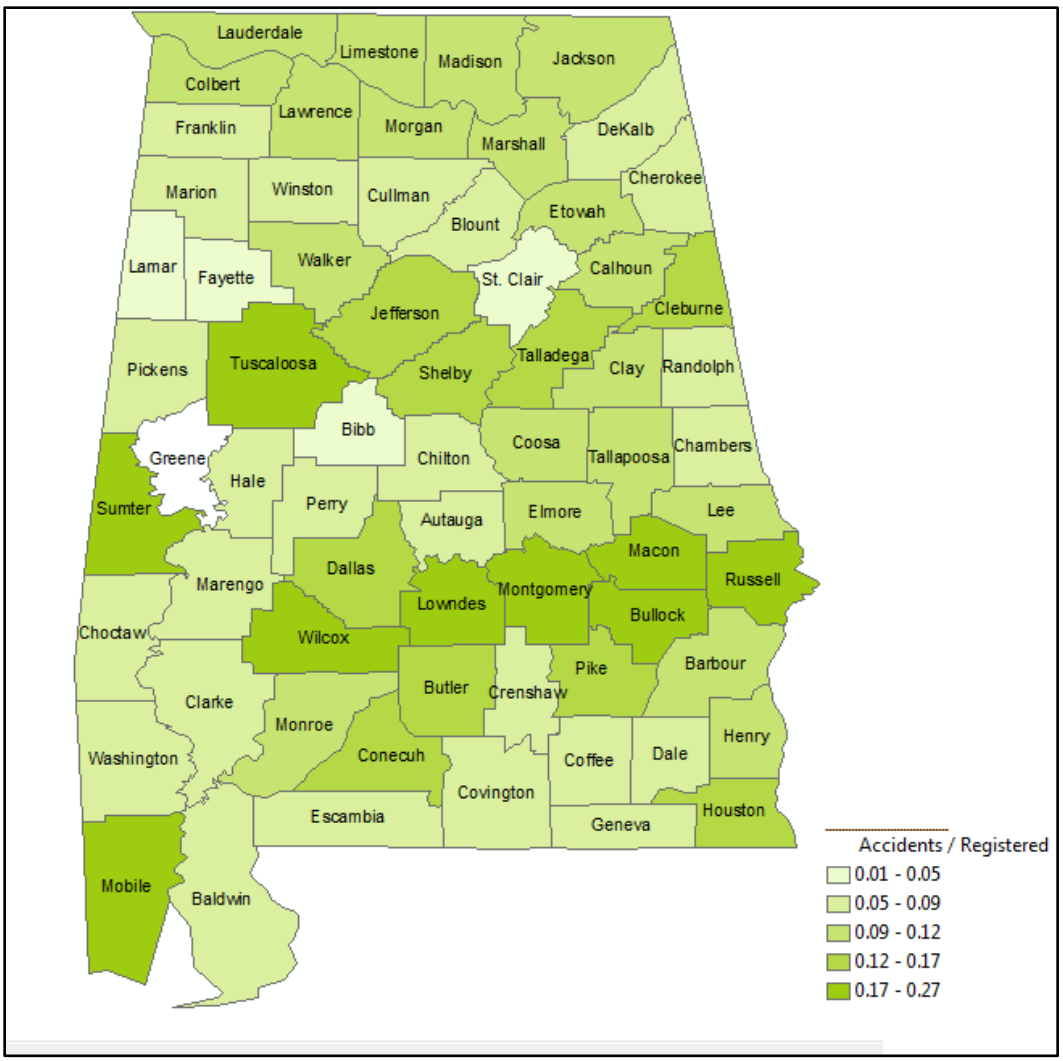

Figure 4-7 Classification of Alabama Counties based on Motorcycle Crashes per Number of Registered Motorcycles in 2008

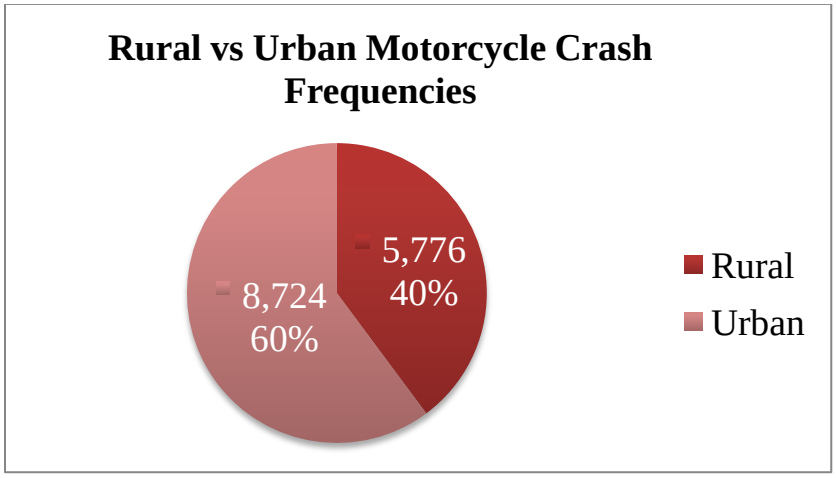

Figure 4-8 Classification of Motorcycle Crashes in the State of Alabama by Development Type (1999-2008)

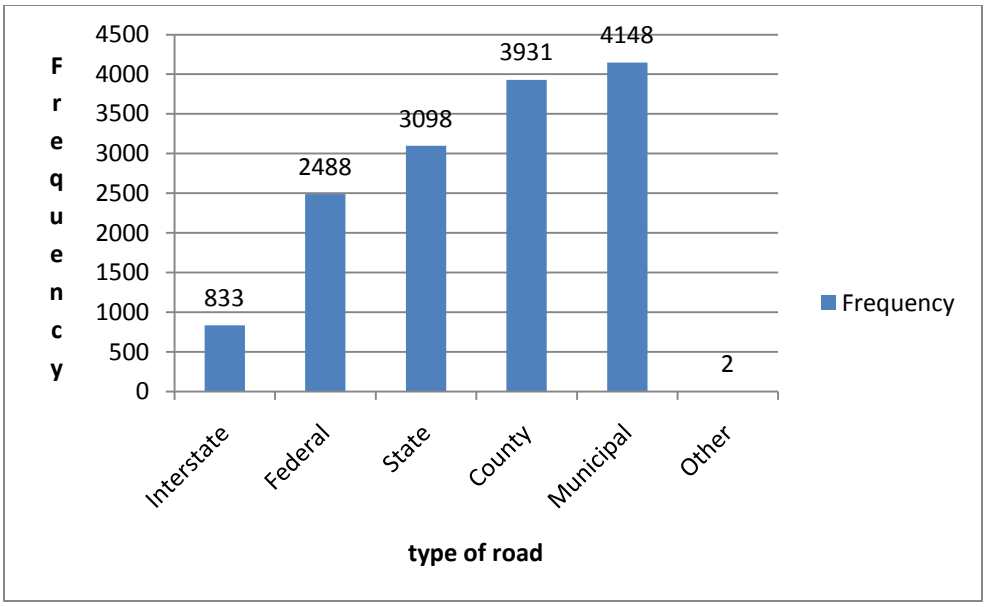

Figure 4-9 Distribution of Motorcycle Crashes in the State of Alabama by Road Type (1999-2008)

4.3.4. Crash Location on Road

This variable refers the exact location of the motorcycle accident (i.e., on-road, off-road, at intersection, on a median etc). The study results are summarized in Figure 4-10 and indicate that the majority of motorcycle crashes (58.7%) take place on the road way and followed by off-road crashes (20.5%), and crashes at intersections (19.7%).

4.3.5. Traffic Control

The presence and type of traffic control at motorcycle crash locations is considered in Table 4-3. The majority of motorcycle crashes took place at uncontrolled locations (53.1%), followed by non-passing zones (21.5%). Traffic signals and stop signs were present at nearly 12.2% and 8.6% of motorcycle accident sites, respectively.

