



Analysis of Intersection Fatal and Nonfatal Crashes from 2005 to 2009

Prepared by

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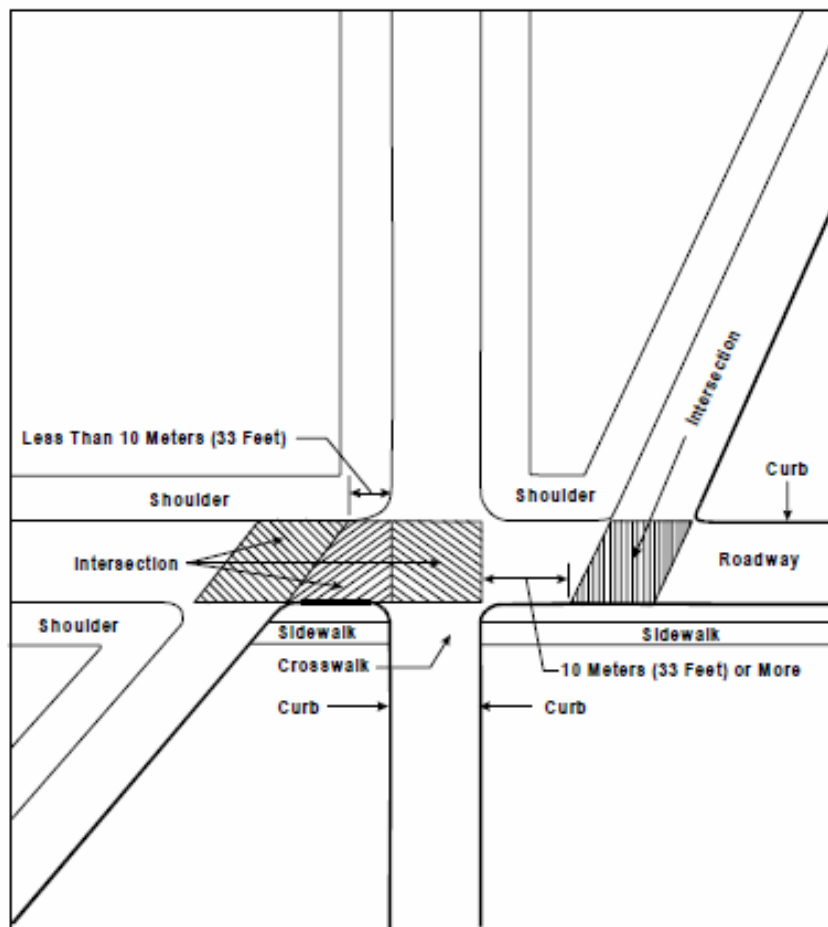


Table of Contents

Executive Summary	3
Introduction.....	4
Overview of Intersection Crashes.....	5
Intersection Crashes by State	8
Red Light Running Violations	11
Manner of Multiple Vehicle Collisions	12
Crashes with Moving Objects.....	12
Conclusions.....	14
Definitions.....	15

Executive Summary

Fatal and nonfatal crash trends at intersections were investigated using data from the National Highway Traffic Safety Administration's (NHTSA) Fatality Analysis Reporting System (FARS) and the National Automotive Sampling System (NASS) General Estimate System (GES) representing data years 2005 through 2009.

Although crash data at all intersections is reported, analysis focuses on those crashes that occur at intersections with properly functioning traffic control lights. The crash components explored include:

- Red light running violation
- Manner of multiple vehicle collisions
- Crashes with moving objects
- State of occurrence

Overall results show that although the number of fatal and nonfatal crashes at intersections has decreased over the last several years, the change is in proportion to the overall motor vehicle traffic crash trends. As a percentage of total crashes, crashes at intersections with traffic control lights have been very stable over the last five years of available data. Because the overall number of crashes has been sharply declining over the last several years, the proportion of crashes at intersections is used in this report to adjust for the overall downward crash trend.

Over the last five years, the number and percent of fatal crashes involving red light running violations has steadily decreased. The decrease of 256 red light running violation fatal crashes represents 58% of the total decrease in fatal crashes at intersections over this time frame. Because of data limitations, it is not clear if nonfatal crashes have been impacted in the same way.

