

# DOCUMENTING THE CHARACTERISTICS OF TRAFFIC CRASHES FOR RITI COMMUNITIES IN IDAHO

FINAL PROJECT REPORT

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**In cooperation with U.S. Department of Transportation,  
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**TECHNICAL REPORT DOCUMENTATION PAGE**

<b>1. Report No.</b>		<b>2. Government Accession No.</b>		<b>3. Recipient's Catalog No.</b>	
<b>4. Title and Subtitle</b> DOCUMENTING THE CHARACTERISTICS OF TRAFFIC CRASHES FOR RITI COMMUNITIES IN IDAHO				<b>5. Report Date</b> September 3, 2020	
				<b>6. Performing Organization Code</b>	
<b>7. Author(s) and Affiliations</b> Ahmed Abdel-Rahim, Skye Swoboda-Colberg, Mohamed Mohamed, and Angel Gonzalez National Institute for Advanced Transportation Technology (NIATT) University of Idaho, 875 Perimeter Drive, MS 0901, Moscow, Idaho 83844-0901				<b>8. Performing Organization Report No.</b> INE/CSET 20.06	
<b>9. Performing Organization Name and Address</b> Center for Safety Equity in Transportation ELIF Building Room 240, 1760 Tanana Drive Fairbanks, AK 99775-5910				<b>10. Work Unit No. (TRAIS)</b>	
				<b>11. Contract or Grant No.</b>	
<b>12. Sponsoring Organization Name and Address</b> United States Department of Transportation Research and Innovative Technology Administration 1200 New Jersey Avenue, SE Washington, DC 20590				<b>13. Type of Report and Period Covered</b>	
				<b>14. Sponsoring Agency Code</b>	
<b>15. Supplementary Notes</b> Report uploaded to:					
<b>16. Abstract</b> This project documents the characteristics of traffic crashes in rural, isolated, tribal, and indigenous (RITI) communities in Idaho and establishes an in-depth understanding of the baseline traffic safety conditions in RITI communities. Different sources of crash data for RITI communities in Idaho was used to conduct an in-depth ten-year crash analysis (2007-2016) to document the characteristics of traffic crashes in rural roads that serve RITI communities in Idaho. The results of analysis of fatal and severe injury crashes on unpaved roads clearly shows that ATVs and pickup trucks and the two most common vehicle types involved in crashes in these roads. The results also showed that the majority of fatal and severe injury crashes on unpaved roads involved male drivers and occupants 24 years or younger with considerable number involving occupants younger than 14 years old. A comparative safety analysis was conducted to identify and document the differences in characteristics between crashes that occurred on unpaved and paved rural roads in Idaho. The results of the analysis show that the percent of fatal and severe injury crashes where no restraining device was used is much higher in unpaved roads (50.4% and 38.3% in unpaved roads compared to 37.9 and 22.8 on paved roads). The same trend also exists in helmet use which shows the critical need for a much more aggressive seat belt and helmet use enforcement among communities who use rural unpaved roads in Idaho. The results also show a substantial difference in ATV crashes on unpaved versus paved. Teenagers or children that are 14 years or younger are more susceptible to fatal and severe injuries on unpaved roads compared to paved roads. Crash injuries for age groups from 15 to 44 are also higher on unpaved roadways. The results also clearly highlight the fact that unpaved roads have higher percentages of crashes where alcohol impairment was a major contributing circumstance. The same is true for speeding and inattention related crashes. A proportion statistical test results show that many of these results have a calculated p-value less than 0.05, indicating that these results are statistically significant at the 95% confidence level.					
<b>17. Key Words</b> Rural, isolated, traffic crashes, unpaved roads, Idaho				<b>18. Distribution Statement</b>	
<b>19. Security Classification (of this report)</b> Unclassified.		<b>20. Security Classification (of this page)</b> Unclassified.		<b>21. No. of Pages</b>	<b>22. Price</b> N/A

## SI\* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS				
Symbol	When You Know	Multiply By	To Find	Symbol
<b>LENGTH</b>				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
<b>AREA</b>				
in <sup>2</sup>	square inches	645.2	square millimeters	mm <sup>2</sup>
ft <sup>2</sup>	square feet	0.093	square meters	m <sup>2</sup>
yd <sup>2</sup>	square yard	0.836	square meters	m <sup>2</sup>
ac	acres	0.405	hectares	ha
mi <sup>2</sup>	square miles	2.59	square kilometers	km <sup>2</sup>
<b>VOLUME</b>				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft <sup>3</sup>	cubic feet	0.028	cubic meters	m <sup>3</sup>
yd <sup>3</sup>	cubic yards	0.765	cubic meters	m <sup>3</sup>
NOTE: volumes greater than 1000 L shall be shown in m <sup>3</sup>				
<b>MASS</b>				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
<b>TEMPERATURE (exact degrees)</b>				
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
<b>ILLUMINATION</b>				
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m <sup>2</sup>	cd/m <sup>2</sup>
<b>FORCE and PRESSURE or STRESS</b>				
lbf	poundforce	4.45	newtons	N
lbf/in <sup>2</sup>	poundforce per square inch	6.89	kilopascals	kPa
APPROXIMATE CONVERSIONS FROM SI UNITS				
Symbol	When You Know	Multiply By	To Find	Symbol
<b>LENGTH</b>				
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
<b>AREA</b>				
mm <sup>2</sup>	square millimeters	0.0016	square inches	in <sup>2</sup>
m <sup>2</sup>	square meters	10.764	square feet	ft <sup>2</sup>
m <sup>2</sup>	square meters	1.195	square yards	yd <sup>2</sup>
ha	hectares	2.47	acres	ac
km <sup>2</sup>	square kilometers	0.386	square miles	mi <sup>2</sup>
<b>VOLUME</b>				
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m <sup>3</sup>	cubic meters	35.314	cubic feet	ft <sup>3</sup>
m <sup>3</sup>	cubic meters	1.307	cubic yards	yd <sup>3</sup>
<b>MASS</b>				
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
<b>TEMPERATURE (exact degrees)</b>				
°C	Celsius	1.8C+32	Fahrenheit	°F
<b>ILLUMINATION</b>				
lx	lux	0.0929	foot-candles	fc
cd/m <sup>2</sup>	candela/m <sup>2</sup>	0.2919	foot-Lamberts	fl
<b>FORCE and PRESSURE or STRESS</b>				
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in <sup>2</sup>

\*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.  
(Revised March 2003)

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## EXECUTIVE SUMMARY

This project documents the characteristics of traffic crashes in rural, isolated, tribal, and indigenous (RITI) communities in Idaho and establishes an in-depth understanding of the baseline traffic safety conditions in RITI communities. Different sources of crash data for RITI communities in Idaho was used to conduct an in-depth ten-year crash analysis (2007-2016) to document the characteristics of traffic crashes in rural roads that serve RITI communities in Idaho. Three different roadway datasets were used in the analysis including the state highway network, the local (county and city) highway networks, and the U.S. Forest service roadway network.

The results of analysis of fatal and severe injury crashes on unpaved roads clearly shows that ATVs and pickup trucks and the two most common vehicle types involved in crashes in these roads. The results also showed that the majority of fatal and severe injury crashes on unpaved roads involved male drivers and occupants 24 years or younger with considerable number involving occupants younger than 14 years old. The results also showed that the majority of these crashes happened during daylight and in clear or cloudy weather conditions. Inclement weather was not a factor that influenced crashes on unpaved roads. Alcohol impairment, inattention, and speeding seem to be the three major contributing circumstances in fatal and severe injury crashes on unpaved roads.

A comparative safety analysis was conducted to identify and document the differences in characteristics between crashes that occurred on unpaved and paved rural roads in Idaho. The results of the analysis show that the percent of fatal and severe injury crashes where no restraining device was used is much higher on unpaved roads (50.4% and 38.3% on unpaved roads compared to 37.9 and 22.8 on paved roads). The same trend also exists in helmet use which shows the critical need for a much more aggressive seat belt and helmet use enforcement among communities who use rural unpaved roads in Idaho. The results also show a substantial difference in ATV crashes on unpaved versus paved. This is not surprising considering ATV usage is largely implemented on these roads due to the environment and location. Teenagers or children that are 14 years or younger are more susceptible to fatal and severe injuries on unpaved roads compared to paved roads. Crash injuries for age groups from 15 to 44 are also higher on unpaved roadways. The results also clearly highlight the fact that unpaved roads have higher percentages of crashes where alcohol impairment was a major contributing circumstance. The same is true for speeding and inattention related crashes. A proportion statistical test results show that many of these results have a calculated p-value less than 0.05, indicating that these results are statistically significant at the 95% confidence level.

A county-based crash rate analysis was conducted to investigate the relative crash rates in rural roads for different counties in Idaho. Four different exposure measures were used to estimate the relative crash rates values. These exposure measures included number of registered drivers in the county, number of registered vehicles in the county, total county population, and total length of roadways in the county. The comparative analysis identified counties that have consistently higher rural crash rates compared to the state average (Boise County and Clark County). Other counties showed highest relative crash rates but produce less consistent results (Custer County and Lincoln County). A more formal statistical analysis that accounts for the spatial variability of these factors and exposure measures would be required to demonstrate that these results are statistically significant.



## **CHAPTER 1. INTRODUCTION**

### **1.1. Project Overview**

This project documents the characteristics of traffic crashes in rural, isolated, tribal, and indigenous (RITI) communities in Idaho and establishes an in-depth understanding of the baseline traffic safety conditions in RITI communities. The project aims to help enhance the understanding of the impact factors that affect rural traffic crash frequencies and severities for RITI communities, and how these factors vary over time and across regions.

### **1.2. Project Goal and Objectives**

The primary goal of this project is to document the characteristics of traffic crashes in RITI communities in Idaho. The long-term vision of the PIs for this project is to establish an in-depth understanding of the baseline traffic safety conditions in RITI communities as a first step towards the ultimate goal of improving safety for these underserved groups through research, education, and outreach activities. The project had the following three objectives:

- 1) Identify and document different sources of crash data for RITI communities in Idaho
- 2) Conduct an in-depth ten-year crash analysis (2007-2016) to document the characteristics of traffic crashes in RITI communities
- 3) Identify and document different sources for traffic exposure data that can be used to estimate crash rates for RITI communities in Idaho

The outcome of this project will help federal, state, tribal, local transportation agencies, and other entities that focus on improving safety on rural highways gain in-depth knowledge on the characteristics of traffic crashes in RITI and similar communities throughout the nation. It will also help identify gaps in crash data collection practices and policies for these communities as well as gaps in traffic exposure measures that can be used to effectively measure crash rates in rural communities. Finally, the outcome of this project will help aid and guide the state of Idaho's efforts to improve safety on Idaho's RITI roadway network through the identification of effective crash countermeasures that has the highest possible return on investment for these communities.

### **1.3. Report Organization**

This report is organized in six chapters. After the introduction, chapter 2 presents the study methodology and data sources. Chapter 3 documents the characteristics of fatal and severe injury crashes on rural paved and unpaved roads followed by chapter 4 that provided the characteristics of fatal and severe injury crashes on rural paved and unpaved roads. Chapter 5 provides a synthesis covering different sources for traffic exposure data for RITI communities in Idaho. Chapter 6 includes the study findings and conclusions.

## CHAPTER 2. STUDY METHODOLOGY AND DATA SOURCES

### 2.1. Overview

Geographic Information Systems (GIS) are used to store, manage, analyze and present spatial data and provide an appropriate platform for studying the distribution and characteristics of vehicle crashes. The research conducted in this project utilized the software suite ESRI ArcGIS 10.2.2 (ESRI 2018) using both the ArcMap and ArcCatalog Products. A File Geodatabase was created to store the data layers and perform analysis, classes were created within the Geodatabase to store features for road networks, vehicle crash records, U.S. census boundary layers and demographic information from the US Census. All features in the database use a Geographic Projections System using the North American Datum of 1983 and are projected in an Idaho Transverse Mercator Projection (IDWR 2018). A projected coordinate system allowed us to measure distances in linear units instead of decimal degrees and facilitated the research's spatial analysis (Longley et al. 2011, p. 138).

### 2.2. Data Sources

#### 2.2.1. Census Data

Census TIGER files (Topologically Integrated Geographic Encoding and Referencing) provided the foundation for identifying area boundaries and incorporating demographic data into our database that is spatially explicit (US Census Bureau, 2018). These boundary layers provide the spatial framework for joining demographic data such as population to the following: blocks, block groups, census tracts, counties, and county Subdivisions.

Population estimates for Idaho in 2016 were obtained from the U.S. Census Bureau and were added to the Census Incorporated Places. This process was used to determine urban and rural areas where rural areas have a population less than 2,500 residents and urban areas have a population greater than or equal to 2,500 residents (Ratcliffe et al, 2016).

#### 2.2.2. Crash Data

Vehicle crash data was obtained from the Idaho Transportation Department (ITD) through the Office of Highway Safety Crash Analysis Reporting System for crashes that occurred between 2007 and 2016 (Webcars, 2018). Crash data were integrated with the GIS database using the latitude and longitude values associated with each crash (using the NAD 83 Geographic Coordinate System). Ten crash layers, one for each year of crash records were exported as a new feature class within the Geodatabase and projected using the NAD 83 Idaho TM projection. The ten feature classes were then merged to a single feature class representing all reported incidents in the State of Idaho between 2007 and 2016.

It is important to note that Idaho's crash data uses a vertical data structure where each row represents a vehicle involved in a crash; therefore, there is a many to one relationship between vehicles and incidents of a crash. A crash involving 4 vehicles will produce 4 rows of data and statistics such as Injury and Fatality counts are represented for the crash, not the vehicle. To simplify the data and avoid duplication, the first record was selected for each crash by excluding records that have a null value in the Accident number field. This secondary dataset was used to calculate the total number of injuries or fatalities for a given period or area. The original dataset was useful for calculating the total number of vehicles involved in crashes.

The location of a crash was geocoded using the verbal description in the crash report. The approximate distance to the nearest mile marker was often used as a secondary location system. One challenge we encountered during this research was measuring the amount of uncertainty in the location of a crash measured as latitude and longitude. Many rural and isolated roads in Idaho lack the cellular signal reception and Geographic Positioning Systems (GPS) signals to accurately measure the location of an incident.

### ***2.2.3 Roadway networks***

Three road networks were used in this project. The first two were provided by ITD, including the State Highway System network and the Local Highway network which includes county and city roadways throughout the state. The third dataset was provided by the US Forest Service, and covered the forest service roadway network. A summary of the characteristics of each of the three roadway network datasets are included in Table 2.1.

**Table 2-1 Characteristics of the three roadway network datasets used in the analysis**

Data Source	Total Data point	Length (miles)	Code	Pavement Type	Paved	Unpaved
Local Highway Network	19,300	27,931	C	Earth		X
			E	Gravel		X
			F	Asphalt < 1" or Dust Suppressant Treated Gravel	X	
			G-1	Road or Cold Plant mixed Asphalt	X	
			G-2	Hot mix asphalt pavement	X	
			J	Other (e.g. concrete)	X	
			B	Unimproved		X
			AC	Asphalt	X	
Forest Service Roadway Network	21,497	31,642	AGG	Crushed Aggregate or Gravel		X
			BST	Bituminous Surface Treatment	X	
			CSOIL	Compacted Soil		X
			IMP	Improved Natural Material		X
			Other	Other		X
			P	Paved	X	
Idaho State Highway System	2,118	5,742	NA	Bituminous Overlay over Existing CRCP	X	
			NA	Overlay over Existing Jointed Concrete Pavement	X	
			NA	Asphalt Concrete Overlay over Existing AC Pavement	X	
			NA	Bituminous	X	
			NA	Bonded PCC Overlay on PCC Pavement	X	
			NA	JRCP - Jointed Plain Concrete Pavement	X	
			NA	JRCP - Jointed Reinforced Concrete Pavement	X	
			NA	Other (includes "white topping")	X	
			NA	Unpaved		X

## **CHAPTER 3. CHARACTERISTICS OF FATAL AND SEVERE INJURY CRASHES ON RURAL UNPAVED ROADS IN IDAHO**

### **3.1. Overview**

The Federal Highway Administration (FHWA) reported in 2012 that there were 1,357,430 miles of unpaved roads, which accounts for almost 35% of total road miles. Some of the unpaved roads are smooth, wide, and have a well-maintained surface with wide shoulders. However, many others have narrow or no shoulders and loose, rutted, or washboard surfaces where drivers could lose control of their vehicle due to severely muddled surfaces. These problems are often the worst where vehicles turn and brake such as on curves and at intersections. Poor quality and loose aggregate can lead to dense dust clouds resulting in low visibility. More dangers of driving on unpaved roads come from the transition from paved to unpaved. If a vehicle is approaching a gravel road without proper warnings, such as reduce speed signs, the driver could lose control of their vehicle. Additional characteristics affecting driving behavior due to physical features of unpaved roads that can impact safety include (FHWA-SA-14-094):

- narrow lanes and/or shoulders
- sharp horizontal/vertical curves
- limited passing, stopping and horizontal sight distance, narrow bridges
- limited sight distance at intersections
- frequent roadside obstacles
- lack of clear roadside recovery area
- minimal or non-compliant signing and delineation

This chapter provides a summary of the characteristics of crashes that occurred on rural unpaved roads in Idaho. The analysis focused on fatal and severe injury (“incapacitated” or “A injury” crashes) crashes that occurred between 2007 and 2016. The analysis covered crash trends, vehicle types, geographic district, driver demographics (age and sex), light conditions, and weather conditions.