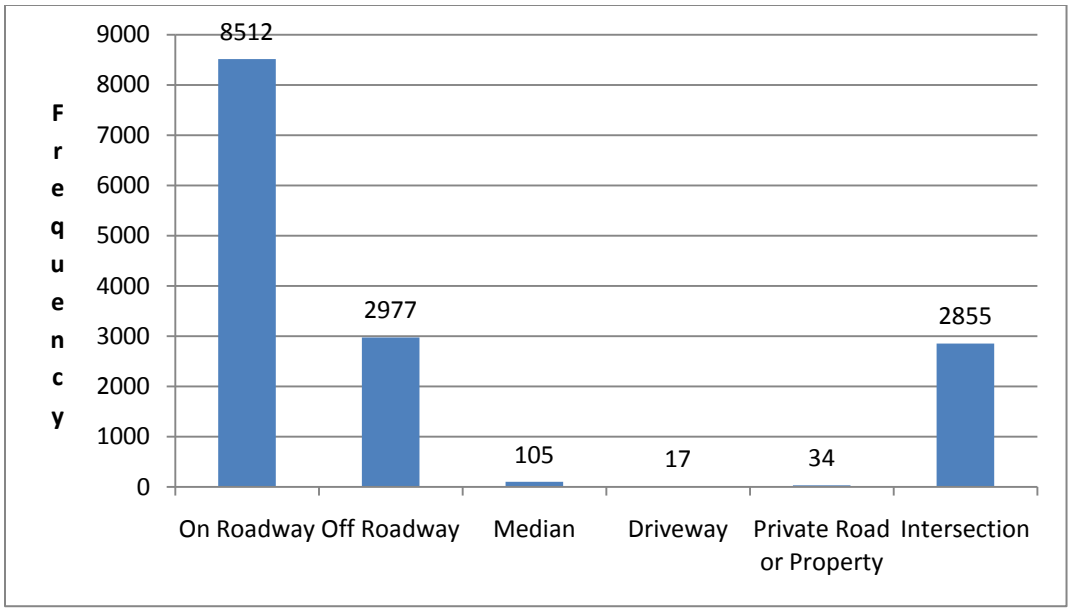

Figure 4-10 Motorcycle Crashes in the State of Alabama by Road Location (1999-2008)

Table 4-3 Type of Traffic Control at the Location of Motorcycle Crashes

Type Of Control	Frequency	Percentage
None	7,703	53.12%
No Passing Zone	2,974	20.51%
Traffic Signal	1,767	12.19%
Stop Sign	1,246	8.59%
Null	237	1.63%
Lane Control Device	206	1.42%
Yield Sign	148	1.02%
Other	84	0.58%
Police Officer	52	0.36%
Flashing Beacon	46	0.32%
RR Flashing Lights	12	0.08%
Flagger	9	0.06%
RR Cross Gates	6	0.04%
RR X Blocks or Pave Mark	5	0.03%
Pedestrian Control	5	0.03%

4.3.6. Distance from Residence to the Location of Incident

Seventy eight percent of reported motorcycle crashes are within 25 miles of the residence of rider. This indicates most of the time incidents take place in an environment that is likely to be familiar to the motorcyclists.

4.3.7. Type of Motorcycle

Motorcycles are broadly classified in to three categories, i.e. cruiser, dirt bike and sports bike depending upon their characteristic and performance. Dirt bikes have smaller displacement, weight and very high power. Sports bikes have less power but bigger displacement and weight. Cruisers have much more weight, bigger displacement and lesser power.

In Alabama total crashes for different motorcycles from 1999-2008 is shown in the Table 4-4.

Table 4-4 Total Crashes to different makes of Motorcycles

Make of Motorcycle	1999 - 2008	2008
Honda	3550	324
Harley Davidson	3296	294
Suzuki M	2718	313
Yamaha M	1932	217
Kawasaki M	1443	128
BMW	161	15

Motorcycle sales statistics 2008 (14) in Alabama indicates most of Harley Davidson motorcycles are cruisers, Kawasaki and Yamaha motorcycles are mostly sports bikes and Suzuki models are mostly dirt bikes. Honda manufactures all kinds of motorcycles. From this information it can be inferred that the number of motorcycle crashes in Alabama is not depended on the types of motorcycles.

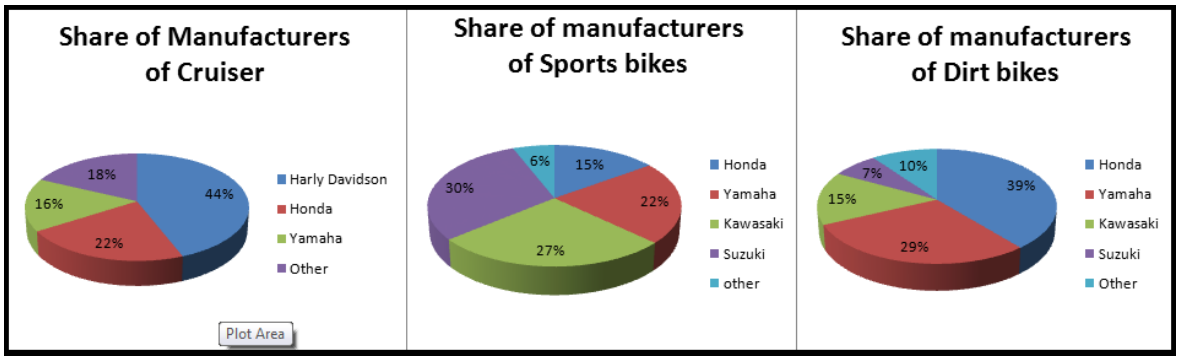

Figure 4-11 Share of Different Manufacturers for Different Types of Motorcycles

4.4. Environmental Conditions

4.4.1. Time of the Day

Figure 4-12 presents the distribution of motorcycle crashes in the state of Alabama from 1999-2008 by time of the day. It can be seen that the frequency of motorcycle crashes is highest during the afternoon peak (from 3:00 to 7:00 PM). Lower than average crash frequencies are observed during night conditions (from 9:00PM to 7:00 AM).

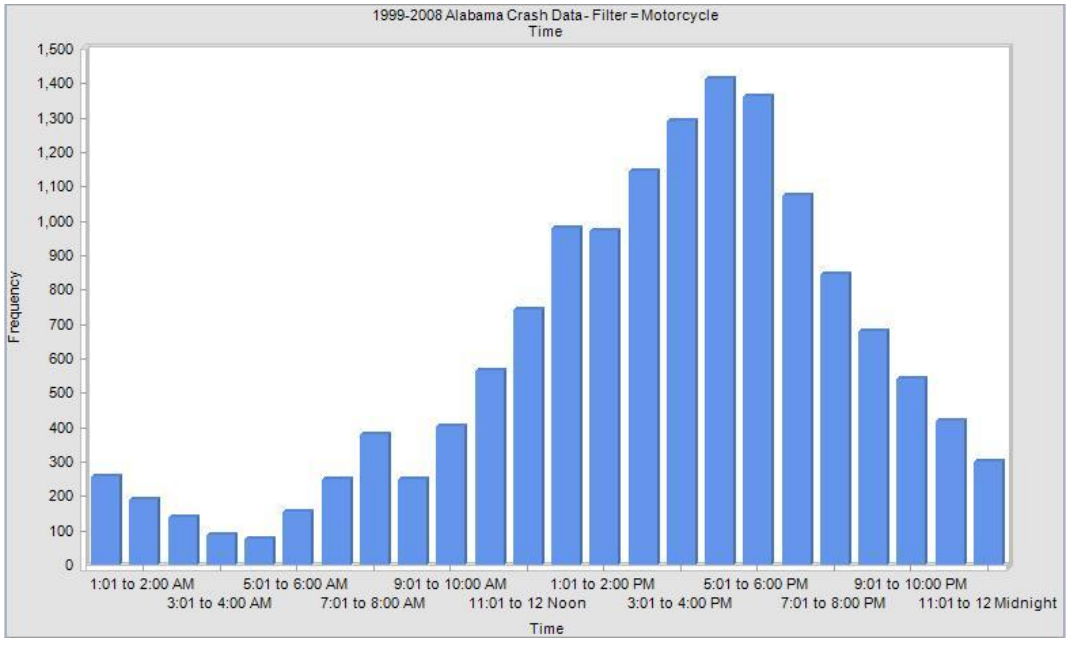

Figure 4-12 Motorcycle Crashes in the State of Alabama by Time of Day (1999-2008)

4.4.2. Day of Week

As expected, motorcycle crash frequencies peek during the weekends. On regular work days, the number of motorcycle crashes is fairly consistent with some higher rates reported on Fridays. Figure 4-13 summarizes the findings from the analysis of motorcycle records for the state of Alabama over the 10 year study period.