Fatal intersection crashes tend to occur within intersections while nonfatal crashes tend to occur while entering or exiting intersections. In addition, over the last five years the proportion of nonfatal intersection crashes occurring while entering or exiting intersections has slowly been increasing.

Many of the other crash variables explored showed very stable findings across the years studied, with the percent of crashes that occur at intersections changing very little from one year to the next.

Introduction

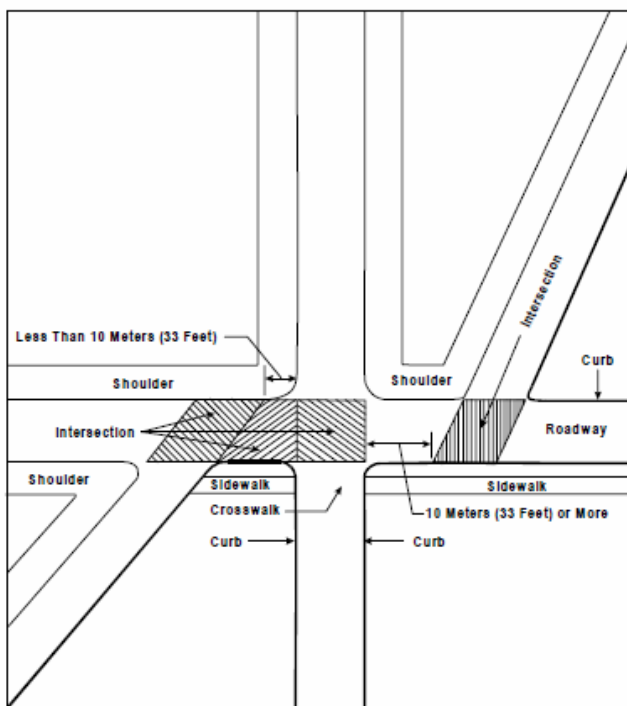
This report describes the characteristics of fatal and nonfatal motor vehicle traffic crashes that occur at roadway intersections in the United States with particular emphasis on those intersections with properly functioning traffic control lights.

The data presented in this report are from the National Highway Traffic Safety Administration's (NHTSA) Fatality Analysis Reporting System (FARS) and the National Automotive Sampling System (NASS) General Estimate System (GES). The data are from the final FARS and GES files from 2005 through 2009. FARS and GES identify crashes that occur at intersections and codes them as within-intersection crashes or intersection-related crashes. FARS is the source for all fatality and fatal crash estimates while GES is the source for all nonfatal injury and crash estimates. The FARS data represents a census of all fatal traffic crashes occurring each year in the United States. The GES data, on the other hand, represents a stratified sample of crashes. Because GES estimates are based on a sample instead of a census, the use of GES data is limited in several ways. First, since all GES estimates are national estimates, no state level estimates are possible. Second, because the GES data are only estimates based on samples, all nonfatal data are rounded in this report. Because of rounding, it should be noted that the total number of nonfatal crashes may not equal the sum of its subcomponents.

Both FARS and GES are based on the American National Standards Institute (ANSI) D-16 Manual on the classification of motor vehicle traffic crashes. ANSI D-16 defines an intersection as an area which:

Contains a crossing or connections of two or more roadways not classified as driveway access, and
Is embraced within the prolongation of the lateral curb lines or, if none, the lateral boundary lines of the roadways. Where the distance along a roadway between two areas meeting these criteria is less than 10 meters (33 feet), the two areas and the roadway connecting them are considered to be parts of a single intersection.

Figure 1 depicts the schematic of intersections as defined by ANSI D-16.



Source: ANSI D-16, Article 2.5.10, Figure 5

ANSI defines a traffic crash as a within-intersection crash if the first harmful event occurred within the limits of an intersection. A traffic crash is considered to be intersection related if the first harmful event occurs on an approach to or exit from an intersection and results from any activity, behavior or control related to the movement of traffic units through the intersection. Junctions between driveways and trafficways are considered driveway access and are not counted as intersections.

In 2009, about 80% of the 2,175 fatal crashes at intersections with traffic control lights occurred within the intersection. In contrast, only 41% of the 1,110,900 nonfatal crashes occurred within the intersection. The trends related to crashes occurring inside or outside intersections will be explored throughout this report.