### **3.2. Analysis and Results**

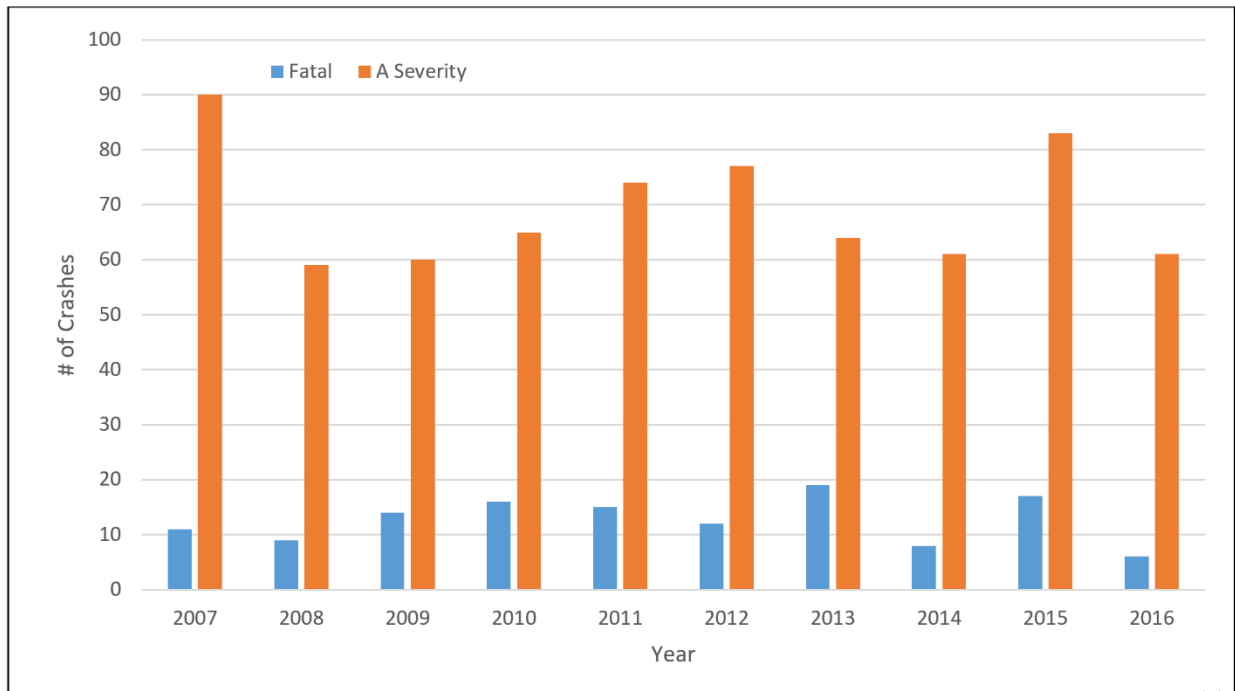
The characteristics of fatal and severe injury crashes in unpaved roads in Idaho are presented in Figure 3.1 through Figure 3.7 and in Table 3.1. Based on these results, the following observations can be made:

- The number of fatal crashes fluctuates from a minimum of 6 fatalities in 2016 to 19 fatalities in 2013. Severe injury crashes showed an increasing trend from 2008 to 2012, followed by a declining trend from 2012 to 2014. Fatal and severe injury crashes went significantly up in 2015, and showed a considerable decline in 2016.
- ATVs and pickup trucks were the two most common vehicle types in fatal and severe injury crashes on unpaved roads in Idaho
- District 3, the southwestern district in Idaho, experienced the highest number of fatal and severe injury crashes on unpaved roads. This is the district that has the most rural recreational attractions in Idaho.
- The majority of fatal and severe injury crashes on unpaved roads involved drivers 24 years or younger with considerable number involving occupants younger than 14 years old.

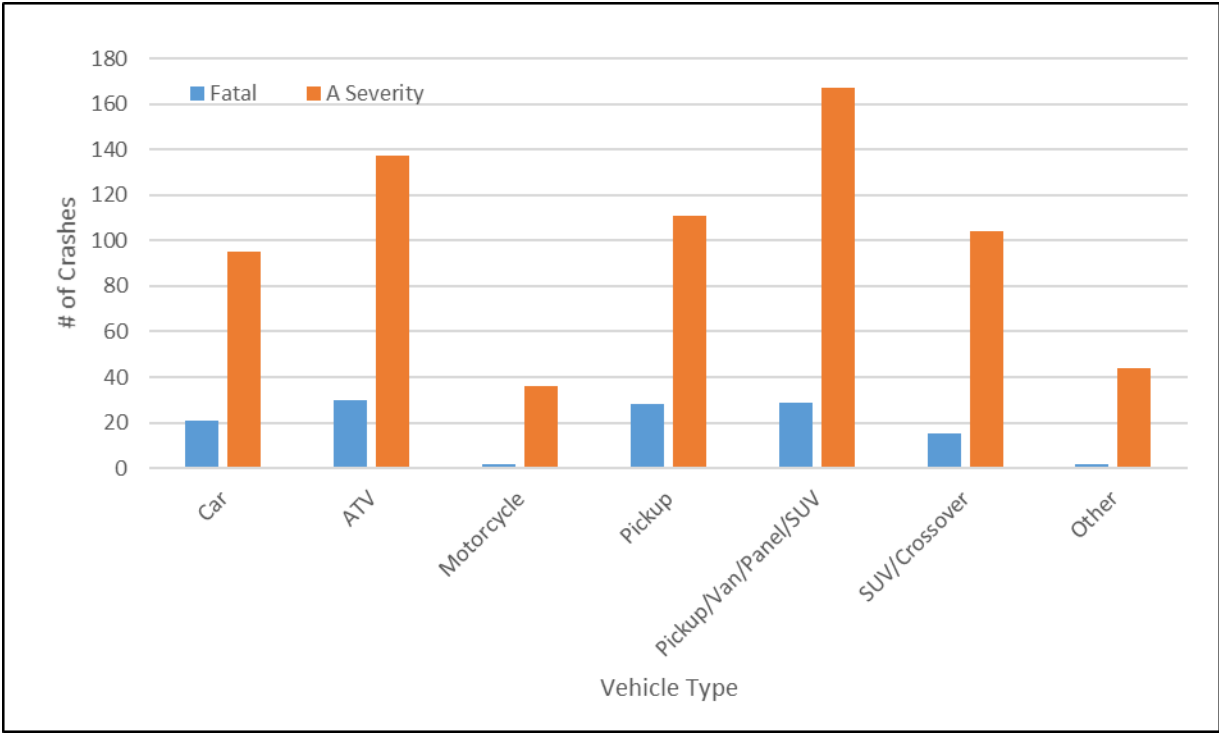
- The majority of fatal and severe injury crashes on unpaved roads involved male drivers and occupants.
- The majority of fatal and severe injury crashes on unpaved roads happened during daylight and in clear or cloudy weather conditions. Inclement weather was not a factor that influenced crashes on unpaved roads.
- Alcohol impairment, inattention, and speeding seem to be the three major contributing circumstances in fatal and severe injury crashes on unpaved roads.

**Table 3.1 Contributing circumstances for fatal and severe injury crashes on unpaved roads in Idaho**

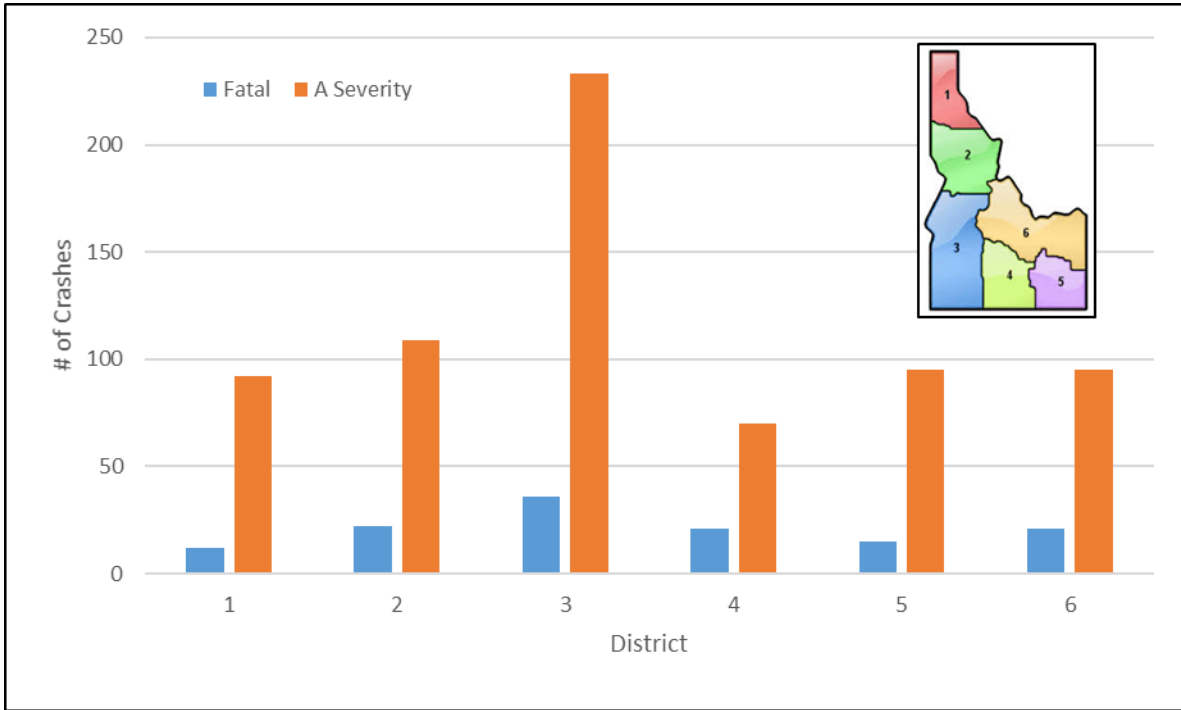
Contributing Circumstances	Fatalities	Percentage (%)	Injuries	Percentage (%)
Alcohol Impaired	33	26	113	16.3
Asleep, Drowsy, Fatigued	2	1.6	4	0.6
Distracted IN or ON Vehicle	4	3.1	15	2.2
Drove Left of Center	8	6.3	30	4.3
Drug Impaired	2	1.6	10	1.4
Exceeded Posted Speed	4	3.1	20	2.9
Failed to Maintain Lane	11	8.7	37	5.3
Failed to Obey Stop Sign	2	1.6	1	0.1
Inattention	19	15	98	14.1
Other	4	3.1	80	11.5
Overcorrected	5	3.9	44	6.3
Speed Too Fast For Conditions	20	15.7	179	25.8
Unknown	11	8.7	48	6.9
Vision Obstruction	2	1.6	15	2.2