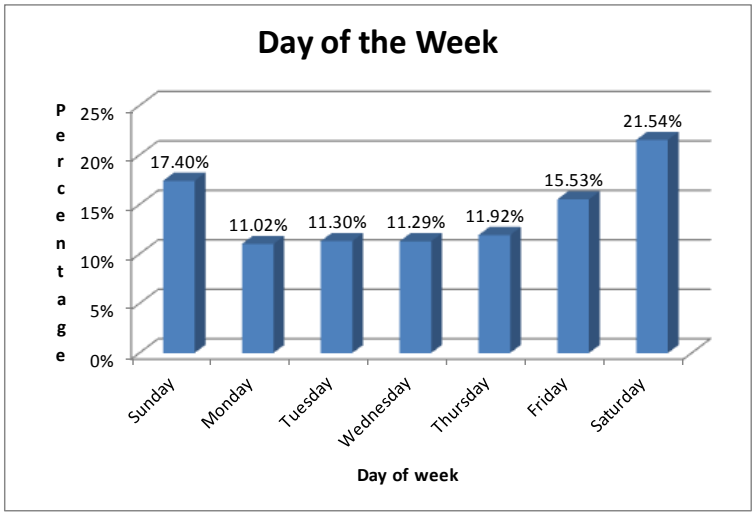

Figure 4-13 Motorcycle Crashes in the State of Alabama by Day of the Week (1999-2008)

4.4.3. Month of Year

As Figure 4-14 indicates the frequency of motorcycle crashes increases during the warm months of the year (April through October) when the ridership is also higher. Inclement weather during winter months deter motorcycle use, thus leading to lower number of motorcycle crashes as the state-wide motorcycle crash database analysis confirms.

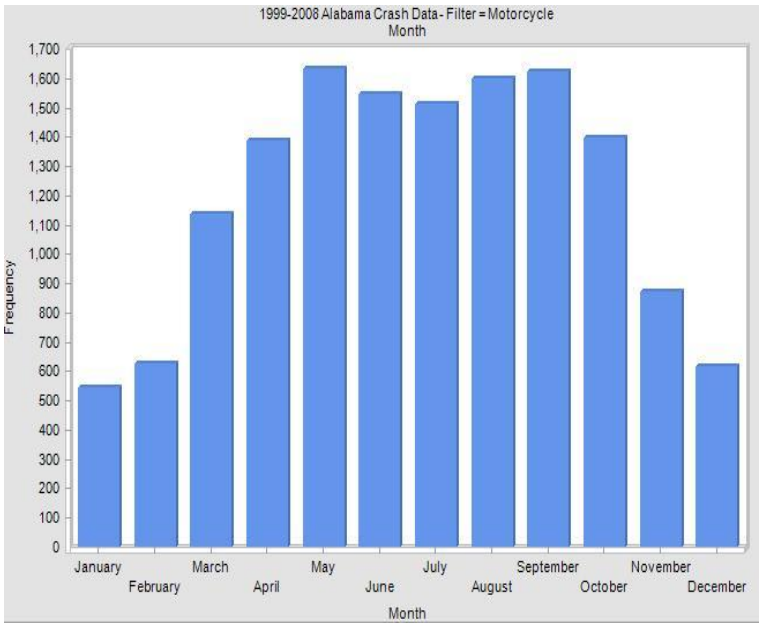

Figure 4-14 Motorcycle Crashes in the State of Alabama by Month (1999-2008)

4.4.4. Weather Condition

Adverse weather conditions are often considered as a contributing factor to traffic accidents. Analysis of the motorcycle crash records in the state of Alabama from 1999 to 2008 indicates that over seventy eight percent of motorcycle crashes took place under clear weather conditions (Figure 4-15). Moreover, eighteen percent of accidents occurred on cloudy day while rain was involved only in 3 percent of crashes reported.

4.5. Human Factors

Human factors considered in the analysis refer to the behaviour of the motorcyclist while riding. These factors include condition of rider, intoxication of rider while riding and manoeuvre of riders involved in incidents.

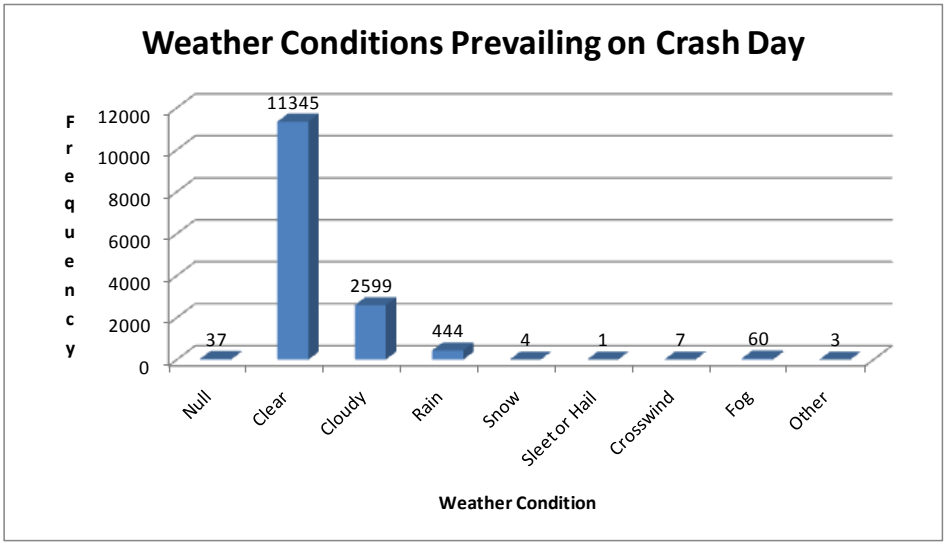

Figure 4-15 Weather Conditions during Motorcycle Crashes in the State of Alabama (1999-2008)

4.5.1. Condition of Motorcyclists at the Time of the Crash

Review of the motorcycle crash reports indicates that an overwhelming 88.85% of motorcycle riders involved in accidents appeared normal (Table 4-5). A tiny fraction of motorcyclists reportedly were fatigued, or ill (0.17% each) while 0.11% riders fell asleep while driving.

Table 4-5Condition of Motorcyclist when involved in Crashes

Condition of Motorcyclist	Crash Frequency	Percentage
No Defect	12,881	88.83%
Apparently Asleep	16	0.11%
Fatigued	25	0.17%
Ill	25	0.17%
Other	285	1.97%
Unknown	1,268	8.74%

4.5.2. Intoxication of Motorcyclist Involved in Crash

Based on police officers accounts from the crash scene, no form of rider intoxication was reported in nearly 85% of motorcycle crashes. Figure 4-16 showcases the relationship between type of intoxication and crash severity. The study crash records indicate that in

5.16% of crashes the motorcyclist was drunk, while riders on drugs and both on drugs and alcohol influence accounted for 0.22% and 0.30% of accidents respectively. These figures are lower than the national average, a fact that may point to a likelihood of underreporting of intoxication of riders involved in motorcycle crashes in the state of Alabama.