Overview of Intersection Crashes, 2005 – 2009

Figures 1 and 2 depict the five year trends regarding the number of fatal, injury, and possible injury crashes. As can be seen, all three of these crash severity types at intersections with traffic lights have been decreasing over the last several years. However, at this same time the overall number of traffic crashes has also been decreasing.

Figure 1. Number of Fatal Crashes Occurring at Intersections with Traffic Control Lights, United States, 2005-2009

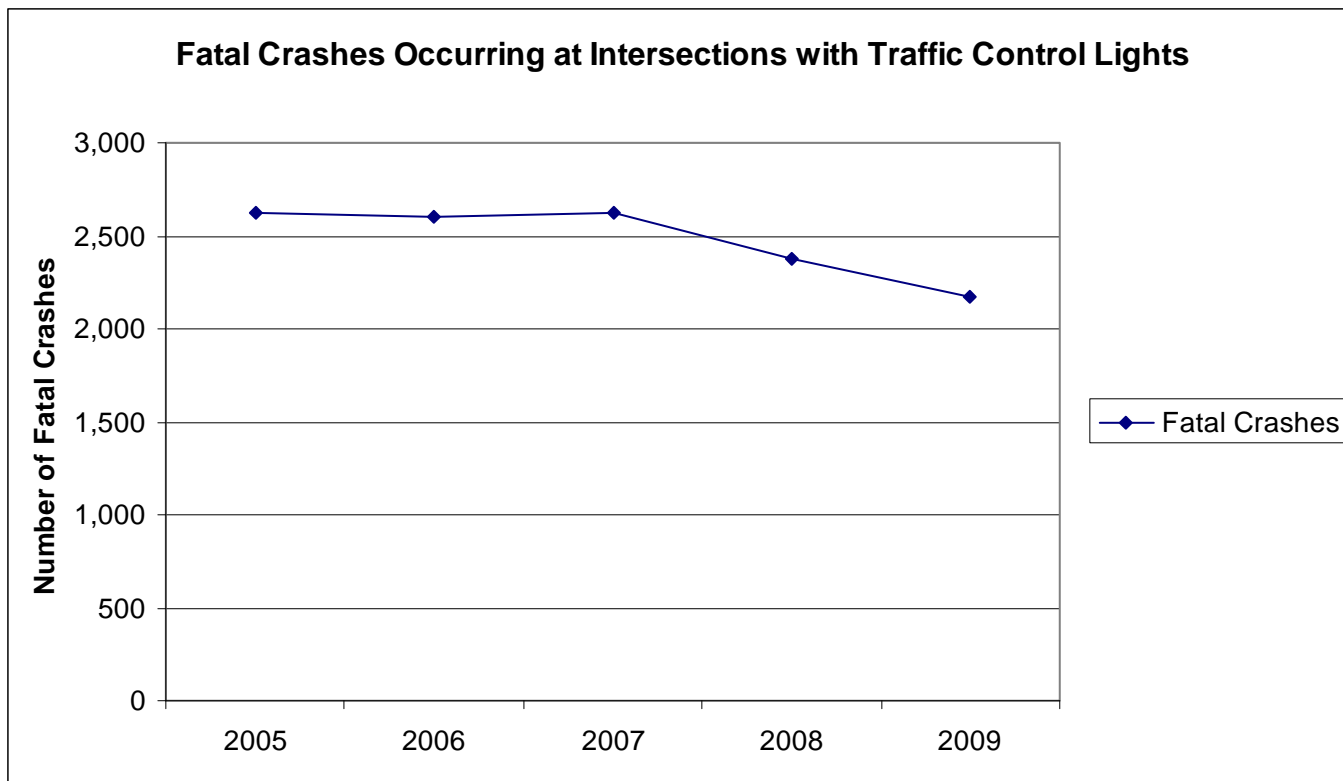
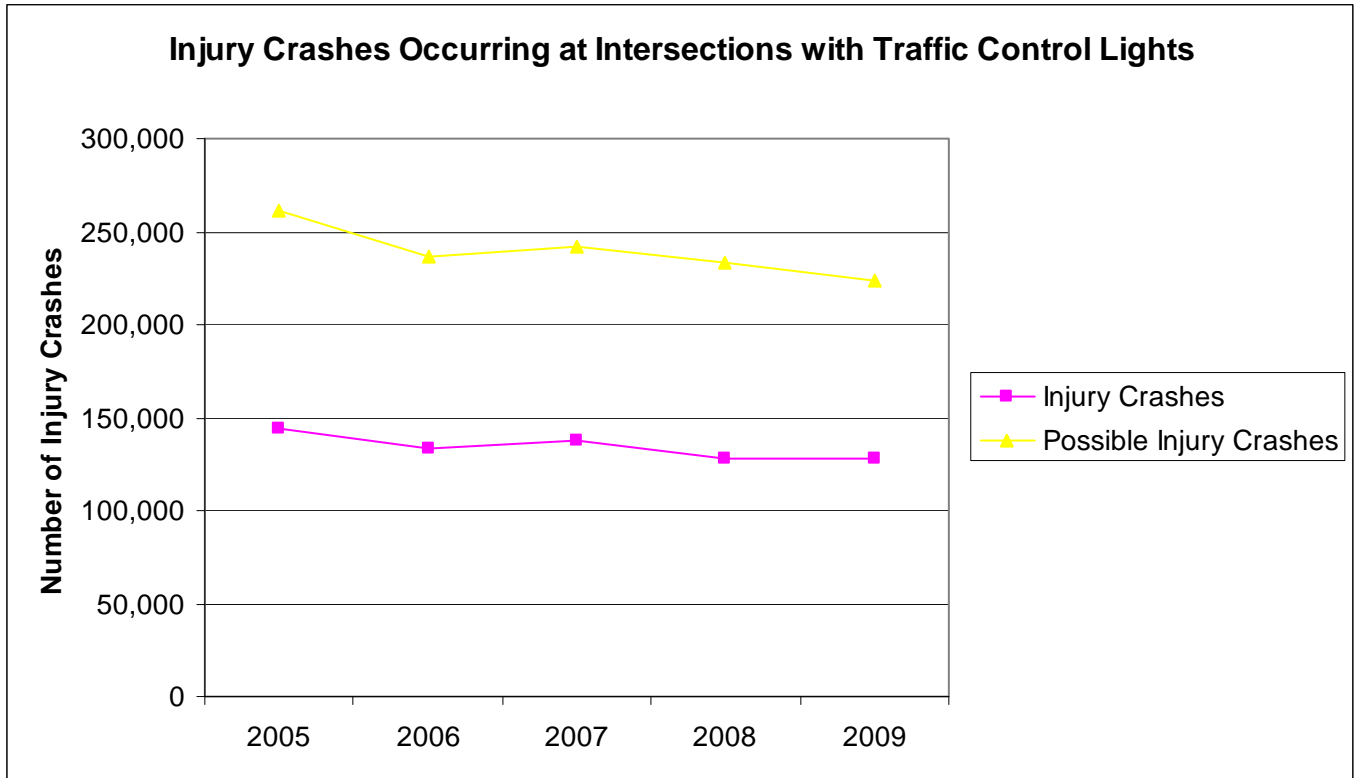
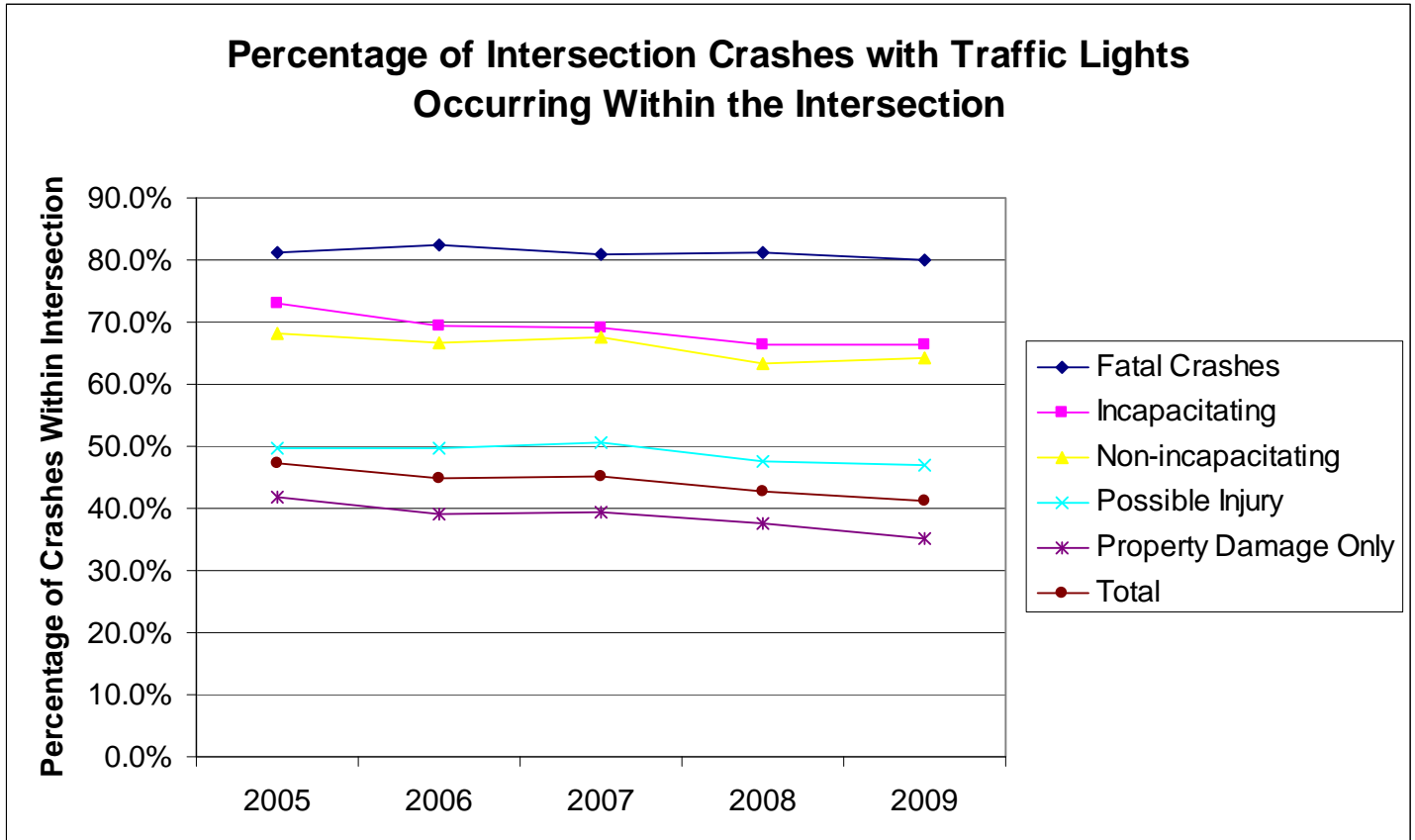