**Figure 3-1 Fatal and severe injury crashes on unpaved roads in Idaho by year**

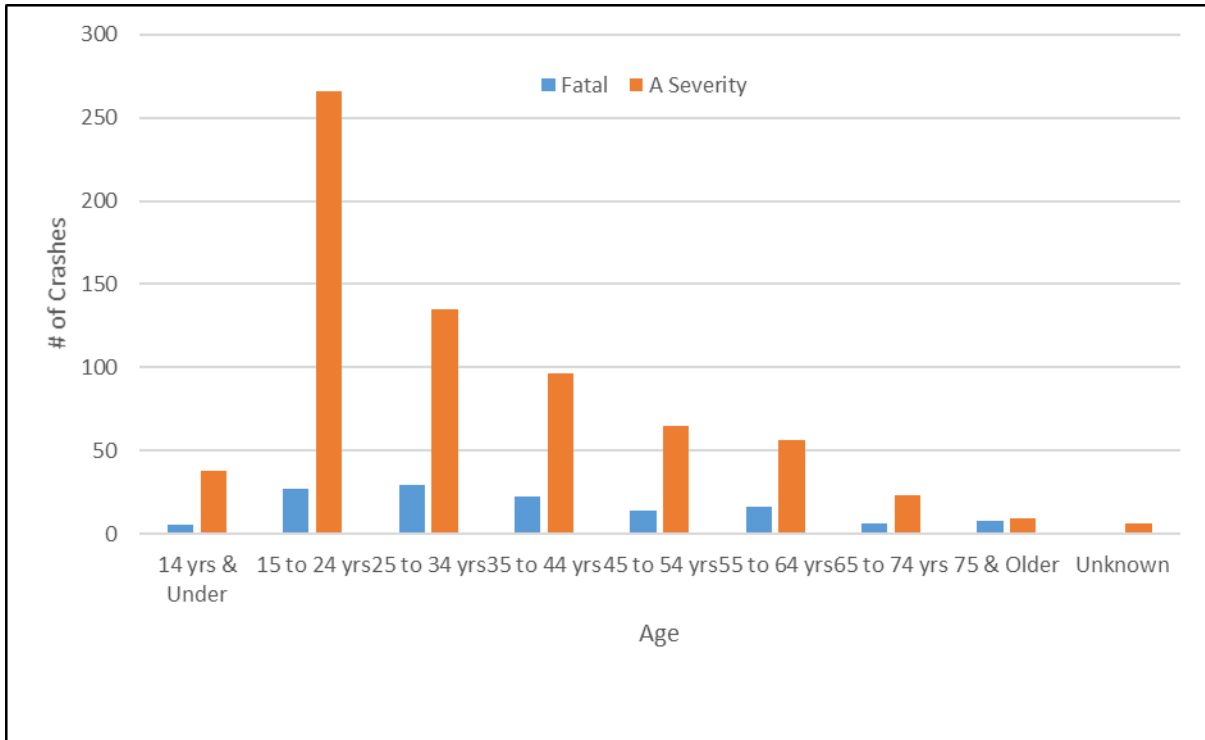


**Figure 3-2 Fatal and Severe injury crashes on unpaved roads in Idaho by vehicle type**

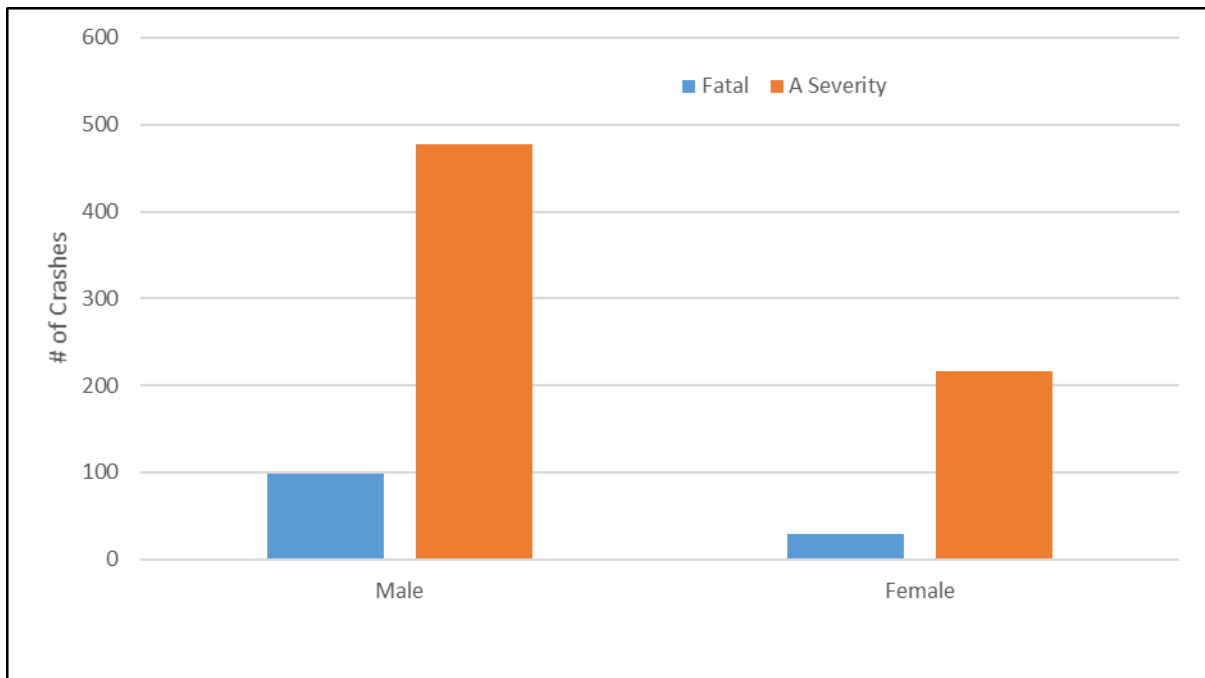


**Figure 3-3 Fatal and severe injury crashes on unpaved roads in Idaho by geographic districts**

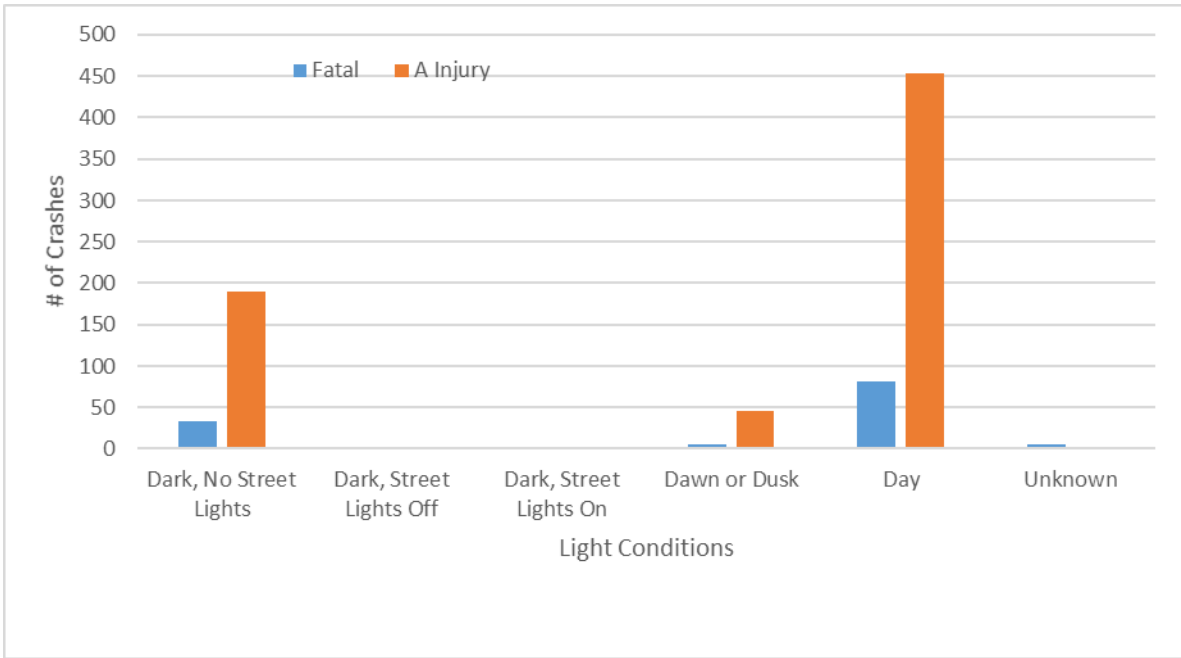




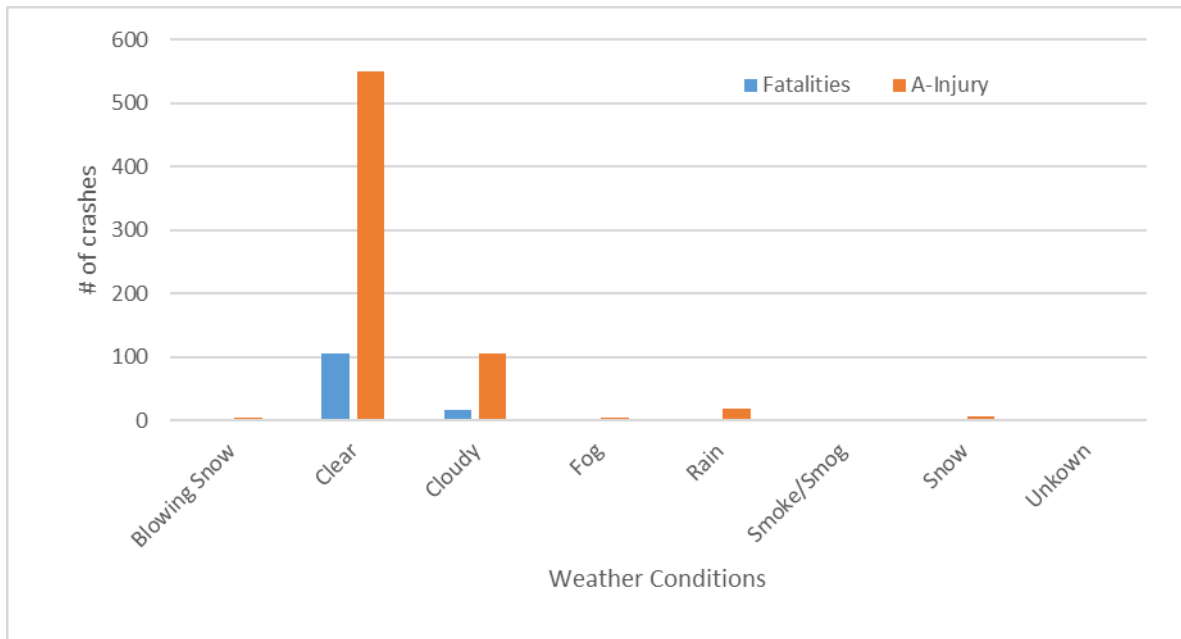
**Figure 3-4 Fatal and severe injury crashes on unpaved roads in Idaho by age**



**Figure 3-5 Fatal and severe injury crashes on unpaved roads in Idaho by gender**



**Figure 3-6 Fatal and severe injury crashes on unpaved roads in Idaho by light conditions**



**Figure 3-7 Fatal and severe injury crashes on unpaved roads in Idaho by weather conditions**

## CHAPTER 4. FATAL AND SEVERE INJURY CRASHES ON RURAL ROADS IN IDAHO

### 4.1. Overview

This chapter documents the characteristics of fatal and severe injury crashes on rural paved roads in Idaho and presents a comparative analysis between crashes on paved and unpaved rural roads to identify major differences in crash causation and contributing circumstances between these two, relatively different, rural roadway networks that serve RITI communities.

### 4.2. Comparative Safety Analysis: Unpaved and Paved Rural Roads in Idaho

Table 4-1, Table 4-2, and Table 4-3, and Figure 4-1 through Figure 4-12 show a comparison between the characteristics of fatal and severe injury crashes on rural unpaved and paved roads in Idaho. Based on the results shown in these Tables and Figures, the following observations can be made from the data presented in the Tables and Figures:

- The percent of fatal and severe injury crashes where no restraining device was used is much higher on unpaved roads (50.4% and 38.3% on unpaved roads compared to 37.9 and 22.8 on paved roads). The same trend also exists in helmet use as can be shown in Table 4-2 and Figure 4-8. This shows the need for much more aggressive seat belt and helmet use enforcement in rural unpaved roads.
- There is a substantial difference in ATV crashes on unpaved versus paved. This is not surprising considering ATV usage is largely implemented on these roads due to the environment and location.
- The proportion of male drivers fatal and severe injury crashes are slightly higher on unpaved roads.
- The categorical age groups for fatal and incapacitating injuries for paved and unpaved roads are presented in Figure 4-7 and Figure 4-8. Ages are divided into 10-year groups starting at the age of 14 or younger and ending at 75 and older. In Idaho teenagers can get their driver's license at 15 years old with restrictions on number of passengers allowed in their vehicle and time of day they're allowed to drive. This type of driver's license is an underage license designed for anyone 17 years or younger and once the licensee becomes 18 years old they're eligible for a regular driver's license. The data presented in the Figure 4-7 and Figure 4-8 clearly shows that teenagers or children that are 14 years or younger are more susceptible to fatal and severe injuries on unpaved roads versus paved roads. Crash injuries for age groups from 15 to 44 are also higher on unpaved roadways, but for the following groups it levels out and then older individuals are more involved in paved crashes.
- The light conditions comparison data presented in Figure 4-9 and Figure 4-10 shows, when compared with paved roads, higher percentage of fatal crashes occur at night with no street lights.
- The data shown in Figure 4-11 and Figure 4-12 shows, again, that inclement weather is not a major factor in fatal and severe injury crashes that occur on unpaved roads. However, when compared to paved roads, a higher percentage of crashes on unpaved roads occur during daylight.

- The data presented in Table 4-3 clearly highlight the fact that unpaved roads have higher percentages of crashes where alcohol impairment was a major contributing circumstance. The same is true for speeding and inattention.

**Table 4-1 Protective device use for paved and unpaved roads in Idaho**

Paved									
Protection Device	Units	%	Fatalities	%	'A" Severity	%	Total Injuries	%	
Air Bag Activated- Belts In Use	419	7.2	93	8.2	555	8.6	648	8.5	
Air Bag Activated- No Belts In Use	132	2.3	44	3.9	133	2.1	177	2.3	
Helmet Used	459	7.9	64	5.7	405	6.3	469	6.2	
No Helmet	221	3.8	47	4.2	189	2.9	236	3.1	
Non-Activated Air Bag- Belts In Use	435	7.5	53	4.7	562	8.7	615	8.1	
Non-Activated Air Bag- No Belts In Use	116	2.0	34	3.0	161	2.5	195	2.6	
None	1425	24.5	428	37.9	1474	22.8	1902	25.1	
Shoulder and Lap	2152	37.0	300	26.5	2492	38.6	2792	36.8	
Shoulder Belt Only	34	0.6	7	0.6	56	0.9	63	0.8	
Unknown/Other	423	7.3	60	5.3	427	6.6	487	6.4	

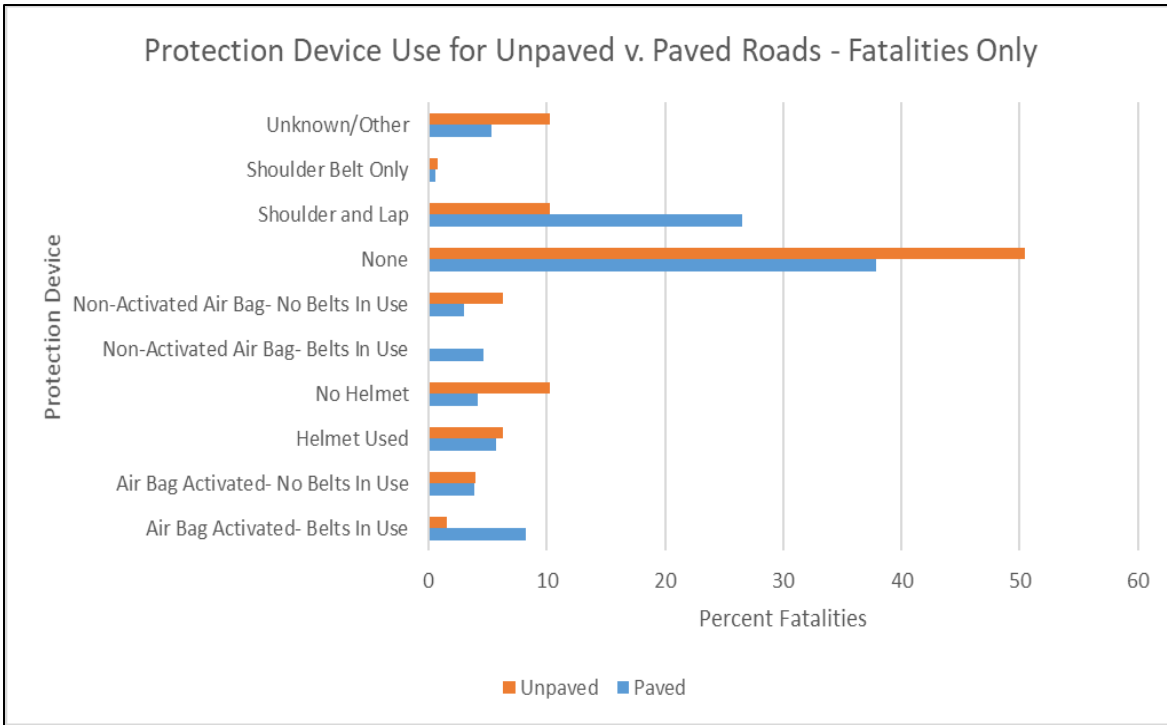
Unpaved									
Protection Device	Units	%	Fatalities	%	'A" Severity	%	Total Injuries	%	
Air Bag Activated- Belts In Use	9	1.7	2	1.6	8	1.2	10	1.2	
Air Bag Activated- No Belts In Use	9	1.7	5	3.9	15	2.2	20	2.4	
Helmet Used	56	10.6	8	6.3	59	8.5	67	8.2	
No Helmet	68	12.8	13	10.2	71	10.2	84	10.2	
Non-Activated Air Bag- Belts In Use	20	3.8	0	0.0	28	4.0	28	3.4	
Non-Activated Air Bag- No Belts In Use	20	3.8	8	6.3	28	4.0	36	4.4	
None	203	38.3	64	50.4	266	38.3	330	40.2	
Shoulder and Lap	92	17.4	13	10.2	141	20.3	154	18.8	
Shoulder Belt Only	3	0.6	1	0.8	3	0.4	4	0.5	
Unknown/Other	50	9.4	13	10.2	75	10.8	88	10.7	

**Table 4-2 Vehicle type for fatal and severe injury crashes on paved and unpaved Idaho roads**

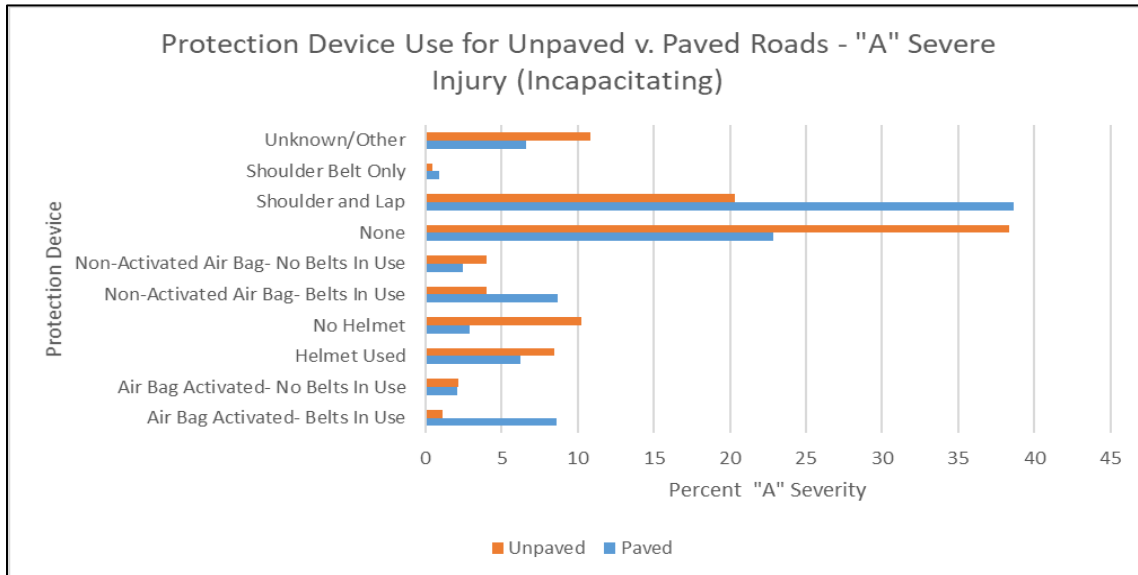
Vehicle Type	Unpaved					Paved				
	Fatal	%	A Severity	%	Total	Fatal	%	A Severity	%	Total
Car	21	16.5	95	13.7	116	1992	34.3	370	32.7	2280
ATV	30	23.6	137	19.7	167	128	2.2	23	2.0	125
Motorcycle	2	1.6	36	5.2	38	719	12.4	118	10.4	629
Pickup	28	22.0	111	16.0	139	740	12.7	157	13.9	768
Pickup/Van/Panel/SUV	29	22.8	167	24.1	196	1058	18.2	228	20.2	1334
SUV/Crossover	15	11.8	104	15.0	119	577	9.9	133	11.8	742
Other	2	1.6	44	6.3	46	602	10.4	101	8.9	576
Total	127	100	694	100	821	5816	100	1130	100	6454