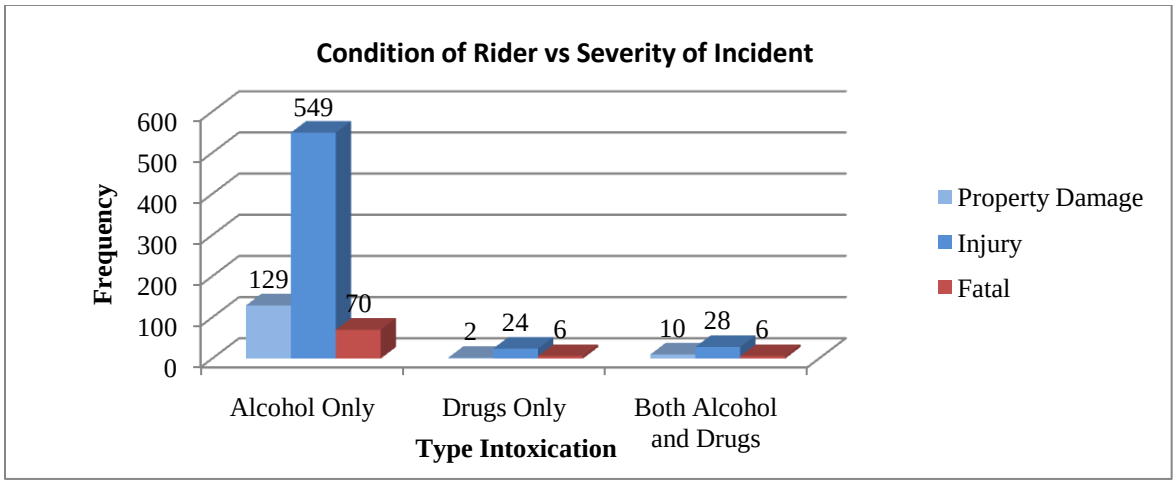

Figure 4-16 Intoxication and Motorcycle Crash Severity in the State of Alabama (1999-2008)

4.5.3. Manoeuvre of Motorcycle at the Time of the Crash

As shown in Table 4-6Analysis of motorcycle records in Alabama shows that the majority of motorcycle crashes happen while going straight (57.2%). This fact implies that driver inattention or other human factors may be more relevant to the crash than road geometry or roadway design factors. Approximately 13.3% crashes occur as motorcycles are turning left turn and 6% while slowing down or stopping. In comparison, national statistics indicate that 38% of crashes happen while going straight, 26% are crashes with fixed object and only 4% crashes occurred while turning left.

Table 4-6 Type of Vehicle Maneuver at the Location of Motorcycle Crashes

Value	Frequency	Percentage
Go Straight Ahead	8,299	57.23%
Left Turn	1,924	13.27%
Slowing or Stopping	882	6.08%
Exiting Private Rd or Prop	447	3.08%
Right Turn	433	2.99%
Avoid Object in Road	336	2.32%
Start in Traffic	309	2.13%
Pass on Left	286	1.97%
Change Lanes Left	211	1.46%
Unknown	191	1.32%
Change Lanes Right	180	1.24%
Other	162	1.12%
Backing	161	1.11%
Wrong Side of Road	158	1.09%
U-turn	106	0.73%
Pass on Right	87	0.60%
Merge Left	81	0.56%
Merge Right	69	0.48%
Stopped in Traffic	65	0.45%
Start From Park	30	0.21%
Go Straight in Right T Lane	26	0.18%
Go Straight in Left T Lane	18	0.12%
Parked Illegally	13	0.09%
Wrong Way on One Way	8	0.06%
Bicycle Across Road	6	0.04%
Parked Legally	4	0.03%
Bicycle With Traffic in Rd	3	0.02%
Enter Parked Position	2	0.01%
Pass on One Way St	1	0.01%
Bicycle in Bike Path	1	0.01%
Pushed By Pedestrian	1	0.01%

4.6. Motorcycle Rider Profile

The study of over 14,700 motorcycle accidents that occurred from 1999 to 2008 in the state of Alabama revealed the factors and conditions that were present during the crash occurrence. Considering the results of the analysis that were presented earlier in

this chapter an attempt is made to develop the profile of a typical motorcyclist involved in a motorcycle crash based on historical records. The characteristics of this typical profile are as follows:

White, male rider in his twenties, helmeted, sober at the time of the crash, from the state of Alabama riding on a straight path within 25 miles of his residence on a municipal road in a rural setting in the afternoon under clear weather conditions.

While the description above certainly does not cover all possible scenarios, it does provide some understanding on the most pertinent characteristics of motorcycle users that appear most commonly in motorcycle crash in the state of Alabama. The motorcyclist profile developed above can be used when considering countermeasures to reduce the severity and frequency of motorcycle crashes as well as when designing and delivering education programs to promote traffic safety practices among motorcycle users in Alabama.

5. JEFFERSON COUNTY MOTORCYCLE CRASH DATA ANALYSIS AND RESULTS

The analysis of state-wide data in Chapter 4 indicated that Jefferson County experienced the largest number of motorcycle crashes during the study period. Thus a filter was used to obtain the motorcycle crashes for Jefferson County over the 1999-2008 time period and additional analysis was performed with this subset of data to determine whether conditions or rider behaviour in Jefferson County differed, compared to the rest of the state. A total of 2,125 crash records were analysed and the results are summarized next.

5.1. Background Information

Figure 5-1 shows the number of accidents in each year in Jefferson County for the study period from 1999 to 2008. It can be observed from the results that the motorcycle accidents followed an increasing trend since 2000 but have stabilized in the recent years (2005 to 2008).

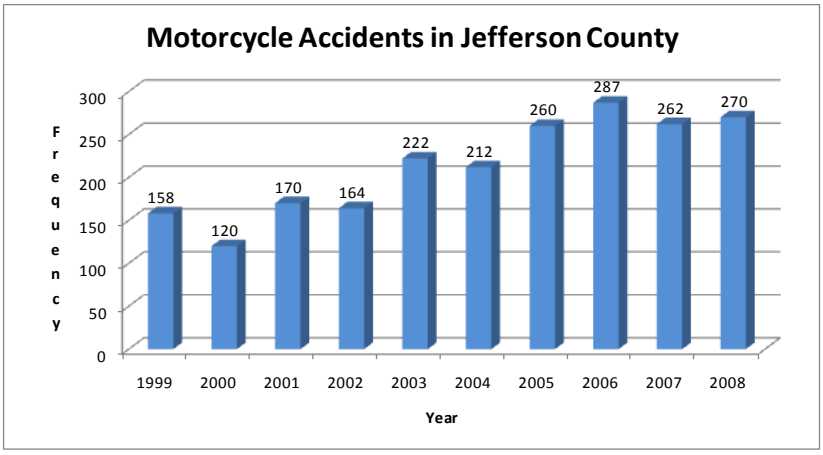

Figure 5-1 Number of Motorcycle Crashes in Jefferson County (1999-2008)

Figure 5-2 provides information on the severity of reported crashes in Jefferson County. The data show that fatal accidents constitute 1.2-4.9% of the total crashes, injury-related represent 57.8%-71.5% of total and property damage only account for the remaining 26.6-37.6%. It should be noted that Jefferson County experiences a lower percentage of fatal motorcycle crashes when compared to state-wide results.

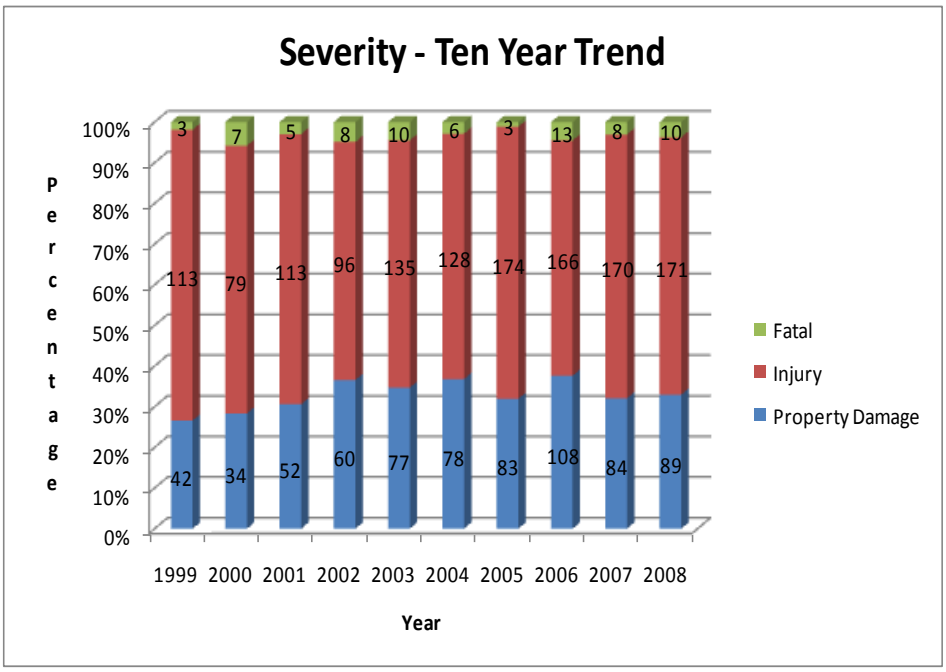

Figure 5-2 Severity of Accident in Each Year in Jefferson County

5.2. Demographics

The analysis of Jefferson County crash records over the 10-year study period shows that motorcyclists who are 16 to 30 years of age are involved in 38% of all motorcycle crashes reported. The 26-30 years old age group is leading the way (13% of total), followed by the 21 to 25 year olds (12%). Overall, a slight shift toward older

motorcyclists involved in crashes is observed in Jefferson County, as compared to the state-wide data.