Figure 2. Number of Injury Crashes Occurring at Intersections with Traffic Control Lights, United States, 2005-2009



Over the last five years there has been a gradual decrease in the percent of intersection crashes occurring within the intersection, with a corresponding increase in the percent of crashes occurring while entering or exiting intersections. As shown in Figure 3, while the percent of fatal crashes occurring within intersections has been very stable (approximately 80%), nonfatal crashes (incapacitating, non-incapacitating, and possible injury), property damage only crashes, and total crashes have all shown decreases in the percent occurring within intersections. None of these shifts has been large, with property damage only crashes representing the largest change from 41.9% of crashes occurring within intersections in 2005 to 35.1% occurring in intersections in 2009.

Figure 3. Percentage of Intersection Crashes with Traffic Lights Occurring Within the Intersection, United States, 2005-2009



The number of fatalities and nonfatal injuries involving intersections with traffic lights was also examined. Similar to overall crash trends, intersection crashes represent a smaller proportion of fatalities (6.5% to 7.6% of all fatalities) while a much larger percentage of nonfatal injuries (25% to 28% of possible injury and 18% to 20% of injuries) are associated with intersections. Also similar to overall crash trends, the percent of injuries occurring while entering or exiting intersections are slowly increasing.

Intersection Crashes by State

Although this report focuses on national trends, one analysis was conducted to provide state level data. At the state level, only fatal crash data is available through the NHTSA data systems. Provided below is the number of fatal crashes at intersections by year along with the fatal crash rate per 100,000 population and percentage of all fatal crashes. Several states including Vermont, Wyoming, North Dakota, Maine, Idaho, and Montana have a very low percentage of fatal crashes occurring at intersections with traffic lights (lower than 2% of all fatal crashes). Other states including Florida, Delaware, New York, New Hampshire, New Mexico, District of Columbia have relatively high proportions of fatal crashes at intersections with traffic control lights (12% or higher). It should be noted that although the District of Columbia has a very high percentage of crashes at intersections (averaging 33%) it also has one of the lowest overall number of fatal crashes (averaging 34 fatal crashes a year).