**Table 4-3 Contributing circumstances for fatal and severe injury crashes on paved and unpaved roads**

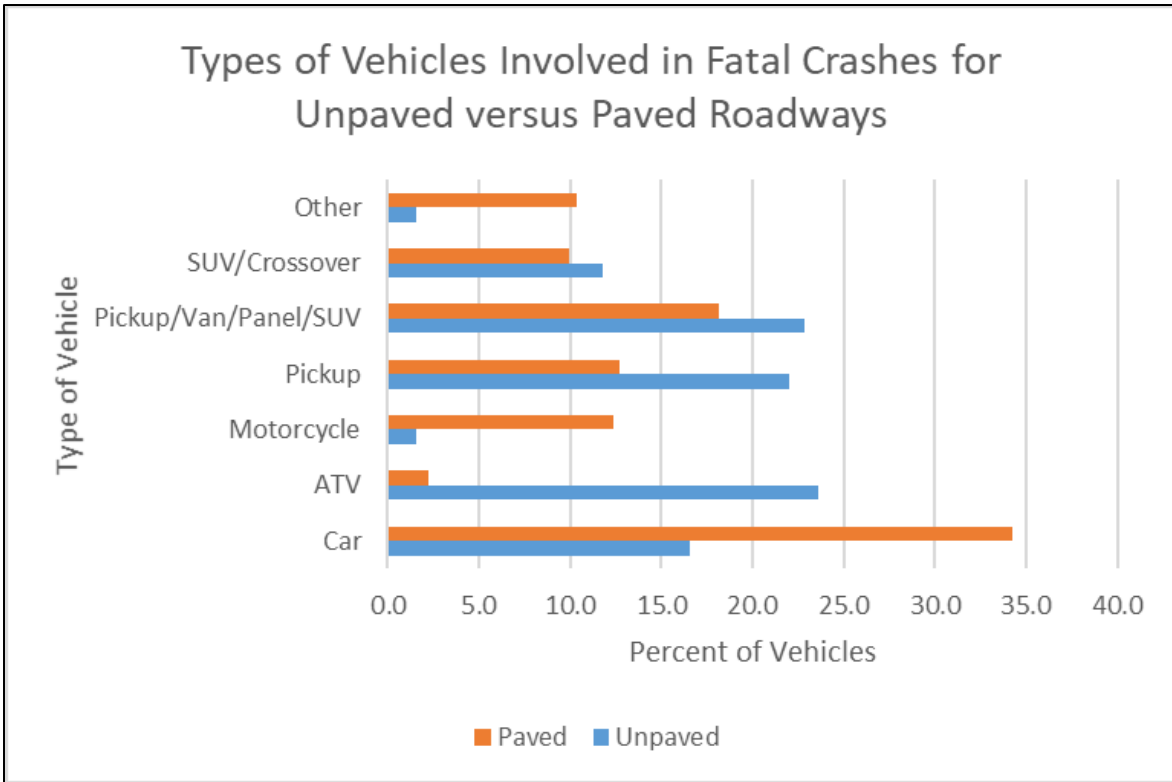
Contributing Circumstances	Unpaved				Paved			
	Fatalities	%	Injuries	%	Fatalities	%	Injuries	%
<b>Alcohol Impaired</b>	<b>33</b>	<b>26.0</b>	<b>113</b>	<b>16.3</b>	<b>170</b>	<b>15.0</b>	<b>751</b>	<b>11.6</b>
Animal(s) in Roadway	0	0.0	4	0.6	10	0.9	128	2.0
Asleep, Drowsy, Fatigued	2	1.6	4	0.6	49	4.3	395	6.1
Distracted IN or ON Vehicle	4	3.1	15	2.2	13	1.2	146	2.3
Drove Left of Center	8	6.3	30	4.3	105	9.3	292	4.5
Drug Impaired	2	1.6	10	1.4	14	1.2	72	1.1
Depressed, Angry, Disturbed	1	0.8	1	0.1	2	0.2	17	0.3
Exceeded Posted Speed	4	3.1	20	2.9	32	2.8	115	1.8
Failed to Maintain Lane	11	8.7	37	5.3	123	10.9	393	6.1
Failed to Obey Stop Sign	2	1.6	1	0.1	21	1.9	107	1.7
Failed to Yield	0	0.0	7	1.0	37	3.3	306	4.7
Following Too Close	0	0.0	3	0.4	5	0.4	99	1.5
Foot Slipped Off or Caught On Pedal	0	0.0	1	0.1	0	0.0	2	0.0
Improper Backing	0	0.0	3	0.4	2	0.2	18	0.3
Improper Overtaking	0	0.0	1	0.1	17	1.5	70	1.1
Improper Turn	1	0.8	6	0.9	3	0.3	44	0.7
Improperly Parked	0	0.0	3	0.4	1	0.1	1	0.0
<b>Inattention</b>	<b>19</b>	<b>15.0</b>	<b>98</b>	<b>14.1</b>	<b>138</b>	<b>12.2</b>	<b>1005</b>	<b>15.6</b>
Other	2	1.6	29	4.2	82	7.3	429	6.6
Other Vehicle Defect	0	0.0	15	2.2	1	0.1	47	0.7
Overcorrected	5	3.9	44	6.3	81	7.2	300	4.6
Physical Impairment	0	0.0	2	0.3	5	0.4	17	0.3
Sick	0	0.0	1	0.1	4	0.4	35	0.5
<b>Speed Too Fast For Conditions</b>	<b>20</b>	<b>15.7</b>	<b>179</b>	<b>25.8</b>	<b>125</b>	<b>11.1</b>	<b>945</b>	<b>14.6</b>
Steering	0	0.0	2	0.3	0	0.0	6	0.1
Unknown	11	8.7	48	6.9	82	7.3	640	9.9
Vision Obstruction	2	1.6	15	2.2	3	0.3	59	0.9
Wrong Side or Wrong Way	0	0.0	2	0.3	5	0.4	15	0.2



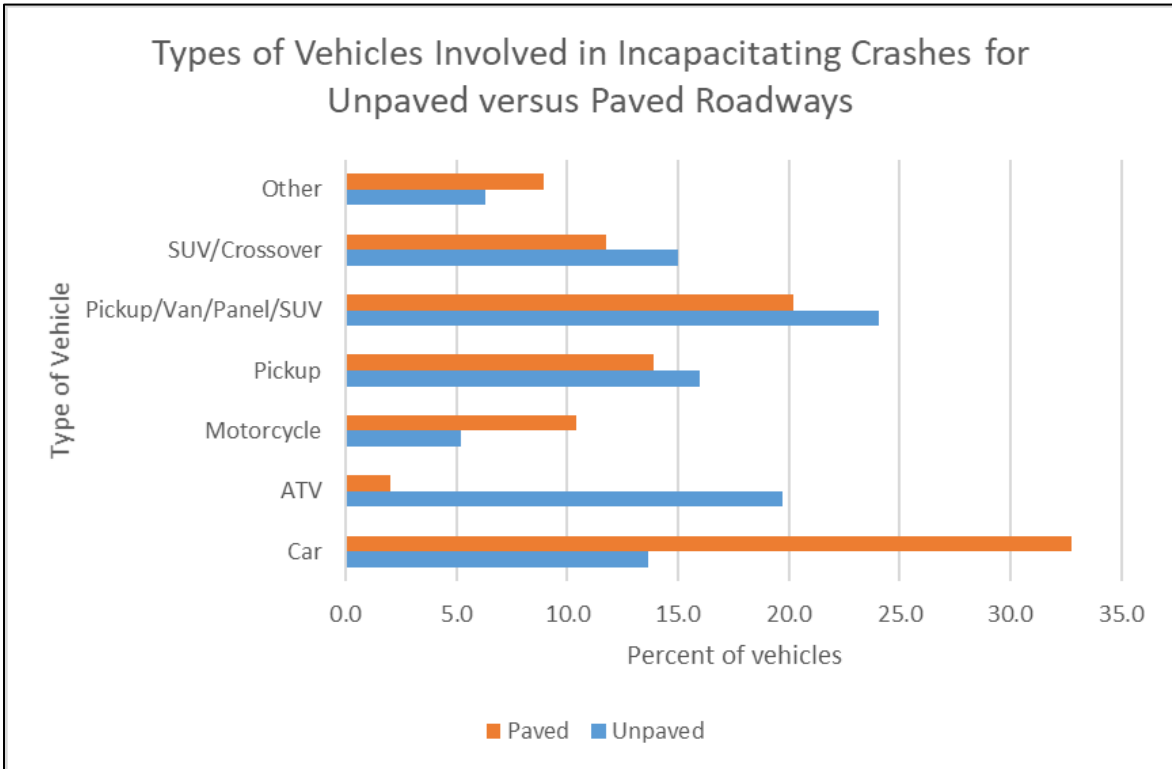
**Figure 4-1 Protective device use for fatal crashes on paved and unpaved roads in Idaho**



**Figure 4-2 Protective device use for fatal and severe injury crashes on paved and unpaved roads**



**Figure 4-3 Vehicle type for fatal crashes on paved and unpaved Idaho roads**



**Figure 4-4 Vehicle type for severe injury crashes on paved and unpaved roads in Idaho**

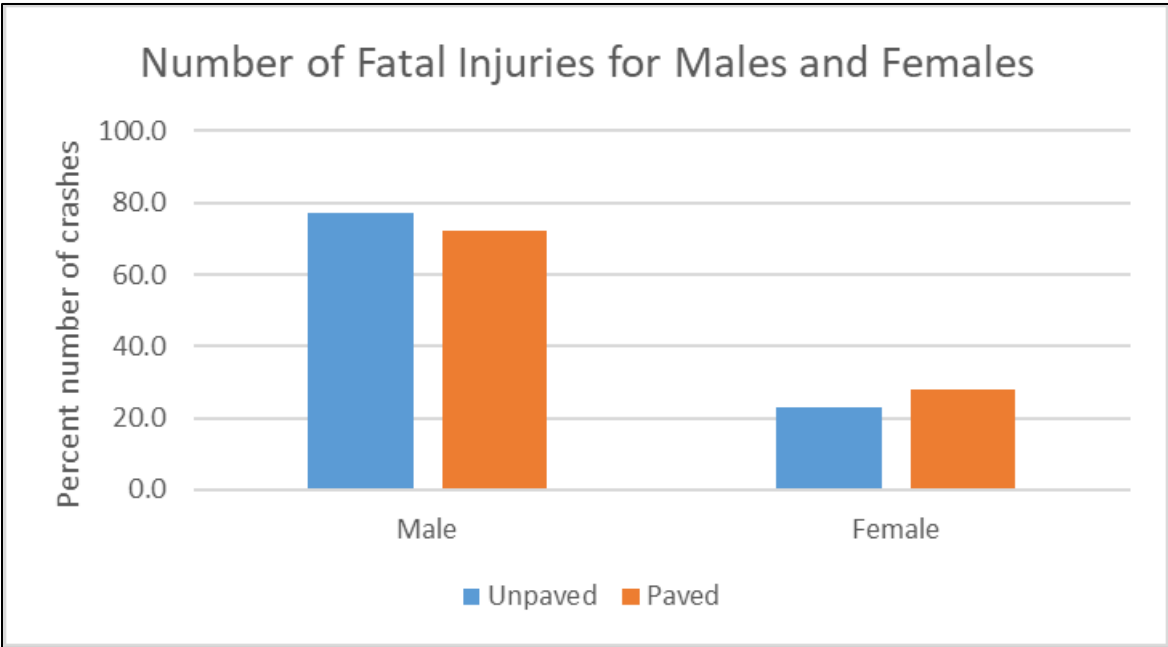


Figure 4-5 Number of fatalities by gender on paved and unpaved roads in Idaho

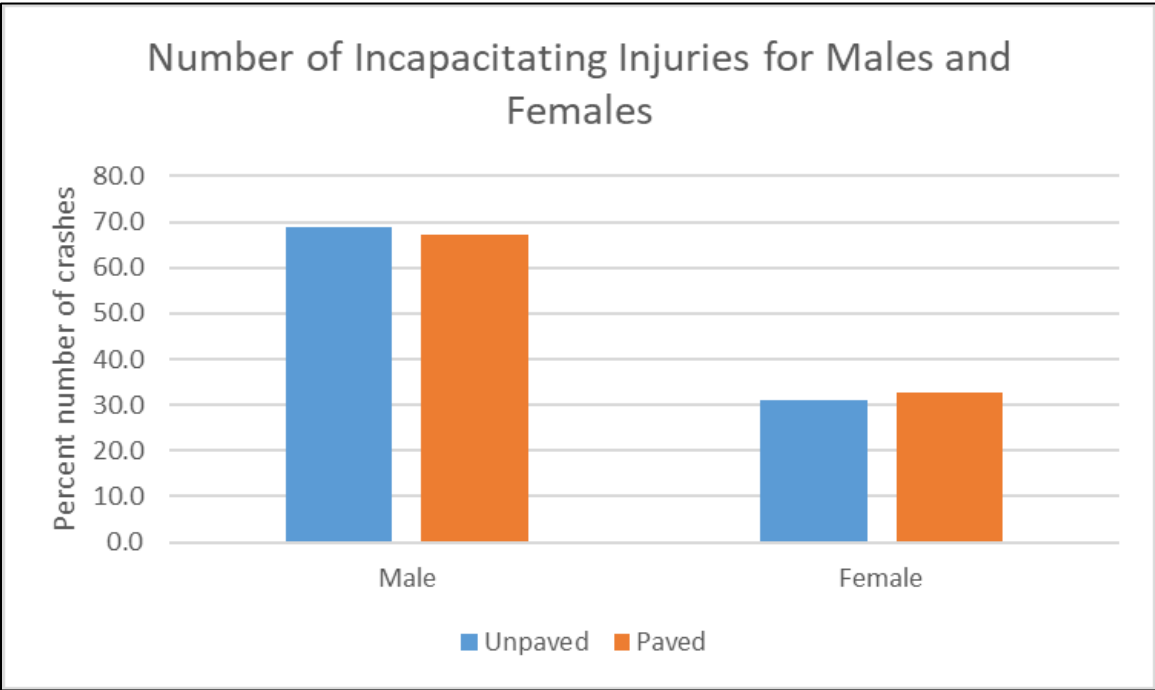
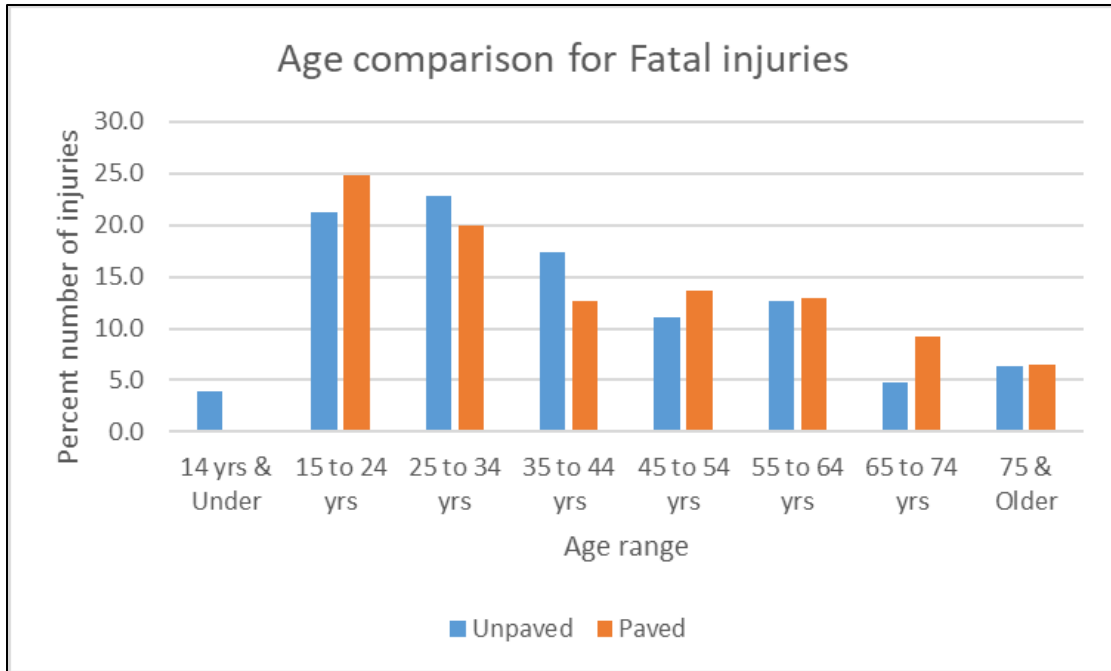
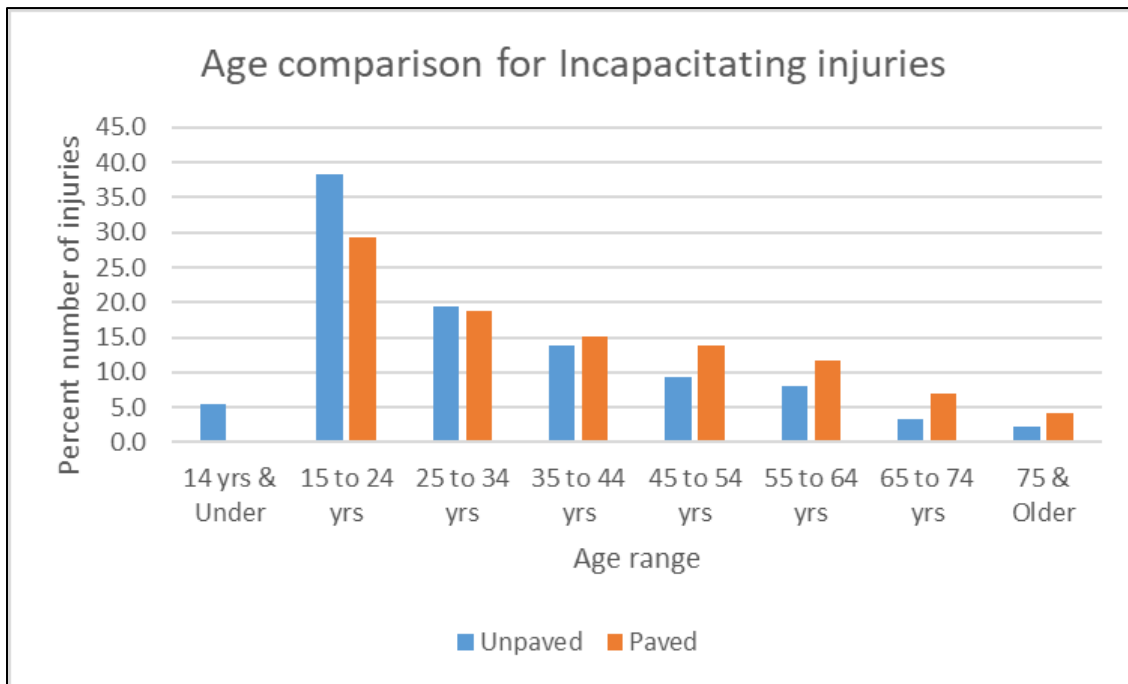


Figure 4-6 Number of severe Injury crashes by gender on paved and unpaved roads in Idaho