Similar to the statewide analysis results, 78.6 % of motorcyclists involved in crashes were male. As far as race is concerned 56% of motorcyclists were white and 38% African Americans. These numbers are statistically different that those reported for the state of Alabama where white motorcyclists were involved in over 74% of crashes and African Americans in 22%. Thus African American motorcyclists are over represented in crashes reported in Jefferson County over the study period.

Figure 5-3 shows the different types of earlier citations and frequencies of such cases in Jefferson County from 1999 to 2008. Contrary to the statewide results, the citations were overwhelmingly focused on DUI's, in Jefferson County driving with a suspended license was cited most frequently, closely followed by DUI alcohol citations.

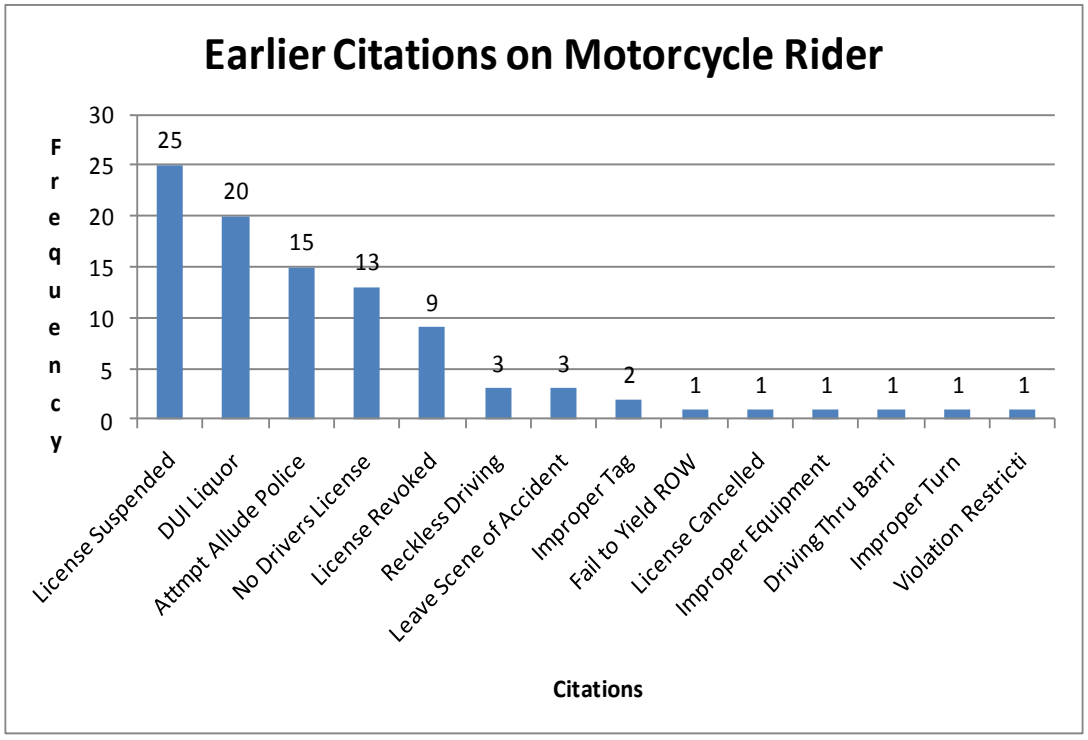

Figure 5-3 Types of Earlier Citations on Riders Involved in Motorcycle Crashes in Jefferson County (1999-2008)

5.3. Infrastructure

Figure 5-4 shows the location of all motorcycle crashes that occurred in Jefferson County over the 10-year study period. It can be seen that the City of Birmingham City is over represented in the Jefferson County compared to other regions contributing 934 motorcycle crashes (46% of total). An additional 420 crashes occurred in rural areas of Jefferson County, and 171 and 100 crashes were reported in the cities of Bessemer and Hoover, respectively.

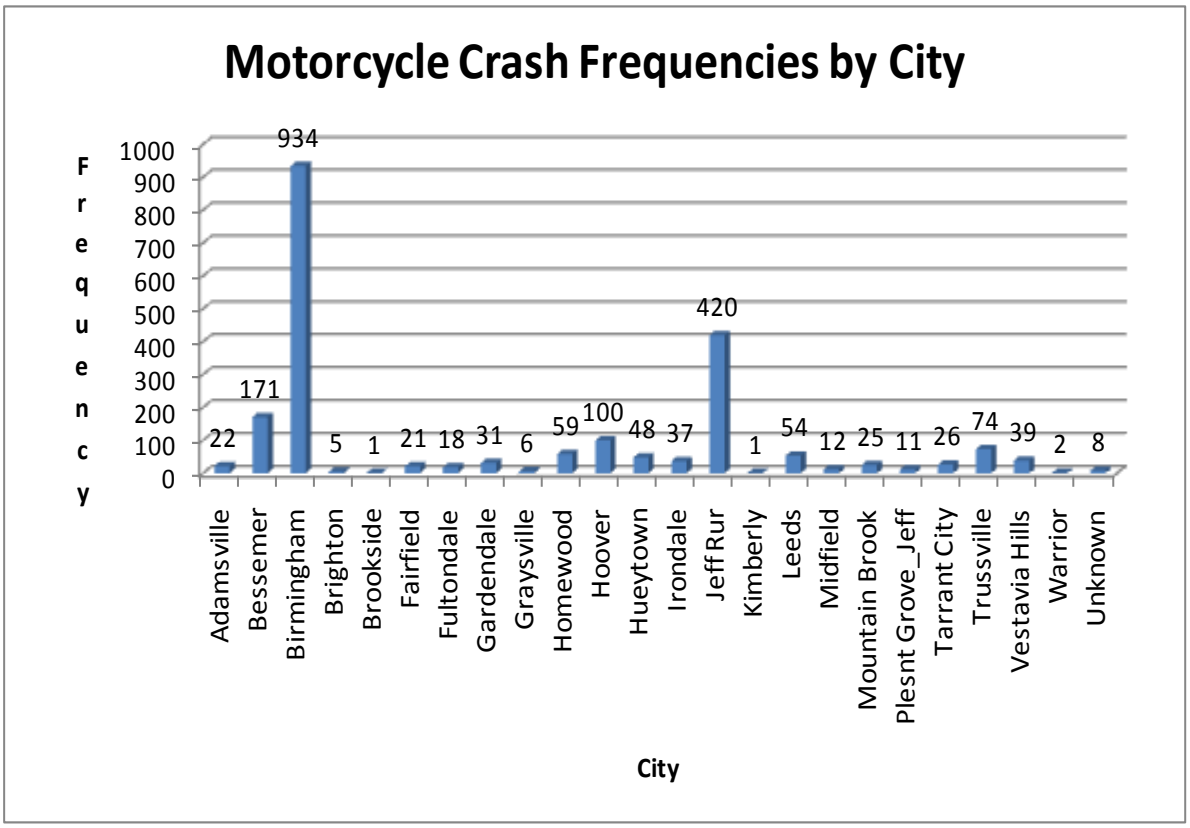

Figure 5-4 Jefferson County Motorcycle Crash Frequencies by City (1999 - 2008)

In Jefferson County motorcycle crashes that took place in urban regions outnumbered rural ones 4 to 1 (Figure 5-5). As was anticipated, more motorcycle crashes

in Jefferson County occurred in urban settings (80.2%) compared to the statewide statistics (60% urban).