Table 1. Fatal crashes Involving intersections with traffic lights by state

	2009	2008	2007	2006	2005
US. TOTAL	2,175	2,374	2,627	2,601	2,619
<i>Rate per 100,000 population</i>	0.7	0.8	0.9	0.9	0.9
<i>Percent of all Fatal Crashes</i>	7%	7%	7%	7%	7%
Alabama	41	45	34	32	47
<i>Rate per 100,000 population</i>	0.9	1.0	0.7	0.7	1.0
<i>Percent of all Fatal Crashes</i>	5%	5%	3%	3%	5%
Alaska	3	4	9	8	4
<i>Rate per 100,000 population</i>	0.4	0.6	1.3	1.2	0.6
<i>Percent of all Fatal Crashes</i>	5%	7%	12%	11%	6%
Arizona	80	94	113	130	110
<i>Rate per 100,000 population</i>	1.2	1.4	1.8	2.1	1.8
<i>Percent of all Fatal Crashes</i>	11%	11%	12%	12%	11%
Arkansas	16	8	12	8	14
<i>Rate per 100,000 population</i>	0.6	0.3	0.4	0.3	0.5
<i>Percent of all Fatal Crashes</i>	3%	1%	2%	1%	2%
California	268	308	332	351	338
<i>Rate per 100,000 population</i>	0.7	0.8	0.9	1.0	0.9
<i>Percent of all Fatal Crashes</i>	10%	10%	9%	9%	9%
Colorado	41	54	60	41	63
<i>Rate per 100,000 population</i>	0.8	1.1	1.2	0.9	1.4
<i>Percent of all Fatal Crashes</i>	9%	11%	12%	8%	11%
Connecticut	12	17	25	26	14
<i>Rate per 100,000 population</i>	0.3	0.5	0.7	0.7	0.4
<i>Percent of all Fatal Crashes</i>	6%	6%	9%	9%	5%
Delaware	10	13	11	23	13
<i>Rate per 100,000 population</i>	1.1	1.5	1.3	2.7	1.5
<i>Percent of all Fatal Crashes</i>	10%	12%	10%	17%	11%
District of Columbia	11	7	13	11	15
<i>Rate per 100,000 population</i>	1.8	1.2	2.2	1.9	2.6
<i>Percent of all Fatal Crashes</i>	39%	22%	36%	33%	34%
Florida	282	339	419	359	330
<i>Rate per 100,000 population</i>	1.5	1.8	2.3	2.0	1.9
<i>Percent of all Fatal Crashes</i>	12%	12%	14%	12%	10%
Georgia	78	75	92	73	82
<i>Rate per 100,000 population</i>	0.8	0.8	1.0	0.8	0.9
<i>Percent of all Fatal Crashes</i>	7%	5%	6%	5%	5%
Hawaii	10	9	8	15	15
<i>Rate per 100,000 population</i>	0.8	0.7	0.6	1.2	1.2
<i>Percent of all Fatal Crashes</i>	10%	9%	6%	10%	12%