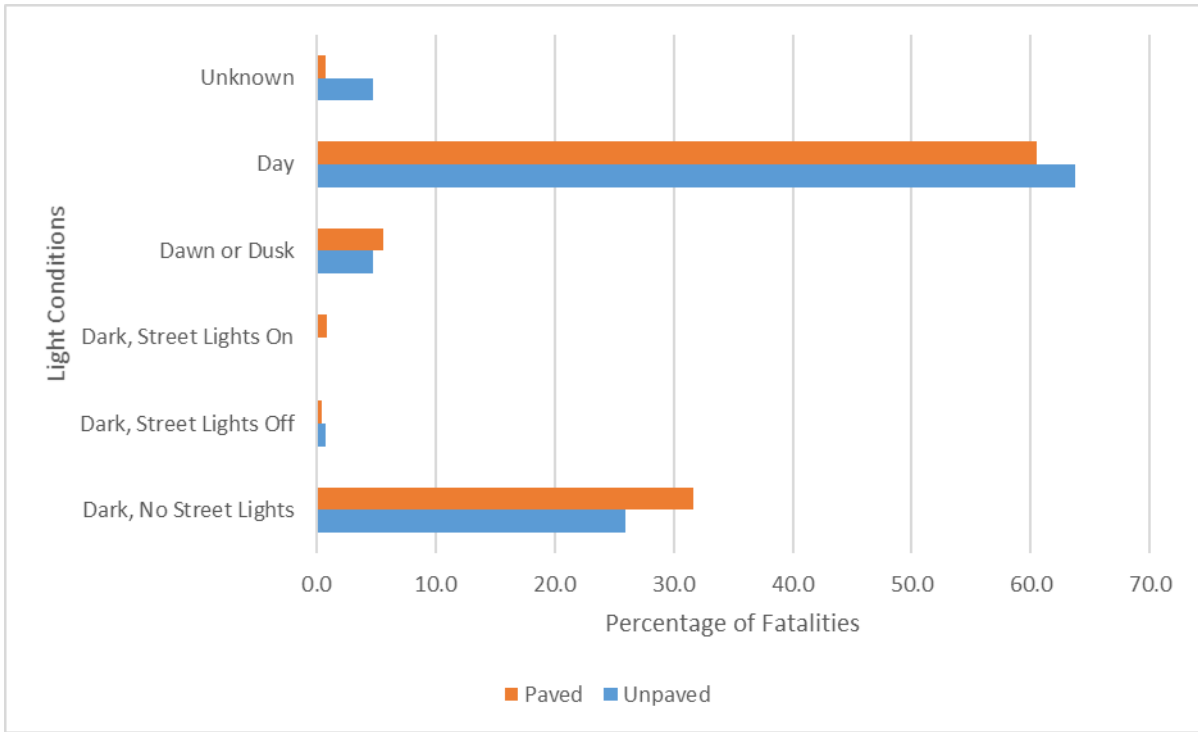




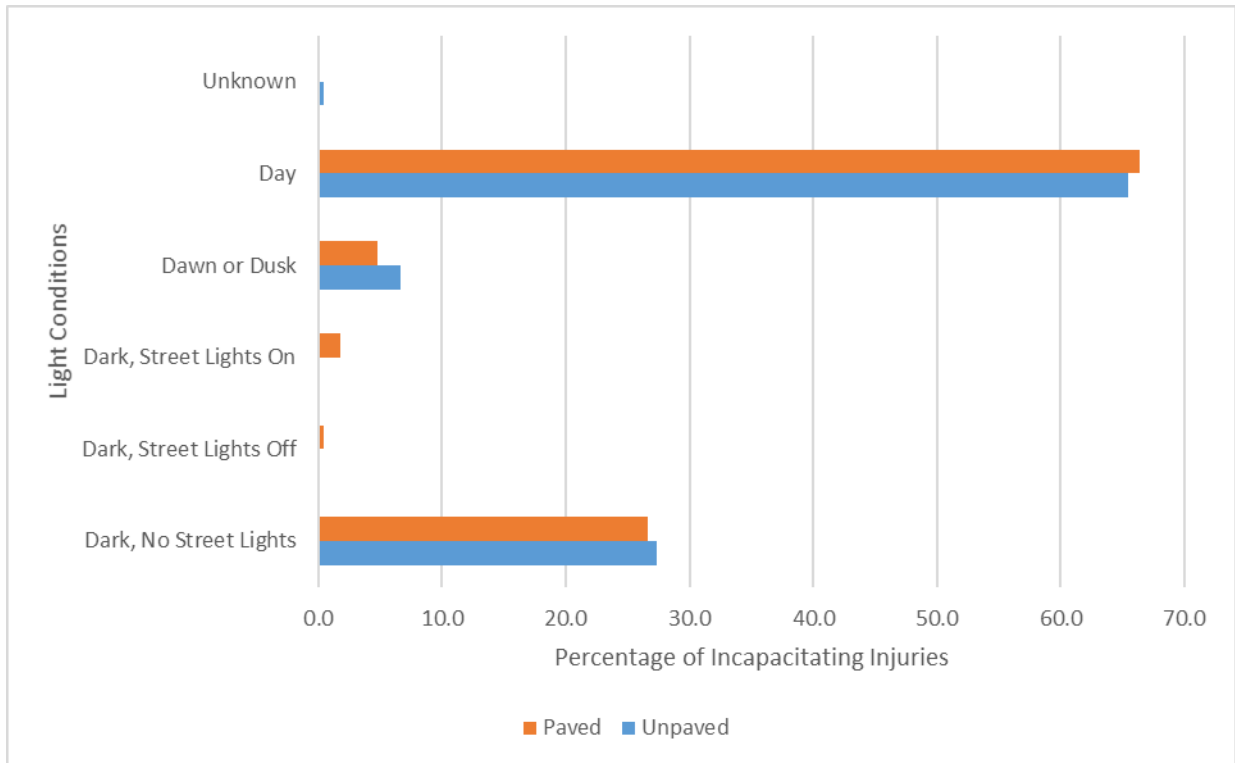
**Figure 4-7 Fatal crashes by age on paved and unpaved roads in Idaho**



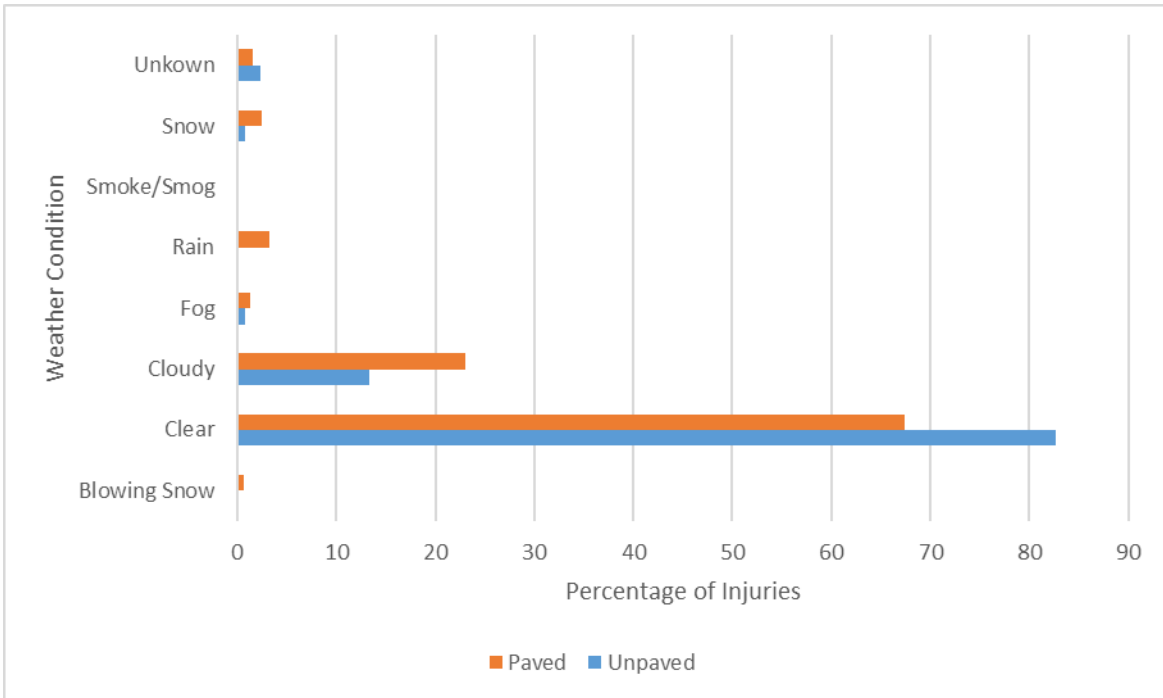
**Figure 4-8 A Sever injury crashes by age on paved and unpaved roads in Idaho**



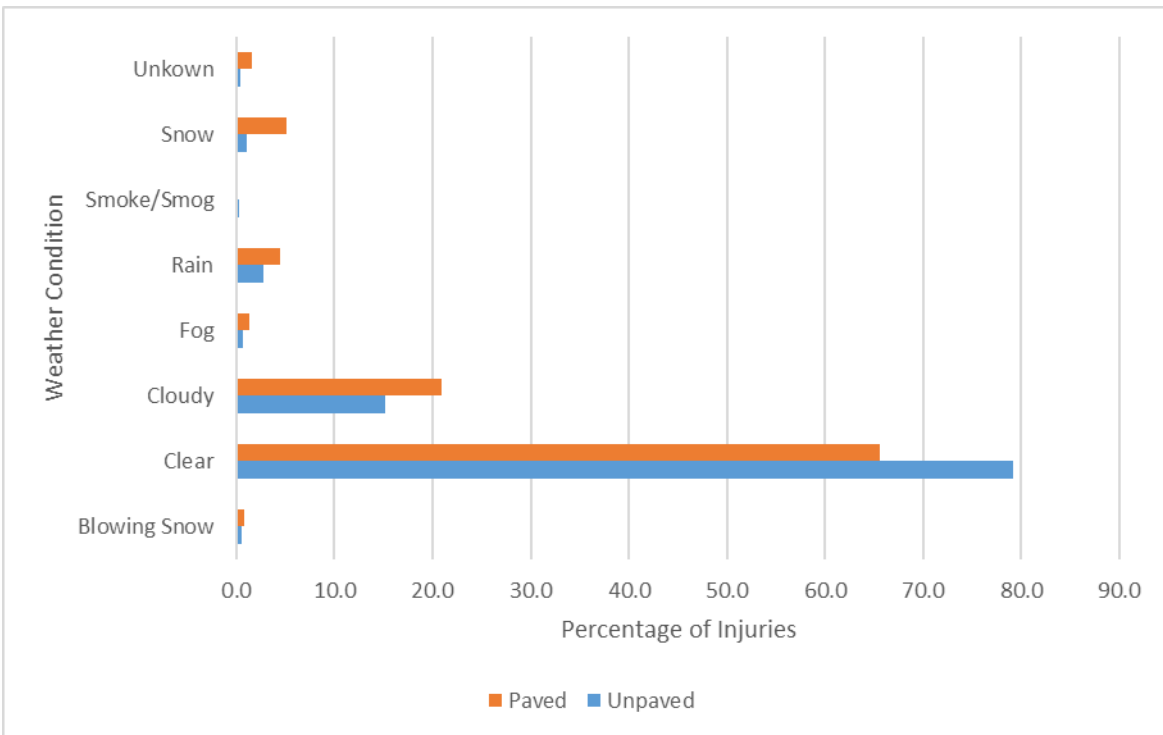
**Figure 4-9 Fatal crashes by time of day on paved and unpaved roads in Idaho**



**Figure 4-10 A Severe injury crashes by time of day on paved and unpaved roads in Idaho**



**Figure 4-11 Fatal crashes by weather conditions on paved and unpaved roads in Idaho**



**Figure 4-12 A Severity crashes by weather conditions on paved and unpaved roads in Idaho**

### 4.3. Proportion Analysis – Paved and Unpaved Roads

In this proportion analysis, fatal and severe injury crashes on unpaved roads will be compared to paved roads for various categories. The proportion of various characteristics of crashes on roads of different crash severities, number of crashes, types of vehicles, age, and impairment were isolated for comparison. These proportions were then statistically tested to determine if differences between pairs of proportions were statistically significant. Given adequate sample sizes and assumptions of independence of the proportions, the z-statistic for a standard Normal random variable was utilized for the test. The following steps describe the analytical procedures used:

1. The null hypothesis is defined by the difference between two proportions being tested is zero. The null ( $H_0$ ) hypothesis statement is  $p\text{-value} \leq \alpha$  and the alternative ( $H_a$ ) hypothesis is  $p\text{-value} > \alpha$ .
2. The confidence level is 95%, thus  $\alpha$  (alpha) is 5% or 0.05.
3. The weighted average ( $X_w$ ) of the two proportions was calculated. The formula used is below.

$$p = \frac{n_1 p_1 + n_2 p_2}{n_1 + n_2}$$

4. The standard error of the difference between proportions was computed by the following formula:

$$E = \sqrt{\frac{p(1-p)}{n_1} + \frac{p(1-p)}{n_2}}$$

5. The Z-statistic was computed by:

$$z = \frac{|p_1 - p_2|}{E}$$

6. The P-value is then computed.
7. Once the P-value is calculated the result can be compared to  $\alpha$ .

Reflecting on the extensive data presented in Table 4.4, the most commonly used protection device used by Idahoans and visitors are shoulder and lap belts. Unfortunately, more people involved in fatal and incapacitating injuries on unpaved roads do not use any form of protection. The data shows an alarming trend of 40% of people not using any protection devices on unpaved roads with 50% of fatal injuries occurring because of no protection device. The shift in ATV use on unpaved roads could contribute to the large percentage of people succumbing to fatal crashes. Individuals between the ages of 25 and 34 are more susceptible to fatal injuries on unpaved roads and individuals between the ages of 15 and 24 are more susceptible to incapacitating injuries on unpaved roads. For Idaho, rural roads make up approximately 75% of total roads and 32% of total fatalities. This warrants more need for education and enforcement for these rural low volume roads. These proportion test results show that many of these results have a calculated p-value less than 0.05, indicating that these results are statistically significant at the 95% confidence level.

**Table 4-4 Proportion analysis of a variety of factors for fatal and severe injury crashes on paved and unpaved roads in Idaho**

<b>Crash Severity</b>	<b>Frequency (unpaved)</b>	<b>%</b>	<b>Frequency (Paved)</b>	<b>%</b>	<b><math>\chi^2_w</math></b>	<b>Error</b>	<b>Z</b>	<b>P-value</b>	<b>% Ratio</b>
Fatal	127		1130						
"A" - Incapacitating	694		6465						
<b># of Incapacitating and Fatal Injuries by Vehicle Type</b>	<b>Frequency</b>	<b>%</b>	<b>Frequency</b>	<b>%</b>	<b><math>\chi^2_w</math></b>	<b>Error</b>	<b>Z</b>	<b>P-value</b>	<b>% Ratio</b>
Car	116	14.1	2650	34.9	2402.5	88.3	28.7	0.00	0.40
ATV	167	20.3	148	2.0	149.9	5.5	3.5	0.00	10.42
Motorcycle	38	4.6	747	9.8	677.7	24.9	28.5	0.00	0.47
Pickup	139	16.9	925	12.2	848.2	31.1	25.2	0.00	1.39
Pickup/Van/Panel/SUV	196	23.9	1562	20.6	1428.6	52.5	26.0	0.00	1.16
SUV/Crossover	119	14.5	875	11.5	801.2	29.4	25.7	0.00	1.26
Other	46	5.6	677	8.9	615.4	22.6	27.9	0.00	0.63
<b># of Fatal Injuries by Vehicle Type</b>	<b>Frequency</b>	<b>%</b>	<b>Frequency</b>	<b>%</b>	<b><math>\chi^2_w</math></b>	<b>Error</b>	<b>Z</b>	<b>P-value</b>	<b>% Ratio</b>
Car	21	16.5	370	32.7	334.7	31.3	11.2	0.00	0.51
ATV	30	23.6	23	2.0	23.7	2.2	3.2	0.0022	11.61
Motorcycle	2	1.6	118	10.4	106.3	9.9	11.7	0.00	0.15
Pickup	28	22.0	157	13.9	144.0	13.4	9.6	0.00	1.59
Pickup/Van/Panel/SUV	29	22.8	228	20.2	207.9	19.4	10.3	0.00	1.13
SUV/Crossover	15	11.8	133	11.8	121.1	11.3	10.5	0.00	1.00
Other	2	1.6	101	8.9	91.0	8.5	11.7	0.00	0.18
<b>Age ("A" Severity and Fatal)</b>	<b>Frequency</b>	<b>%</b>	<b>Frequency</b>	<b>%</b>	<b><math>\chi^2_w</math></b>	<b>Error</b>	<b>Z</b>	<b>P-value</b>	<b>% Ratio</b>
14 yrs & Under	43	5.3	26	0.3	27.7	1.0	17.0	0.00	15.31
15 to 24 yrs	293	36.0	2157	28.6	1974.1	72.5	25.7	0.00	1.26
25 to 34 yrs	164	20.1	1425	18.9	1301.3	47.8	26.4	0.00	1.07
35 to 44 yrs	118	14.5	1114	14.8	1016.3	37.3	26.7	0.00	0.98
45 to 54 yrs	79	9.7	1042	13.8	947.5	34.8	27.7	0.00	0.70
55 to 64 yrs	72	8.8	891	11.8	810.6	29.8	27.5	0.00	0.75
65 to 74 yrs	29	3.6	551	7.3	499.8	18.3	28.4	0.00	0.49
75 & Older	17	2.1	340	4.5	308.3	11.3	28.6	0.00	0.46

**Table 4.4 (Cont.) Proportion analysis of a variety of factors for fatal and severe injury crashes on paved and unpaved roads in Idaho**