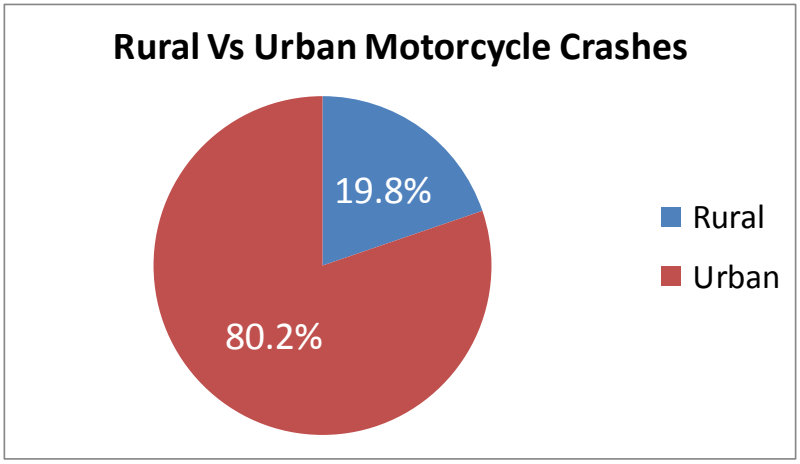

Figure 5-5 Classification of Motorcycle Crashes Jefferson County by Development Type (1999 - 2008)

As far as road type is concerned, 43.1% of Jefferson County motorcycle crashes occurred on municipal roads, followed by county roads (21.3%). Motorcycle crashes on Interstates accounted for 11.5%, or twice the state-wide average. Figure 5-6 shows the distribution of motorcycle crashes by road type.

It should be also mentioned that the majority of road accidents in Jefferson County (1,304 crashes, or 61%) occurred on the roadway, 478 (or 22%) at intersections and 322 were off-road crashes (15%).

The majority of motorcycle crashes took place at uncontrolled locations (59.4%). Traffic signals and stop signs were present at nearly 18% and 9.3% of motorcycle accident sites, respectively.

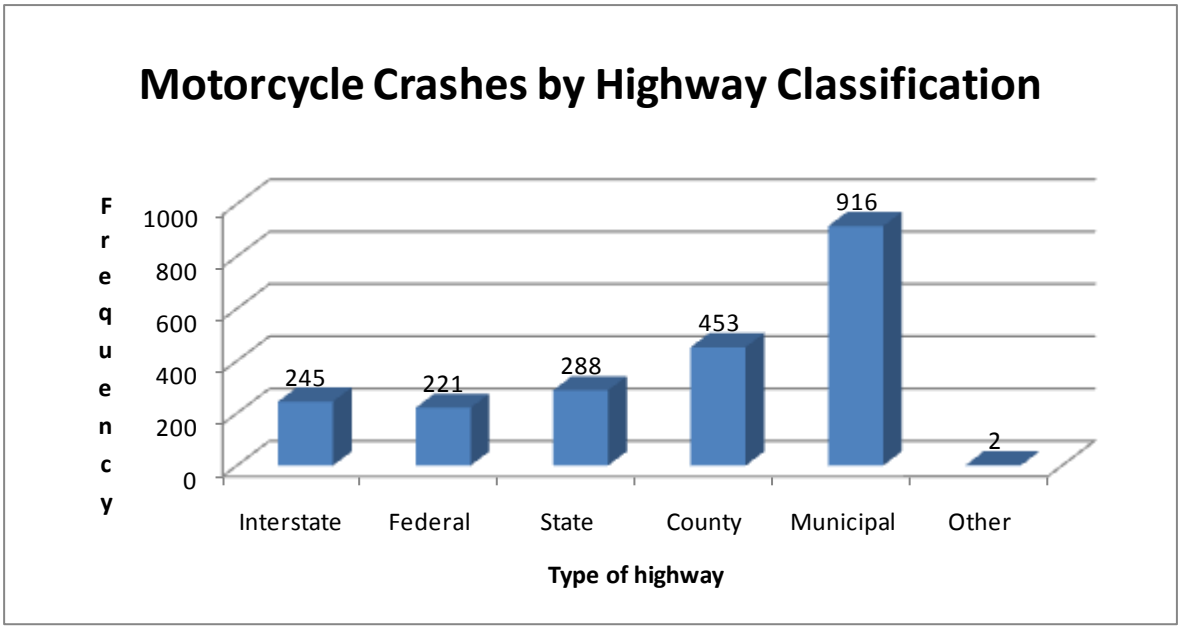

Figure 5-6 Distribution of Motorcycle Crashes in Jefferson County by Road Type (1999-2008)

5.4. Environmental Conditions

Figure 5-7 shows the distribution by time of day of motorcycle crashes for Jefferson County from 1999 to 2008. It can be seen that the distribution follows the same general trend than that of the state wide data with more crashes occurring during the 4pm to 5pm peak.

The distributions of motorcycle crashes in Jefferson County per day of the week and month of the year are nearly identical to that observed from the state-wide crash analysis (Figures 5-8 and 5-9). The same is true as far as weather-related factors are concerned.

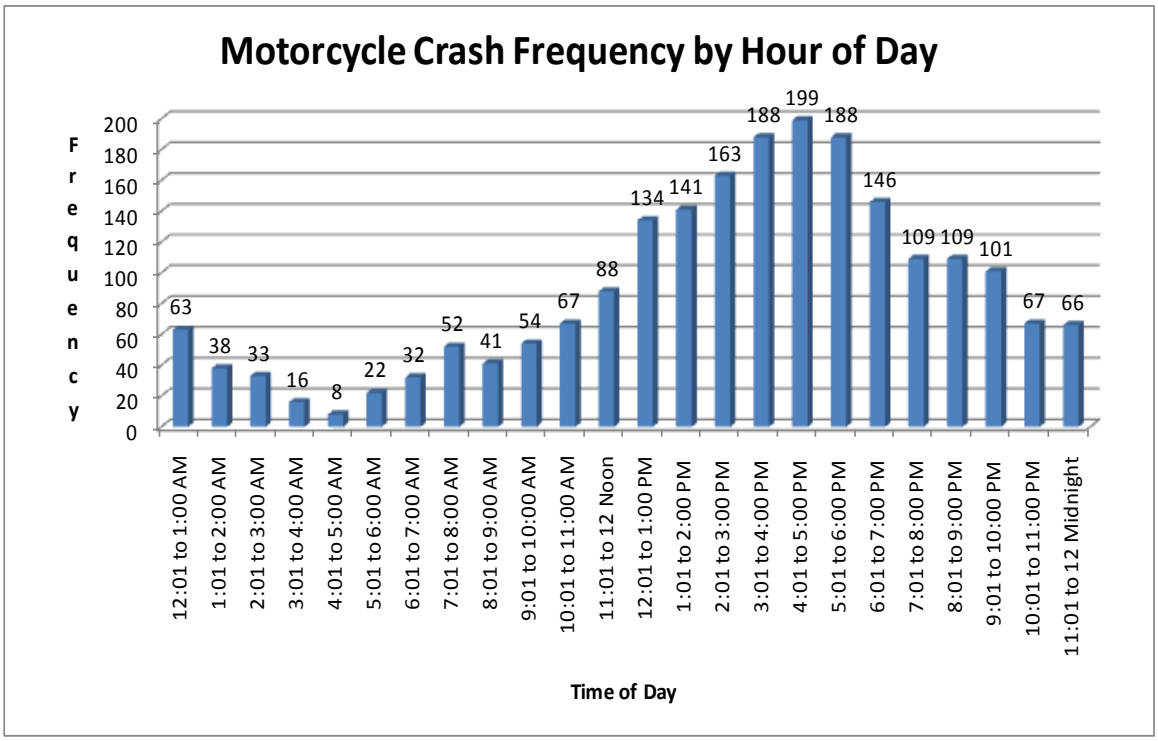

Figure 5-7 Motorcycle Crashes in Jefferson County by Time of Day (1999-2008)