State (continued)	2009	2008	2007	2006	2005
Idaho	3	4	3	6	4
<i>Rate per 100,000 population</i>	0.2	0.3	0.2	0.4	0.3
<i>Percent of all Fatal Crashes</i>	2%	2%	1%	3%	2%
Illinois	81	75	108	105	139
<i>Rate per 100,000 population</i>	0.6	0.6	0.8	0.8	1.1
<i>Percent of all Fatal Crashes</i>	10%	8%	10%	9%	11%
Indiana	53	53	48	55	54
<i>Rate per 100,000 population</i>	0.8	0.8	0.8	0.9	0.9
<i>Percent of all Fatal Crashes</i>	8%	7%	6%	7%	6%
Iowa	10	10	13	13	12
<i>Rate per 100,000 population</i>	0.3	0.3	0.4	0.4	0.4
<i>Percent of all Fatal Crashes</i>	3%	3%	3%	3%	3%
Kansas	12	20	18	17	15
<i>Rate per 100,000 population</i>	0.4	0.7	0.6	0.6	0.5
<i>Percent of all Fatal Crashes</i>	3%	6%	5%	4%	4%
Kentucky	21	33	36	46	43
<i>Rate per 100,000 population</i>	0.5	0.8	0.8	1.1	1.0
<i>Percent of all Fatal Crashes</i>	3%	4%	4%	5%	5%
Louisiana	24	32	41	28	38
<i>Rate per 100,000 population</i>	0.5	0.7	0.9	0.7	0.8
<i>Percent of all Fatal Crashes</i>	3%	4%	5%	3%	4%
Maine	2	4	3	4	0
<i>Rate per 100,000 population</i>	0.2	0.3	0.2	0.3	0.0
<i>Percent of all Fatal Crashes</i>	1%	3%	2%	2%	0%
Maryland	47	51	43	56	83
<i>Rate per 100,000 population</i>	0.8	0.9	0.8	1.0	1.5
<i>Percent of all Fatal Crashes</i>	9%	9%	8%	9%	14%
Massachusetts	7	13	16	19	23
<i>Rate per 100,000 population</i>	0.1	0.2	0.2	0.3	0.4
<i>Percent of all Fatal Crashes</i>	2%	4%	4%	5%	6%
Michigan	73	70	69	78	73
<i>Rate per 100,000 population</i>	0.7	0.7	0.7	0.8	0.7
<i>Percent of all Fatal Crashes</i>	9%	8%	7%	8%	7%
Minnesota	33	24	25	23	23
<i>Rate per 100,000 population</i>	0.6	0.5	0.5	0.4	0.5
<i>Percent of all Fatal Crashes</i>	9%	6%	5%	5%	5%
Mississippi	14	15	25	11	16
<i>Rate per 100,000 population</i>	0.5	0.5	0.9	0.4	0.6
<i>Percent of all Fatal Crashes</i>	2%	2%	3%	1%	2%
Missouri	45	37	47	50	42
<i>Rate per 100,000 population</i>	0.8	0.6	0.8	0.9	0.7
<i>Percent of all Fatal Crashes</i>	6%	4%	5%	5%	4%
Montana	6	6	2	2	3
<i>Rate per 100,000 population</i>	0.6	0.6	0.2	0.2	0.3
<i>Percent of all Fatal Crashes</i>	3%	3%	1%	1%	1%
Nebraska	12	7	17	20	10
<i>Rate per 100,000 population</i>	0.7	0.4	1.0	1.1	0.6
<i>Percent of all Fatal Crashes</i>	6%	4%	7%	9%	4%