<b>Drug and Alcohol Involved</b>	<b>Frequency (unpaved)</b>	<b>%</b>	<b>Frequency (Paved)</b>	<b>%</b>	<b><math>\chi^2_w</math></b>	<b>Error</b>	<b>Z</b>	<b>P-value</b>	<b>% Ratio</b>
Impaired	158	19.2	1007	13.3	924.1	33.9	25.0	0.00	1.45
Unimpaired	663	80.8	6577	86.7	5999.3	220.4	26.8	0.00	0.93
<b>Protection Device</b>	<b>Frequency</b>	<b>%</b>	<b>Frequency</b>	<b>%</b>	<b><math>\chi^2_w</math></b>	<b>Error</b>	<b>Z</b>	<b>P-value</b>	<b>% Ratio</b>
Air Bag Activated- Belts In Use	10	1.2	648	8.5	585.7	21.5	29.7	0.00	0.14
Air Bag Activated- No Belts In Use	20	2.4	177	2.3	161.7	5.9	26.5	0.00	1.04
Helmet Used	67	8.2	469	6.2	429.7	15.8	25.5	0.00	1.32
No Helmet	84	10.2	236	3.1	221.2	8.1	18.7	0.00	3.29
Non-Activated Air Bag- Belts In Use	28	3.4	615	8.1	557.7	20.5	28.7	0.00	0.42
Non-Activated Air Bag- No Belts In Use	36	4.4	195	2.6	179.5	6.6	24.2	0.00	1.71
None	330	40.2	1902	25.1	1748.4	64.2	24.5	0.00	1.60
Shoulder and Lap	154	18.8	2792	36.8	2534.3	93.1	28.3	0.00	0.51
Shoulder Belt Only	4	0.5	63	0.8	57.2	2.1	28.3	0.00	0.59
Unknown/Other	88	10.7	487	6.4	448.0	16.4	24.3	0.00	1.67
<b>Light Conditions</b>	<b>Frequency</b>	<b>%</b>	<b>Frequency</b>	<b>%</b>	<b><math>\chi^2_w</math></b>	<b>Error</b>	<b>Z</b>	<b>P-value</b>	<b>% Ratio</b>
Dark, No Street Lights	223	27.16	2077	27.39	1895.9	69.6	26.6	0.00	0.99
Dark, Street Lights Off	1	0.122	32	0.422	29.0	1.0	29.6	0.00	0.29
Dark, Street Lights On	1	0.122	126	1.661	113.8	4.2	30.0	0.00	0.07
Dawn or Dusk	52	6.334	372	4.905	340.7	12.5	25.6	0.00	1.29
Day	535	65.16	4966	65.48	4533.2	166.5	26.6	0.00	1.00
Unknown	9	1.096	11	0.145	10.8	0.4	5.3	0.00	7.56
<b>Weather Conditions</b>	<b>Frequency</b>	<b>%</b>	<b>Frequency</b>	<b>%</b>	<b><math>\chi^2_w</math></b>	<b>Error</b>	<b>Z</b>	<b>P-value</b>	<b>% Ratio</b>
Blowing Snow	4	0.487	59	0.778	53.6	2.0	28.2	0.00	0.63
Clear	654	79.66	4993	65.84	4569.2	167.9	25.8	0.00	1.21
Cloudy	122	14.86	1613	21.27	1467.4	53.9	27.7	0.00	0.70
Fog	6	0.731	104	1.371	94.4	3.5	28.4	0.00	0.53
Rain	19	2.314	325	4.285	295.1	10.8	28.3	0.00	0.54
Smoke/Smog	2	0.244	10	0.132	9.2	0.3	25.0	0.00	1.85
Snow	8	0.974	361	4.76	326.5	12.0	29.5	0.00	0.20

**Table 4.4 (Cont.) Proportion analysis of a variety of factors for fatal and severe injury crashes on paved and unpaved roads in Idaho**

Contributing Circumstances	Frequency (unpaved)	%	Frequency (paved)	%	$\chi^2_{adj}$	Error	Z	P-value	% Ratio
Alcohol Impaired	146	17.78	921	12.14	845.3	31.0	25.0	0.00	1.46
Animal(s) in Roadway	4	0.487	138	1.82	124.9	4.6	29.3	0.00	0.27
Asleep, Drowsy, Fatigued	6	0.731	444	5.854	401.2	14.7	29.8	0.00	0.12
Distracted IN or ON Vehicle	19	2.314	159	2.097	145.3	5.3	26.3	0.00	1.10
Drove Left of Center	38	4.629	397	5.235	361.9	13.3	27.0	0.00	0.88
Drug Impaired	12	1.462	86	1.134	78.8	2.9	25.7	0.00	1.29
Emotional f?? Depressed, Angry, Disturbed	2	0.244	19	0.251	17.3	0.6	27.5	0.00	0.97
Exceeded Posted Speed	24	2.923	147	1.938	135.0	4.9	24.9	0.00	1.51
Failed to Maintain Lane	48	5.847	516	6.804	470.3	17.3	27.1	0.00	0.86
Failed to Obey Stop Sign	3	0.365	128	1.688	115.8	4.2	29.5	0.00	0.22
Failed to Yield	7	0.853	343	4.523	310.2	11.4	29.5	0.00	0.19
Following Too Close	3	0.365	104	1.371	94.1	3.4	29.4	0.00	0.27
Foot Slipped Off or Caught On Pedal	1	0.122	2	0.026	1.9	0.0	20.8	0.00	4.62
Improper Backing	3	0.365	20	0.264	18.3	0.7	25.9	0.00	1.39
Improper Overtaking	1	0.122	87	1.147	78.6	2.9	30.0	0.00	0.11
Improper Turn	7	0.853	47	0.62	43.1	1.6	25.6	0.00	1.38
Improperly Parked	3	0.365	2	0.026	2.1	0.1	17.9	0.00	13.86
Inattention	117	14.25	1143	15.07	1042.8	38.3	26.8	0.00	0.95
Other	31	3.776	511	6.738	464.1	17.0	28.2	0.00	0.56
Other Vehicle Defect	15	1.827	48	0.633	44.8	1.6	20.3	0.00	2.89
Overcorrected	49	5.968	381	5.024	348.6	12.8	26.0	0.00	1.19
Physical Impairment	2	0.244	22	0.29	20.0	0.7	27.9	0.00	0.84
Sick	1	0.122	39	0.514	35.3	1.3	29.7	0.00	0.24
Speed Too Fast For Conditions	199	24.24	1070	14.11	984.9	36.2	24.1	0.00	1.72
Steering	2	0.244	6	0.079	5.6	0.2	21.4	0.00	3.08
Unknown	59	7.186	722	9.52	657.2	24.1	27.5	0.00	0.75
Vision Obstruction	17	2.071	62	0.818	57.6	2.1	21.4	0.00	2.53
Wrong Side or Wrong Way	2	0.244	20	0.264	18.2	0.7	27.6	0.00	0.92

## CHAPTER 5. COUNTY-BASED RELATIVE CRASH RATE ANALYSIS FOR RURAL CRASHES IN IDAHO

### 5.1. Overview

This chapter presents the results of county-based relative crash rate analysis for rural crashes in Idaho conducted using four area-based exposure measures. The four exposure measures used to estimate crash rates for each of the 44 counties in Idaho include number of registered drivers, number of registered passenger vehicles, total population based on 2010 census, and total length of roadway network. Driver's license registration and registered passenger vehicles were obtained from the Department of Motor Vehicles, 2010 Population estimates were obtained from the US Census and the total length of the roadways was calculated in ArcGIS 10.2 using the state and local roadways network datasets provided by the Idaho Transportation Department.

### 5.2. Analysis and Results

RITI communities are often located in areas that are not accessible by high volume transportation corridors such as Highways and Interstates and therefore actual vehicle counts on the roadways are in many cases unknown or not up-to-date. In this study, four area-based exposure measures were used to estimate the amount of traffic that would be expected within each of the 44 counties in Idaho including the population of the county, the total miles of roadways in the county, the total number of driver's licenses in the county and the total number of vehicles registered in the county. These area-based metrics, however, are not without their shortcomings, as the vehicle crash rates can only be applied within the boundary of each county and at the spatial scale of individual counties. They do not capture the variability of crash rates within the county or describe relationships between the traffic volumes of different counties. Nevertheless, they serve as important indicators of the overall trends of rural crash rates in Idaho.

Table 5-1 lists the four exposure measures used to estimate crash rates for each of the 44 counties in Idaho. Table 5-2 through Table 5-5 and Figure 5-1 through 5-4 present crash rates for total crashes, number of vehicles involved in crashes, fatal and severe injury crashes, and injury crashes for rural crashes in Idaho. The results in the Figures are presented as choropleth maps with values classified using the Standard Deviation of the exposure measure values. These maps show that the distribution of crashes among counties in Idaho is uneven, with higher rates occurring in more rural areas with lower population counts. It is important to note that the number of registered vehicles and number of driver licenses issued are related to population estimates and the vehicle crash rate is likely influenced by these smaller values to normalize the rate by. The number of miles of road within a county provides a unique way of verifying which counties experience higher or lower vehicle crash rates.

The results presented in Figure 5-1 indicate that Boise County, Custer County and Clark County as having the highest number of Fatal and A severity crashes according to population-based metrics. The road-based metric indicates that Jerome County in the southern part of the state has a significantly higher crash rate. This could be explained by the small and relatively compact size of the county which would influence the final result in a similar fashion as the low population density in Boise County. Figures 5-2 through 5-4 show a similar distribution of values with higher values concentrated in the central portion of the state and smaller values along the periphery of the State with higher population values and larger County size.



Results of the analysis show consistent results. Boise County and Clark County have consistently high rural crash rates compared to the State average. Other counties that showed highest relative crash rates but produce less consistent results include Custer County and Lincoln County. A more formal statistical analysis that accounts for the spatial variability of these factors and normalization criteria would be required to demonstrate that these results are statistically significant.

**Table 5-1 Four county-based exposure measures to estimate relative rural crash rates**

<b>County</b>	<b>Number of Registered Drivers</b>	<b>Number of Registered Vehicles</b>	<b>Total Population (2010)</b>	<b>Total Length of Roadway Network</b>
Ada	278,182	290,266	392,365	32,923
Adams	2,624	3,767	3,976	1,550
Bannock	54,473	61,571	82,839	10,701
Bear Lake	4,509	6,121	5,986	1,785
Benewah	7,915	9,390	9,285	1,489
Bingham	27,778	37,801	45,607	7,105
Blaine	16,993	21,376	21,376	9,208
Boise	5,141	7,297	7,028	1,428
Bonner	32,091	38,188	40,877	7,286
Bonneville	69,020	87,375	104,234	15,573
Boundary	8,214	10,119	10,972	1,747
Butte	2,833	2,570	2,891	1,624
Camas	762	1,168	1,117	651
Canyon	106,279	141,012	188,923	14,205
Caribou	5,659	6,723	6,963	2,304
Cassia	16,958	18,119	22,952	4,098
Clark	1,165	858	982	1,201
Clearwater	7,356	7,840	8,761	2,635
Custer	2,666	4,389	4,368	3,776
Elmore	15,766	21,885	27,038	6,950
Franklin	9,533	11,109	12,786	1,390
Fremont	8,031	10,679	13,242	4,673
Gem	13,787	15,263	16,719	1,471
Gooding	8,823	13,041	15,464	1,673
Idaho	11,058	13,767	16,267	11,478
Jefferson	15,928	21,180	26,140	2,652
Jerome	13,357	18,536	22,374	1,596
Kootenai	102,912	123,648	138,494	10,256
Latah	25,268	25,896	37,244	3,935
Lemhi	6,204	7,577	7,936	5,040
Lewis	2,407	3,839	3,821	1,486
Lincoln	3,549	4,336	5,208	1,099
Madison	20,776	19,577	37,536	1,770
Minidoka	11,471	17,853	20,069	2,201
Nez Perce	30,280	33,762	39,265	4,561
Oneida	3,840	4,011	4,286	1,356
Owyhee	10,557	10,442	11,526	4,910
Payette	17,566	18,958	22,623	1,437
Power	6,427	7,313	7,817	2,830
Shoshone	9,936	12,889	12,765	5,439
Teton	6,751	8,337	10,170	1,236
Twin Falls	53,103	63,090	77,230	10,296
Valley	9,071	10,312	9,862	6,576
Washington	6,859	8,707	10,198	1,809
<b>Total</b>	<b>1,073,878</b>	<b>1,261,957</b>	<b>1,567,582</b>	<b>219,409</b>

**Table 5-2 Rural crashes in different counties in Idaho relative to the number of registered drivers**

County	Number of Crashes	Number of Vehicles Involved	Number of Fatalities	Number of Injuries	Number of Registered Drivers	Relative Crash Rate (Crash/1000 Registered Drivers)			
						Number of Crashes	Number of Vehicles Involved	Number of Fatalities	Number of Injuries
Ada	636	1,142	65	1,042	278,182	2.29	4.11	0.23	3.75
Adams	56	78	21	83	2,624	21.34	29.73	8.00	31.63
Bannock	227	314	53	389	54,473	4.17	5.76	0.97	7.14
Bear Lake	67	90	20	117	4,509	14.86	19.96	4.44	25.95
Benewah	88	114	23	128	7,915	11.12	14.40	2.91	16.17
Bingham	330	495	89	529	27,778	11.88	17.82	3.20	19.04
Blaine	74	112	22	125	16,993	4.35	6.59	1.29	7.36
Boise	284	346	55	393	5,141	55.24	67.30	10.70	76.44
Bonner	358	532	82	518	32,091	11.16	16.58	2.56	16.14
Bonneville	314	510	57	564	69,020	4.55	7.39	0.83	8.17
Boundary	96	132	19	159	8,214	11.69	16.07	2.31	19.36
Butte	42	56	8	74	2,833	14.83	19.77	2.82	26.12
Camas	12	15	5	15	762	15.75	19.69	6.56	19.69
Canyon	757	1,333	136	1,346	106,279	7.12	12.54	1.28	12.66
Caribou	53	70	20	84	5,659	9.37	12.37	3.53	14.84
Cassia	206	290	66	327	16,958	12.15	17.10	3.89	19.28
Clark	41	54	15	64	1,165	35.19	46.35	12.88	54.94
Clearwater	65	82	15	91	7,356	8.84	11.15	2.04	12.37
Custer	97	110	29	110	2,666	36.38	41.26	10.88	41.26
Elmore	406	555	94	664	15,766	25.75	35.20	5.96	42.12
Franklin	95	124	22	163	9,533	9.97	13.01	2.31	17.10
Fremont	111	173	28	230	8,031	13.82	21.54	3.49	28.64
Gem	86	124	18	135	13,787	6.24	8.99	1.31	9.79
Gooding	158	211	45	238	8,823	17.91	23.91	5.10	26.97
Idaho	264	321	79	347	11,058	23.87	29.03	7.14	31.38
Jefferson	117	170	27	196	15,928	7.35	10.67	1.70	12.31
Jerome	266	424	82	491	13,357	19.91	31.74	6.14	36.76
Kootenai	558	868	96	884	102,912	5.42	8.43	0.93	8.59
Latah	207	291	45	331	25,268	8.19	11.52	1.78	13.10
Lemhi	104	122	27	141	6,204	16.76	19.66	4.35	22.73
Lewis	42	58	11	61	2,407	17.45	24.10	4.57	25.34
Lincoln	61	84	23	88	3,549	17.19	23.67	6.48	24.80
Madison	81	141	21	161	20,776	3.90	6.79	1.01	7.75
Minidoka	126	192	42	206	11,471	10.98	16.74	3.66	17.96
Nez Perce	198	284	50	305	30,280	6.54	9.38	1.65	10.07
Oneida	49	54	17	82	3,840	12.76	14.06	4.43	21.35
Owyhee	84	98	26	133	10,557	7.96	9.28	2.46	12.60
Payette	178	265	34	287	17,566	10.13	15.09	1.94	16.34
Power	99	126	35	170	6,427	15.40	19.60	5.45	26.45
Shoshone	119	155	36	155	9,936	11.98	15.60	3.62	15.60
Teton	39	59	7	52	6,751	5.78	8.74	1.04	7.70
Twin Falls	389	618	90	622	53,103	7.33	11.64	1.69	11.71
Valley	149	194	18	230	9,071	16.43	21.39	1.98	25.36
Washington	70	99	17	96	6,859	10.21	14.43	2.48	14.00
<b>Average</b>	<b>178.61</b>	<b>265.57</b>	<b>40.68</b>	<b>286.95</b>	<b>24,406.32</b>	<b>13.67</b>	<b>18.41</b>	<b>3.73</b>	<b>20.88</b>