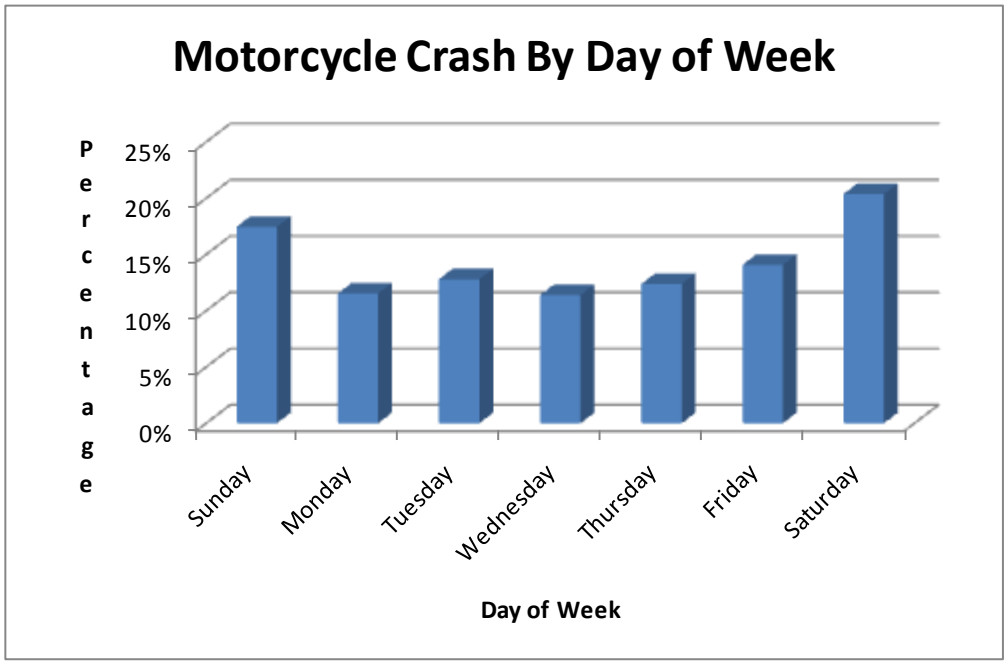

Figure 5-8 Motorcycle Crashes in Jefferson County by Day of the Week (1999-2008)

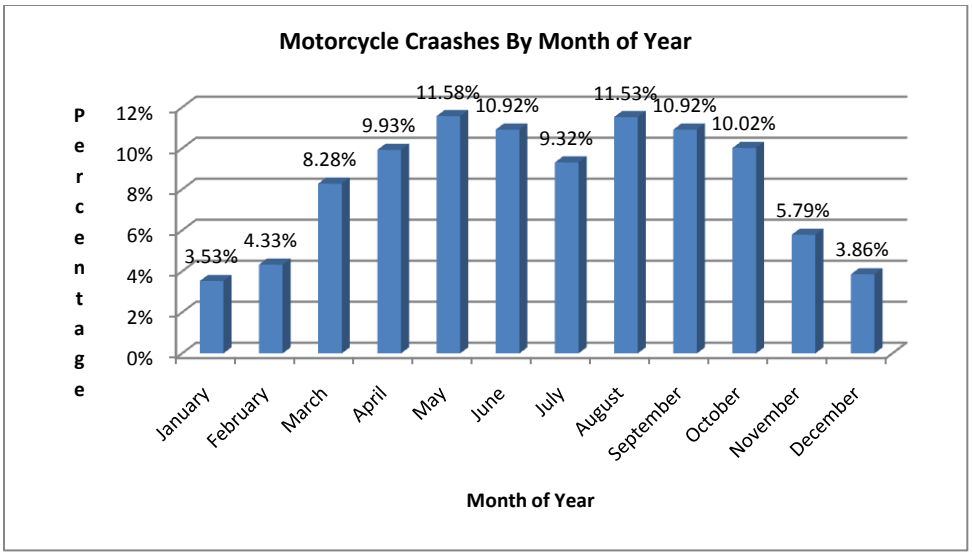

Figure 5-9 Motorcycle Crashes in Jefferson County by Month (1999-2008)

5.5. Human Factors

As shown also in the state-wide motorcycle crash analysis, analysis of Jefferson county records over the 10-year study period indicates that motorcyclist condition (i.e. fatigue, illness, or drowsiness) played no significant role in the crashes considered. Moreover, consistency between state and county records was observed when considering the maneuver leading to the crash. Once again, the majority of motorcycle crashes in Jefferson County happen while going straight (54.7%), while approximately 13.9% crashes occur as motorcycles are turning left turn and 6.3% while slowing down or stopping.

5.6. Discussion

The study of 2,125 motorcycle crash records for the Jefferson County for the period 1999 to 2008 revealed the conditions and factors that were present during the crash occurrence. Whereas some differences were observed between state and Jefferson

County demographic and infrastructure-related factors as noted earlier, environmental conditions and human factors were pretty consistent.

The typical motorist profile involved in motorcycle crashes developed for the state of Alabama also applies to the Jefferson County riders. However, one should recognize that African American riders are overrepresented in Jefferson County, and that slight older motorcyclists are involved in Jefferson County crashes, as compared to the state-wide data.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1. Summary and Conclusions

Review of motorcycle crash historical trends in the state of Alabama shows that the number of crashes increased threefold over the past decade. This is an alarming fact that requires immediate attention. To gain a better understanding of the magnitude of the problem and contributing factors, this project performed an analysis of motorcycle crash records for the state of Alabama, and Jefferson County, in particular for the period 1999 to 2008. The analysis used simple statistical techniques and focused on demographic, infrastructure, environmental and behavioral factors contributions to motorcycle accident occurrence. A total of 14,775 motorcycle crash records were considered in the statewide analysis and 2,125 in the analysis of Jefferson County motorcycle crash records. In summary, the state-wide analysis performed in this study revealed the following:

- The number of motorcycle accidents has been increasing steadily in the last decade and more than doubled during the study period (from 854 in 1999 to 2,044 in 2008).
- Fatal motorcycle crashes represented 3.4-5.2% of total, personal injury accounted for 64.6-67.5%, and property damage only was present in 28.8-31.0% of crashes.
- There are four times more male motorcyclists involved in a crash than females. However, given the lower number of women riders, females are still overrepresented as far as crashes are concerned.

- 1,300 motorcycle crashes over the 10-year study period, Jefferson County is rated as the County with the highest motorcycle crash frequency followed by Mobile, Tuscaloosa, Montgomery and Madison Counties.
- When exposure is taken under consideration Counties with the highest ratios of motorcycle crashes to registrations include Mobile, Sumter, Greene, Wilcox, Lowndes, Montgomery, Bullock, Macon and Russell.
- 40% of motorcycle crashes occurred in rural settings where as the remaining 60% took place in urban regions.
- The majority of motorcycle crashes occur during daylight hours and the peak of crash incidence coincides with the afternoon traffic peak (4-6 PM).
- Motorcycle crash occurrence is significantly higher over the weekend (21.5% on Saturday as compared to 11.4% on a typical week day).
- Geometric and weather conditions as well as the condition of the rider at the time of the crash appear to have little effect on motorcycle crash occurrence in the state of Alabama
- Intoxication of the motorcyclist was reported in less than 6% of motorcycle crashes. The intensity of crashes increases dramatically when intoxication is present.
- Rural parts of the State are more dangerous in terms of motorcycle safety than urban parts of State. The ratio of rural to urban motorcycle crashes is three to two.

The analysis of Jefferson County motorcycle crash records for the period 1999 to 2008 revealed many similarities to the statewide analysis. As expected, urban crashes were overrepresented in Jefferson County. The city of Birmingham, Bessemer, and Hoover experienced to highest numbers of crashes involving motorcycles. Another finding was that African American riders were overrepresented in Jefferson County, and

that slight older motorcyclists are involved in Jefferson County crashes, as compared to the state-wide data. These differences need to be taken under consideration when customizing interventions for the population at-risk.

Overall the analysis confirmed the need for action and identified contributing factors to motorcycle crashes. Through education, enforcement, outreach, and legislation, the state of Alabama should intensify its efforts to prevent motorcycle crashes, prevent injury when a crash occurs, and reduce the seriousness of injury after a crash. It is recommended that initiatives should be undertaken that will foster motorcycle rider education and licensing; reduction of the number of impaired motorcyclists; increase of motorist awareness of motorcycles; and increase of helmet use and enforcement.

6.2. Recommendations

Largely adopted from the National Agenda for Motorcycle Safety proposed by NHTSA, the following paragraphs provide a set of recommendations that can assist us to understand the motorcycle safety problem better and implement actions leading to a reduction of motorcycle crashes in the state of Alabama in the future.

Expand Research Efforts

While there is a substantial body of work relating to motorcycle safety in the United States and abroad, few of these studies, research projects, or statistical reports were done in coordination with one another. This renders an incomplete picture of motorcycle safety nationwide and in the State of Alabama in particular. A detailed causation study needs to be funded in the state of Alabama to investigate in depth the

motorcycle safety problem in Alabama, identify at-risk populations and develop recommendations for potential improvements.

Convey Research Information to Users

In addition to acquiring information about motorcycle crashes and safety, there is a need to disseminate information to those who need it most: motorcyclists and those who influence motorcycle safety. Toward this goal, it is recommended that the state of Alabama does the following:

- Create a clearinghouse to distribute current, practical information about motorcycle safety based on recent research.
- Develop research-based safety information that can be used easily by the consumer media and in rider education and training systems.
- Explore public service announcements, advertising in enthusiast and near-enthusiast media, and any other viable avenues for distributing safety information.

User Attitudes

The safety of motorcyclists is affected by their attitudes toward skill development, their ability to practice risk management, and the influence of their riding peers regarding such issues as protective apparel and riding while impaired. Thus it is recommended that future work focuses on:

- Study of factors that affect and shape motorcyclists' attitudes and behavior and how they affect crash involvement.

- Using information about how motorcyclists form attitudes about safety issues, create programs that reduce dangerous behavior and reinforce safe behavior.

Rider Education and Training

Motorcycle rider education and training comprise the centerpiece of a comprehensive motorcycle safety program. The challenges are to get motorcyclists to take training and to keep quality rider training affordable and accessible to all interested parties. To address such challenges it is recommended that the State of Alabama:

- Expands motorcycle safety programs to accommodate all who need or seek training.
- Conducts uniform follow-up research into the effectiveness and impact of rider education and training.
- Merges rider education and training and licensing functions to form one-stop operations.
- Increases the number of states conducting Motorcycle Safety Program Assessments.
- Establishes benchmarks for rider education and training effectiveness and program operation excellence.
- Explores the effectiveness of on-street training.
- Mandates certification for instructors, similar to other thirty four states in US.
- Updates the process to modify curricula, The Alabama process involves a six step procedure unlike many states which follow a decision by a single department, which makes the process simpler and more flexible.

Licensing

Compared to other states Alabama has fewest licensed riders per capita (0.04%) and more motorcycles registered (1% to1.9%) (15). This indicates the necessity of comprehensive, fair, and effective motorcycle operator testing and licensing systems that are used to measure the readiness of riders to ride safely. Toward this goal the state of Alabama should:

- Develop a procedure for a riding test required in addition to the current knowledge test for issuing the motorcycle endorsement.
- Develop and implement programs to allow the state motorcycle safety programs to issue motorcycle endorsements immediately upon successful completion of rider training courses.
- Enforce penalties for operating a motorcycle without a proper endorsement.
- Provide motorcycle specific training to license examiners administering testing for motorcyclists.
- Develop an enhanced motorcycle licensing model and evaluate its effectiveness.

Impairment Issues

Alcohol continues to be a prominent factor in serious motorcycle crashes. Other substances and causes of impairment, including prescription drugs, over-the-counter drugs, illegal recreational drugs, environmental factors, and drowsiness, are unknown factors in motorcycle crashes. The following recommendations are offered for potential adoption.

- Study how alcohol, drugs and other substances, including over-the-counter medications, can affect a motorcyclist's operating skills.
- Study the alcohol, drug and other substance use patterns of motorcyclists.
- Continue to discourage mixing alcohol and other drugs with motorcycling.
- Educate law enforcement about unique alcohol-related behavior of motorcyclists.
- Encourage partnerships with groups already involved in alcohol/substance abuse issues related to motor vehicle crashes, e.g., Mothers Against Drunk Driving (MADD), Students Against Destructive Decisions (SADD).

Protective Gear

The protective apparel worn by a motorcyclist provides the only defense against injury in a crash. This apparel includes a Federal Motor Vehicle Safety Standard (FMVSS) 218 compliant helmet, heavy-duty jacket and pants, boots, gloves, and eye protection. Because of changes in technology and use of protective equipment, additional research in this area is needed. Recommendations in this area include:

- Use effective strategies to increase the use of FMVSS 218 compliant helmets.
- Educate motorcyclists about the value of protective apparel by providing an information source on related research and a forum for the exchange of information.
- Conduct research regarding protective apparel effectiveness, and consider development or adoption of existing standards, if research justifies.
- Address the protective gear issue for eyes and face.

Law Enforcement

Law enforcement is responsible for ensuring compliance with laws and regulations intended to promote and maintain highway safety, and are an integral component of motorcycle safety. It is recommended that the state of Alabama promotes initiatives toward educating law enforcement and judicial officials about unique motorcycle safety issues and resources. Moreover, the state of Alabama can:

- Encourage inclusion of law enforcement officials in Motorcycle Safety Program Assessments.
- Develop and implement standardized data gathering and reporting for motorcycle crashes.
- Include motorcycle crash investigation procedures in the basic course given to crash investigators.
- Appropriate sanctions should be applied to those found guilty of contributing to motorcycle crashes. The sanctions, such as mandatory attendance at a motorcycle awareness course, would be designed to expand knowledge of motorcycle issues.

Motorists Awareness of Motorcyclists

There is a continuing need to help other motorists "think of motorcycles" and to educate motorcyclists to be aware of this problem. Specific recommendations include the following:

- Educate operators of other vehicles to be more conscious of the presence of motorcyclists.
- Remind motorcyclists that they may be overlooked and provide defensive strategies for overcoming this situation.

- Include questions regarding motorcyclists on driver's license tests and include information in driving manuals.
- Include the completion of a motorcyclist awareness class in sanctions against motorists found guilty of violating a motorcyclist's right-of-way.
- Adequate funding needs to be devoted to the development and implementation of motorist awareness issues.

Traffic Safety Community Attitude

Highway safety organizations throughout the United States, public and private, place less emphasis on motorcycle safety when compared with other modes of transportation. To improve the situation the following recommendations are offered.

- Traffic safety organizations outside of the motorcycling community can better influence motorcycle safety issues by becoming more educated about motorcycle safety issues and adopt them where applicable.
- Increase funding for motorcycle safety programs by elevating their importance to state highway safety offices.
- Representatives of the motorcycle safety community should be integrated into the larger highway safety community to improve cooperative efforts.

Motorcycle Design

The design of motorcycles has made them increasingly more capable and specialized, and generally reflects a greater emphasis on safety. Still additional research and improvements can be made in the areas identified below.

- Conduct research to determine how current motorcycle designs affect crash and injury causation.
- Implement the use of available tire and wheel technology and explore technology, such as run-flat tires, to reduce frequency of loss-of-control crashes caused by puncture flats.
- Study the effectiveness of linked and antilock braking in the field. If these technologies prove valuable, deploy them more widely.
- Conduct research to determine why other motorists fail to see and identify motorcyclists and implement countermeasures.
- Encourage motorcyclists to enhance their conspicuity.
- Encourage manufacturers to make motorcycle apparel and parts conspicuous.
- Reconsider state requirements that prohibit safe conspicuity-enhancing modifications, including safe modification to lighting systems.
- Study the safety implications of lane splitting.

Roadway Characteristics

Roadway design, maintenance, and construction are generally directed toward the needs of multi-wheel vehicles, with the needs of motorcycles often addressed as an afterthought. The state of Alabama should take an active role to identify and prioritize roadway hazards to motorcycle operation.

- Develop and revise state highway standards reflect the needs of motorcyclists and encourage motorcycle-friendly design, construction, and maintenance procedures.
- Post specific warnings for motorcyclists where unavoidable hazards exist.

- Revise the *Manual on Uniform Traffic Control Devices (MUTCD)* so that signage better communicates roadway or construction conditions that present hazards to motorcyclists.
- Educate motorcyclists about the hazards created by common roadway defects and maintenance methods. Emphasize riding skills required to negotiate these hazards through education and training.
- Take steps to remove slippery sealants and repair substances applied to road surfaces.
- Educate road design and maintenance personnel about conditions that pose hazards to motorcyclists.

Intelligent Transportation Systems

The deployment of Intelligent Traffic Systems (ITS) within traffic is rapidly increasing. Current ITS and Intelligent Vehicle Initiative (IVI) development efforts have generally ignored the presence of motorcycles and their riders. The state of Alabama should include motorcycles in the design and deployment of Intelligent Transportation Systems in the future.

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BIOGRAPHY

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