**Table 5-3 Rural crashes in different counties in Idaho relative to the number of registered vehicles**

County	Number of Crashes	Number of Vehicles Involved	Number of Fatalities	Number of Injuries	Number of Registered Vehicles	Relative Crash Rate (Crash/1000 Registered Vehicles)			
						Number of Crashes	Number of Vehicles Involved	Number of Fatalities	Number of Injuries
Ada	636	1,142	65	1,042	290,266	2.19	3.93	0.22	3.59
Adams	56	78	21	83	3,767	14.87	20.71	5.58	22.03
Bannock	227	314	53	389	61,571	3.69	5.10	0.86	6.32
Bear Lake	67	90	20	117	6,121	10.95	14.70	3.27	19.12
Benewah	88	114	23	128	9,390	9.37	12.14	2.45	13.63
Bingham	330	495	89	529	37,801	8.73	13.10	2.35	13.99
Blaine	74	112	22	125	21,376	3.46	5.24	1.03	5.85
Boise	284	346	55	393	7,297	38.92	47.42	7.54	53.86
Bonner	358	532	82	518	38,188	9.38	13.93	2.15	13.56
Bonneville	314	510	57	564	87,375	3.59	5.84	0.65	6.46
Boundary	96	132	19	159	10,119	9.49	13.05	1.88	15.71
Butte	42	56	8	74	2,570	16.34	21.79	3.11	28.79
Camas	12	15	5	15	1,168	10.27	12.84	4.28	12.84
Canyon	757	1,333	136	1,346	141,012	5.37	9.45	0.96	9.55
Caribou	53	70	20	84	6,723	7.88	10.41	2.98	12.49
Cassia	206	290	66	327	18,119	11.37	16.01	3.64	18.05
Clark	41	54	15	64	858	47.79	62.94	17.48	74.59
Clearwater	65	82	15	91	7,840	8.29	10.46	1.91	11.61
Custer	97	110	29	110	4,389	22.10	25.06	6.61	25.06
Elmore	406	555	94	664	21,885	18.55	25.36	4.30	30.34
Franklin	95	124	22	163	11,109	8.55	11.16	1.98	14.67
Fremont	111	173	28	230	10,679	10.39	16.20	2.62	21.54
Gem	86	124	18	135	15,263	5.64	8.12	1.18	8.85
Gooding	158	211	45	238	13,041	12.12	16.18	3.45	18.25
Idaho	264	321	79	347	13,767	19.18	23.32	5.74	25.21
Jefferson	117	170	27	196	21,180	5.52	8.03	1.28	9.25
Jerome	266	424	82	491	18,536	14.35	22.87	4.42	26.49
Kootenai	558	868	96	884	123,648	4.51	7.02	0.78	7.15
Latah	207	291	45	331	25,896	7.99	11.24	1.74	12.78
Lemhi	104	122	27	141	7,577	13.73	16.10	3.56	18.61
Lewis	42	58	11	61	3,839	10.94	15.11	2.87	15.89
Lincoln	61	84	23	88	4,336	14.07	19.37	5.30	20.30
Madison	81	141	21	161	19,577	4.14	7.20	1.07	8.22
Minidoka	126	192	42	206	17,853	7.06	10.75	2.35	11.54
Nez Perce	198	284	50	305	33,762	5.87	8.41	1.48	9.03
Oneida	49	54	17	82	4,011	12.22	13.46	4.24	20.44
Owyhee	84	98	26	133	10,442	8.04	9.39	2.49	12.74
Payette	178	265	34	287	18,958	9.39	13.98	1.79	15.14
Power	99	126	35	170	7,313	13.54	17.23	4.79	23.25
Shoshone	119	155	36	155	12,889	9.23	12.03	2.79	12.03
Teton	39	59	7	52	8,337	4.68	7.08	0.84	6.24
Twin Falls	389	618	90	622	63,090	6.17	9.80	1.43	9.86
Valley	149	194	18	230	10,312	14.45	18.81	1.75	22.30
Washington	70	99	17	96	8,707	8.04	11.37	1.95	11.03
<b>Average</b>	<b>178.61</b>	<b>265.57</b>	<b>40.68</b>	<b>286.95</b>	<b>28,680.84</b>	<b>11.19</b>	<b>15.08</b>	<b>3.07</b>	<b>17.23</b>

**Table 5-4 Rural crashes in different counties in Idaho relative to the county population**

County	Number of Crashes	Number of Vehicles involved	Number of Fatalities	Number of Injuries	County Population (2010 Census)	Relative Crash Rate (Crash/1000 population)			
						Number of Crashes	Number of Vehicles involved	Number of Fatalities	Number of Injuries
Ada	636	1,142	65	1,042	392,365	1.62	2.91	0.17	2.66
Adams	56	78	21	83	3,976	14.09	19.62	5.28	20.88
Bannock	227	314	53	389	82,839	2.74	3.79	0.64	4.70
Bear Lake	67	90	20	117	5,986	11.19	15.04	3.34	19.55
Benewah	88	114	23	128	9,285	9.48	12.28	2.48	13.79
Bingham	330	495	89	529	45,607	7.24	10.85	1.95	11.60
Blaine	74	112	22	125	21,376	3.46	5.24	1.03	5.85
Boise	284	346	55	393	7,028	40.41	49.23	7.83	55.92
Bonner	358	532	82	518	40,877	8.76	13.02	2.01	12.67
Bonneville	314	510	57	564	104,234	3.01	4.89	0.55	5.41
Boundary	96	132	19	159	10,972	8.75	12.03	1.73	14.49
Butte	42	56	8	74	2,891	14.53	19.37	2.77	25.60
Camas	12	15	5	15	1,117	10.74	13.43	4.48	13.43
Canyon	757	1,333	136	1,346	188,923	4.01	7.06	0.72	7.13
Caribou	53	70	20	84	6,963	7.61	10.05	2.87	12.06
Cassia	206	290	66	327	22,952	8.98	12.64	2.88	14.25
Clark	41	54	15	64	982	41.75	54.99	15.28	65.17
Clearwater	65	82	15	91	8,761	7.42	9.36	1.71	10.39
Custer	97	110	29	110	4,368	22.21	25.18	6.64	25.18
Elmore	406	555	94	664	27,038	15.02	20.53	3.48	24.56
Franklin	95	124	22	163	12,786	7.43	9.70	1.72	12.75
Fremont	111	173	28	230	13,242	8.38	13.06	2.11	17.37
Gem	86	124	18	135	16,719	5.14	7.42	1.08	8.08
Gooding	158	211	45	238	15,464	10.22	13.65	2.91	15.39
Idaho	264	321	79	347	16,267	16.23	19.73	4.86	21.33
Jefferson	117	170	27	196	26,140	4.48	6.50	1.03	7.50
Jerome	266	424	82	491	22,374	11.89	18.95	3.67	21.95
Kootenai	558	868	96	884	138,494	4.03	6.27	0.69	6.38
Latah	207	291	45	331	37,244	5.56	7.81	1.21	8.89
Lemhi	104	122	27	141	7,936	13.11	15.37	3.40	17.77
Lewis	42	58	11	61	3,821	10.99	15.18	2.88	15.96
Lincoln	61	84	23	88	5,208	11.71	16.13	4.42	16.90
Madison	81	141	21	161	37,536	2.16	3.76	0.56	4.29
Minidoka	126	192	42	206	20,069	6.28	9.57	2.09	10.27
Nez Perce	198	284	50	305	39,265	5.04	7.23	1.27	7.77
Oneida	49	54	17	82	4,286	11.43	12.60	3.97	19.13
Owyhee	84	98	26	133	11,526	7.29	8.50	2.26	11.54
Payette	178	265	34	287	22,623	7.87	11.71	1.50	12.69
Power	99	126	35	170	7,817	12.67	16.12	4.48	21.75
Shoshone	119	155	36	155	12,765	9.32	12.14	2.82	12.14
Teton	39	59	7	52	10,170	3.84	5.80	0.69	5.11
Twin Falls	389	618	90	622	77,230	5.04	8.00	1.17	8.05
Valley	149	194	18	230	9,862	15.11	19.67	1.83	23.32
Washington	70	99	17	96	10,198	6.86	9.71	1.67	9.41
<b>Average</b>	<b>178.61</b>	<b>265.57</b>	<b>40.68</b>	<b>286.95</b>	<b>35,626.86</b>	<b>10.12</b>	<b>13.55</b>	<b>2.77</b>	<b>15.48</b>

**Table 5-5 Rural crashes in different counties in Idaho relative to the total length of roadways**

County	Number of Crashes	Number of Vehicles involved	Number of Fatalities	Number of Injuries	Total Length of Roadways (miles)	Relative Crash Rate (Crash/1000 miles)			
						Number of Crashes	Number of Vehicles involved	Number of Fatalities	Number of Injuries
Ada	636	1,142	65	1,042	12,964	49.06	88.09	5.01	80.37
Adams	56	78	21	83	610	4.32	6.02	1.62	6.40
Bannock	227	314	53	389	4,214	17.51	24.22	4.09	30.01
Bear Lake	67	90	20	117	703	5.17	6.94	1.54	9.02
Benewah	88	114	23	128	586	6.79	8.79	1.77	9.87
Bingham	330	495	89	529	2,798	25.45	38.18	6.86	40.80
Blaine	74	112	22	125	3,626	5.71	8.64	1.70	9.64
Boise	284	346	55	393	562	21.91	26.69	4.24	30.31
Bonner	358	532	82	518	2,869	27.61	41.04	6.32	39.96
Bonneville	314	510	57	564	6,132	24.22	39.34	4.40	43.50
Boundary	96	132	19	159	688	7.40	10.18	1.47	12.26
Butte	42	56	8	74	639	3.24	4.32	0.62	5.71
Camas	12	15	5	15	256	0.93	1.16	0.39	1.16
Canyon	757	1,333	136	1,346	5,594	58.39	102.82	10.49	103.82
Caribou	53	70	20	84	907	4.09	5.40	1.54	6.48
Cassia	206	290	66	327	1,614	15.89	22.37	5.09	25.22
Clark	41	54	15	64	473	3.16	4.17	1.16	4.94
Clearwater	65	82	15	91	1,038	5.01	6.32	1.16	7.02
Custer	97	110	29	110	1,487	7.48	8.48	2.24	8.48
Elmore	406	555	94	664	2,737	31.32	42.81	7.25	51.22
Franklin	95	124	22	163	548	7.33	9.56	1.70	12.57
Fremont	111	173	28	230	1,840	8.56	13.34	2.16	17.74
Gem	86	124	18	135	579	6.63	9.56	1.39	10.41
Gooding	158	211	45	238	659	12.19	16.28	3.47	18.36
Idaho	264	321	79	347	4,520	20.36	24.76	6.09	26.77
Jefferson	117	170	27	196	1,044	9.02	13.11	2.08	15.12
Jerome	266	424	82	491	628	20.52	32.70	6.32	37.87
Kootenai	558	868	96	884	4,039	43.04	66.95	7.40	68.19
Latah	207	291	45	331	1,550	15.97	22.45	3.47	25.53
Lemhi	104	122	27	141	1,985	8.02	9.41	2.08	10.88
Lewis	42	58	11	61	585	3.24	4.47	0.85	4.71
Lincoln	61	84	23	88	433	4.71	6.48	1.77	6.79
Madison	81	141	21	161	697	6.25	10.88	1.62	12.42
Minidoka	126	192	42	206	867	9.72	14.81	3.24	15.89
Nez Perce	198	284	50	305	1,796	15.27	21.91	3.86	23.53
Oneida	49	54	17	82	534	3.78	4.17	1.31	6.32
Owyhee	84	98	26	133	1,933	6.48	7.56	2.01	10.26
Payette	178	265	34	287	566	13.73	20.44	2.62	22.14
Power	99	126	35	170	1,115	7.64	9.72	2.70	13.11
Shoshone	119	155	36	155	2,142	9.18	11.96	2.78	11.96
Teton	39	59	7	52	487	3.01	4.55	0.54	4.01
Twin Falls	389	618	90	622	4,054	30.01	47.67	6.94	47.98
Valley	149	194	18	230	2,589	11.49	14.96	1.39	17.74
Washington	70	99	17	96	712	5.40	7.64	1.31	7.40
<b>Average</b>	<b>178.61</b>	<b>265.57</b>	<b>40.68</b>	<b>286.95</b>	<b>1,963.64</b>	<b>13.78</b>	<b>20.48</b>	<b>3.14</b>	<b>22.13</b>

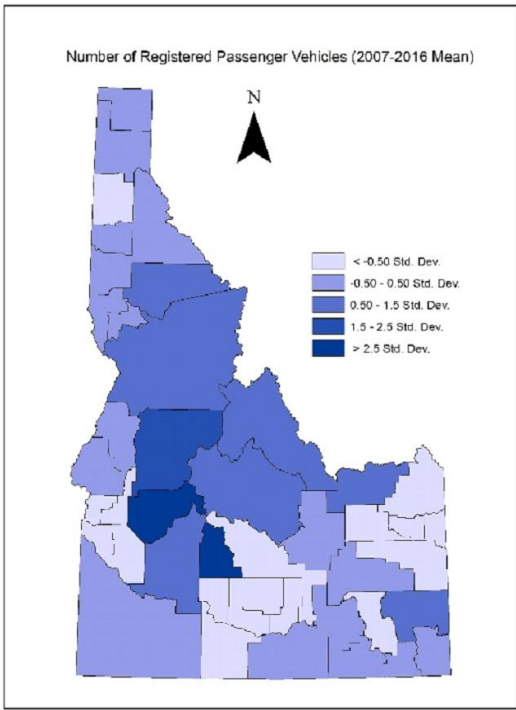
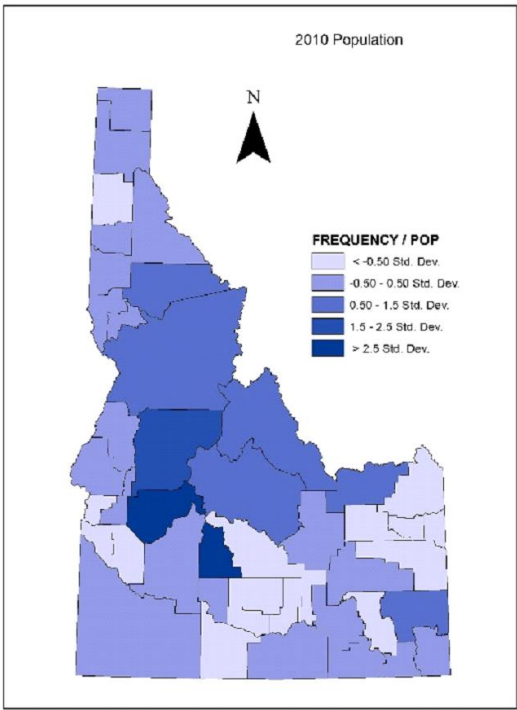
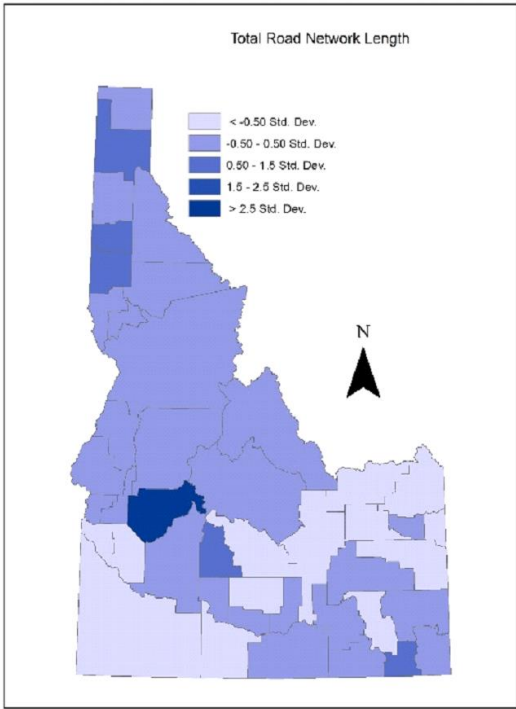
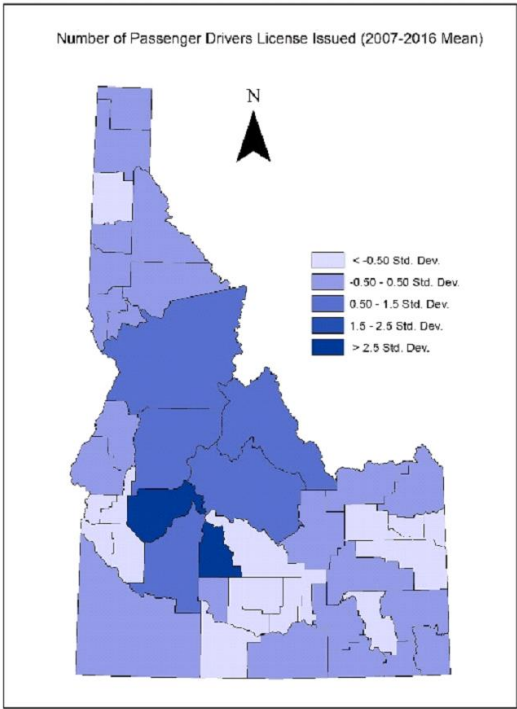


Figure 5-1 Relative crash rates – total rural crashes in Idaho

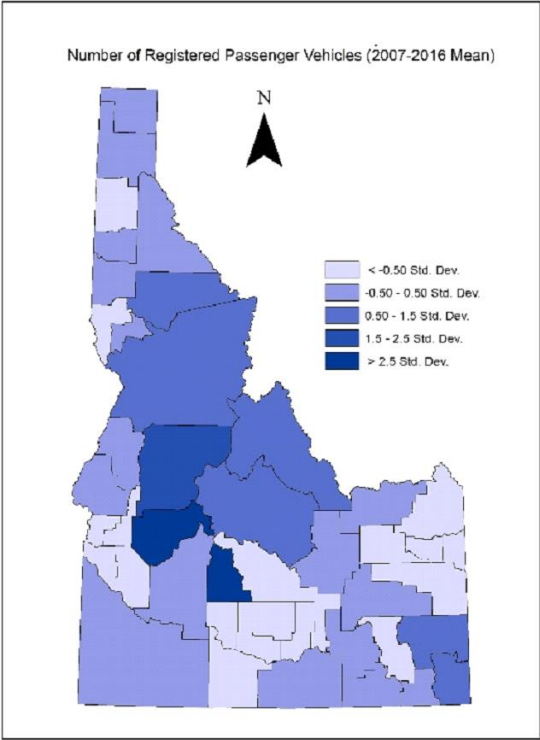
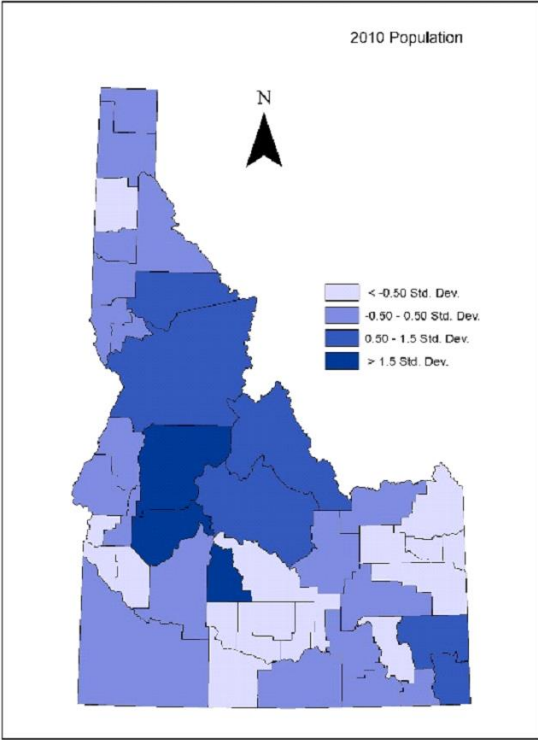
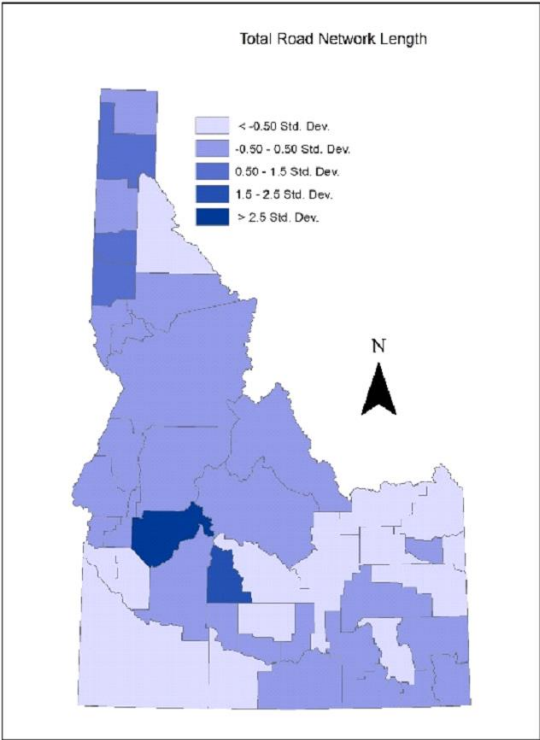
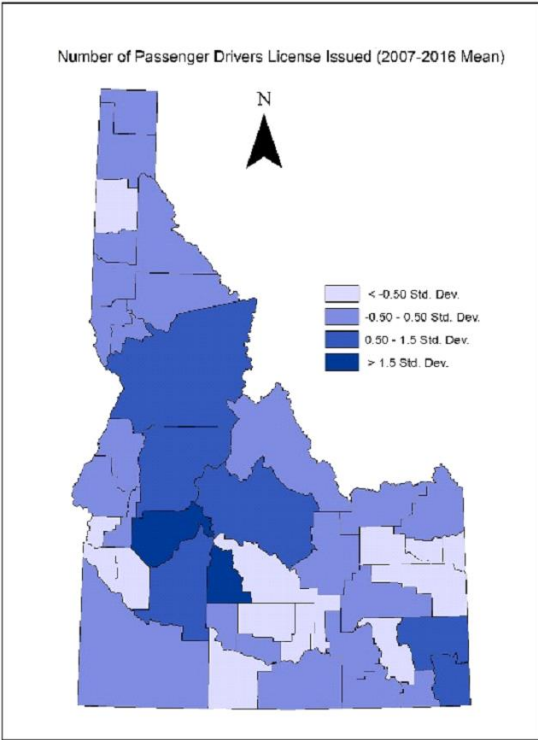


Figure 5-2 Relative crash rates – fatal and severe injury rural crashes in Idaho



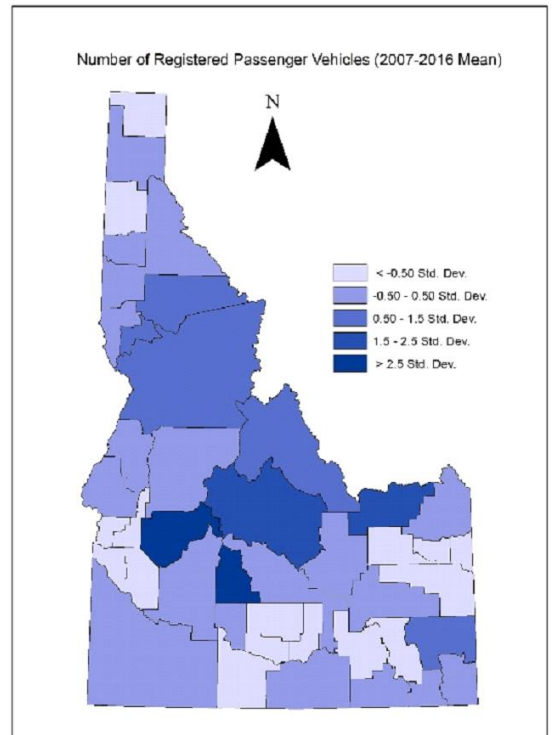
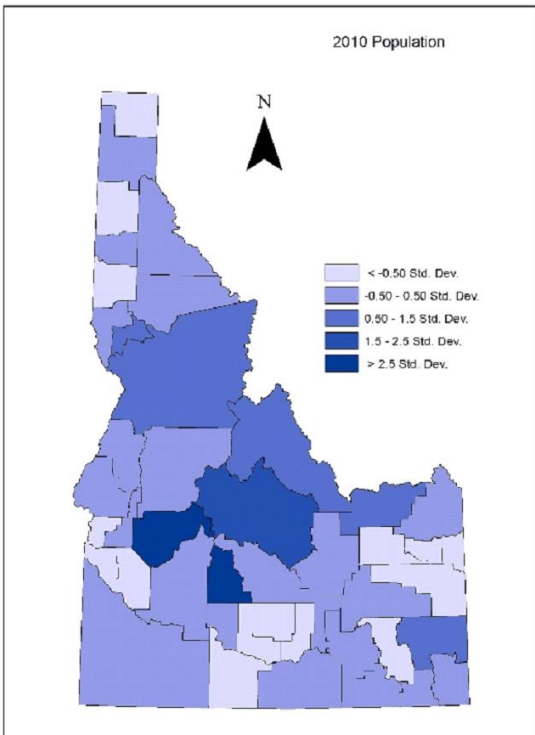
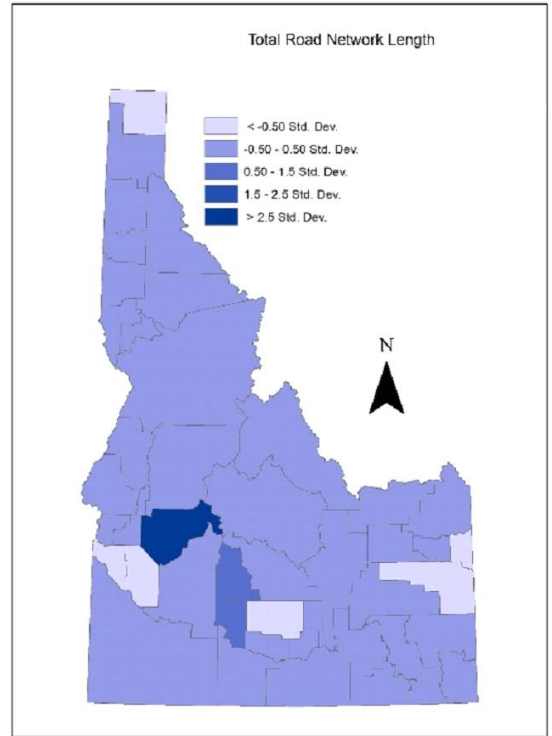
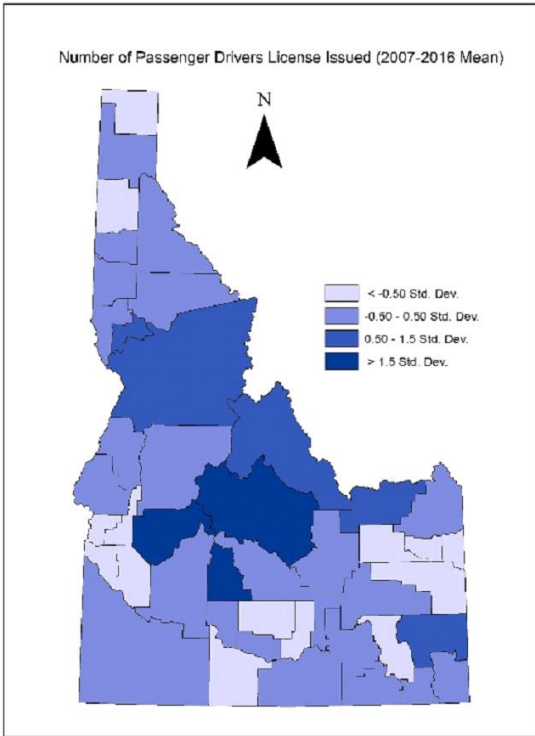
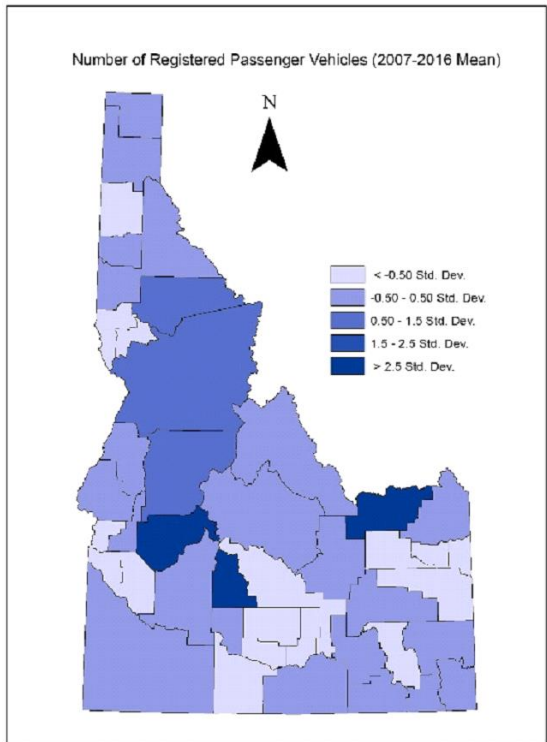
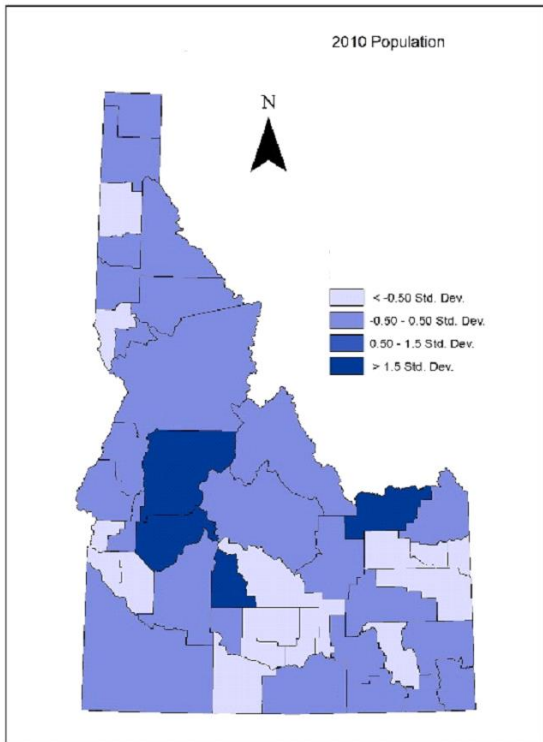
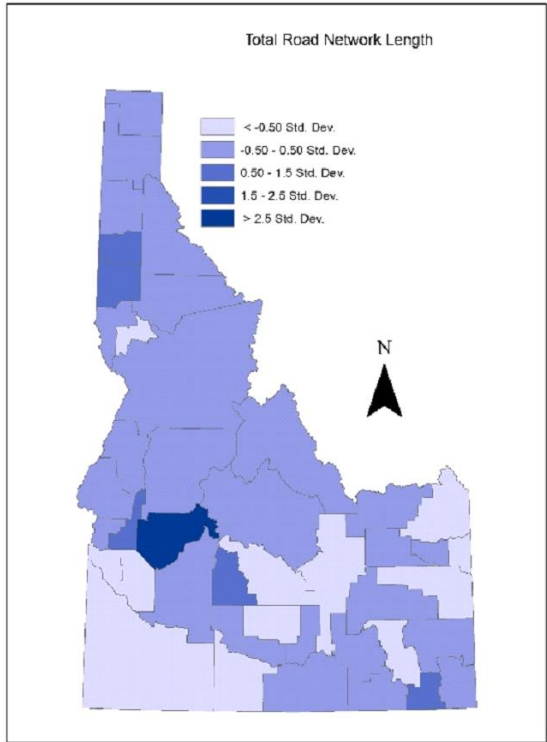
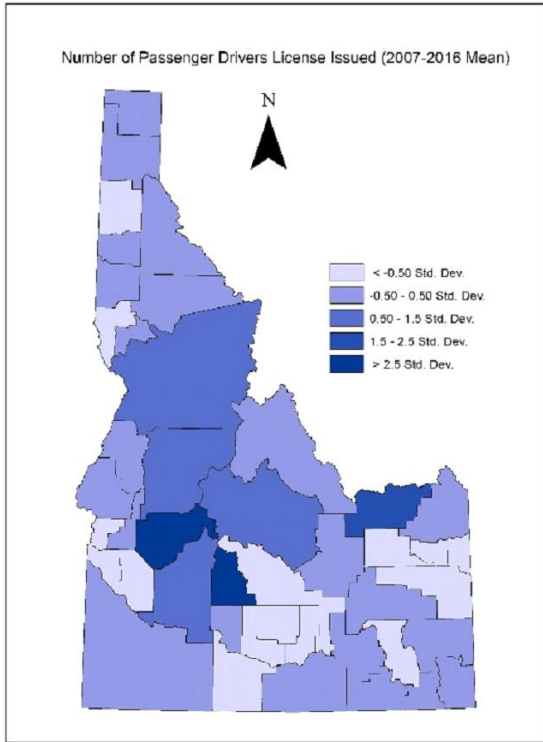


Figure 5-3 Relative crash rates for number of vehicles involved in rural crashes in Idaho



**Figure 5-4 Relative crash rates for injury rural crashes in Idaho**

## CHAPTER 6. STUDY FINDINGS AND CONCLUSIONS

This report documented the characteristics of traffic crashes for RITI communities in Idaho covering fatal and severe injury crashes on low-volume unpaved and paved roads in rural Idaho. The analysis was conducted using Idaho crash records that covered a ten-year period from 2007 to 2016. Three different roadway datasets were used in the analysis including the state highway network, the local (county and city) highway networks, and the U.S. Forest service roadway network.

The results of analysis of fatal and severe injury crashes on unpaved roads clearly shows that ATVs and pickup trucks and the two most common vehicle types involved in crashes in these roads. The results also showed that the majority of fatal and severe injury crashes on unpaved roads involved male drivers and occupants 24 years or younger with considerable number involving occupants younger than 14 years old. The results also showed that the majority of these crashes happened during daylight and in clear or cloudy weather conditions. Inclement weather was not a factor that influenced crashes on unpaved roads. Alcohol impairment, inattention, and speeding seem to be the three major contributing circumstances in fatal and severe injury crashes on unpaved roads.

A comparative safety analysis was conducted to identify and document the differences in characteristics between crashes that occurred on unpaved and paved rural roads in Idaho. The results of the analysis show that the percent of fatal and severe injury crashes where no restraining device was used is much higher on unpaved roads (50.4% and 38.3% on unpaved roads compared to 37.9 and 22.8 on paved roads). The same trend also exists in helmet use which shows the critical need for a much more aggressive seat belt and helmet use enforcement among communities who use rural unpaved roads in Idaho. The results also show a substantial difference in ATV crashes on unpaved versus paved. This is not surprising considering ATV usage is largely implemented on these roads due to the environment and location. Teenagers or children that are 14 years or younger are more susceptible to fatal and severe injuries on unpaved roads compared to paved roads. Crash injuries for age groups from 15 to 44 are also higher on unpaved roadways. The results also clearly highlight the fact that unpaved roads have a higher percentage of crashes where alcohol impairment is a major contributing circumstance. The same is true for speeding and inattention related crashes. A proportion statistical test results show that many of these results have a calculated p-value less than 0.05, indicating that these results are statistically significant at the 95% confidence level.

A county-based crash rate analysis was conducted to investigate the relative crash rates in rural roads for different counties in Idaho. Four different exposure measures were used to estimate the relative crash rates values. These exposure measures included number of registered drivers in the county, number of registered vehicles in the county, total county population, and total length of roadways in the county. The comparative analysis identified counties that have consistently higher rural crash rates compared to the state average (Boise County and Clark County). Other counties showed highest relative crash rates but produce less consistent results (Custer County and Lincoln County). A more formal statistical analysis that accounts for the spatial variability of these factors and exposure measures would be required to demonstrate that these results are statistically significant.

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