State (continued)	2009	2008	2007	2006	2005
Nevada	27	21	36	39	35
<i>Rate per 100,000 population</i>	1.0	0.8	1.4	1.6	1.5
<i>Percent of all Fatal Crashes</i>	12%	7%	11%	10%	9%
New Hampshire	2	0	2	4	4
<i>Rate per 100,000 population</i>	0.2	0.0	0.2	0.3	0.3
<i>Percent of all Fatal Crashes</i>	2%	0%	2%	3%	3%
New Jersey	81	76	64	78	54
<i>Rate per 100,000 population</i>	0.9	0.9	0.7	0.9	0.6
<i>Percent of all Fatal Crashes</i>	15%	14%	9%	11%	8%
New Mexico	13	18	14	18	19
<i>Rate per 100,000 population</i>	0.6	0.9	0.7	0.9	1.0
<i>Percent of all Fatal Crashes</i>	4%	6%	4%	4%	5%
New York	186	192	181	187	185
<i>Rate per 100,000 population</i>	1.0	1.0	0.9	1.0	1.0
<i>Percent of all Fatal Crashes</i>	17%	16%	15%	14%	14%
North Carolina	57	60	78	70	76
<i>Rate per 100,000 population</i>	0.6	0.6	0.9	0.8	0.9
<i>Percent of all Fatal Crashes</i>	5%	5%	5%	5%	5%
North Dakota	1	1	3	0	0
<i>Rate per 100,000 population</i>	0.2	0.2	0.5	0.0	0.0
<i>Percent of all Fatal Crashes</i>	1%	1%	3%	0%	0%
Ohio	64	71	68	73	69
<i>Rate per 100,000 population</i>	0.6	0.6	0.6	0.6	0.6
<i>Percent of all Fatal Crashes</i>	7%	6%	6%	6%	6%
Oklahoma	13	24	18	15	11
<i>Rate per 100,000 population</i>	0.4	0.7	0.5	0.4	0.3
<i>Percent of all Fatal Crashes</i>	2%	4%	3%	2%	2%
Oregon	12	26	20	16	18
<i>Rate per 100,000 population</i>	0.3	0.7	0.5	0.4	0.5
<i>Percent of all Fatal Crashes</i>	4%	7%	5%	4%	4%
Pennsylvania	68	94	102	98	99
<i>Rate per 100,000 population</i>	0.5	0.7	0.8	0.8	0.8
<i>Percent of all Fatal Crashes</i>	6%	7%	7%	7%	7%
Rhode Island	3	5	4	4	8
<i>Rate per 100,000 population</i>	0.3	0.5	0.4	0.4	0.8
<i>Percent of all Fatal Crashes</i>	4%	8%	6%	6%	10%
South Carolina	38	41	43	45	43
<i>Rate per 100,000 population</i>	0.8	0.9	1.0	1.0	1.0
<i>Percent of all Fatal Crashes</i>	5%	5%	4%	5%	4%
South Dakota	2	3	3	1	4
<i>Rate per 100,000 population</i>	0.2	0.4	0.4	0.1	0.5
<i>Percent of all Fatal Crashes</i>	2%	3%	2%	1%	3%
Tennessee	31	49	54	62	55
<i>Rate per 100,000 population</i>	0.5	0.8	0.9	1.0	0.9
<i>Percent of all Fatal Crashes</i>	3%	5%	5%	5%	5%
Texas	167	174	172	157	192
<i>Rate per 100,000 population</i>	0.7	0.7	0.7	0.7	0.8
<i>Percent of all Fatal Crashes</i>	6%	6%	6%	5%	6%

State (continued)	2009	2008	2007	2006	2005
Utah	20	19	13	18	18
<i>Rate per 100,000 population</i>	0.7	0.7	0.5	0.7	0.7
<i>Percent of all Fatal Crashes</i>	9%	8%	5%	7%	8%
Vermont	2	2	1	0	1
<i>Rate per 100,000 population</i>	0.3	0.3	0.2	0.0	0.2
<i>Percent of all Fatal Crashes</i>	3%	3%	2%	0%	1%
Virginia	51	27	49	35	39
<i>Rate per 100,000 population</i>	0.6	0.3	0.6	0.5	0.5
<i>Percent of all Fatal Crashes</i>	7%	4%	5%	4%	4%
Washington	19	21	30	34	26
<i>Rate per 100,000 population</i>	0.3	0.3	0.5	0.5	0.4
<i>Percent of all Fatal Crashes</i>	4%	4%	6%	6%	4%
West Virginia	3	7	9	9	8
<i>Rate per 100,000 population</i>	0.2	0.4	0.5	0.5	0.4
<i>Percent of all Fatal Crashes</i>	1%	2%	2%	2%	2%
Wisconsin	19	30	19	26	32
<i>Rate per 100,000 population</i>	0.3	0.5	0.3	0.5	0.6
<i>Percent of all Fatal Crashes</i>	4%	5%	3%	4%	4%
Wyoming	1	2	2	2	0
<i>Rate per 100,000 population</i>	0.2	0.4	0.4	0.4	0.0
<i>Percent of all Fatal Crashes</i>	1%	1%	1%	1%	0%

Red Light Running Violations

In FARS, there are two data sources to identify if a violation occurred on the part of at least one of the drivers who were involved in an intersection crash.

- Police-reported violations as recorded by the Violations Charged variable, and
- Factors related to the driver as coded in the Related Factors – Driver level variable.

Using both data sources, fatal crashes are coded as involving red light violations if violations charged include one of the following violations:

- Fail to stop for red signal
- Fail to obey signal, generally
- Fail to obey traffic control device
- Turn in violation of traffic control device

Red light violations are also coded if driver related factors included:

- Failure to obey actual traffic control device

It is important to note that violations may be under-reported in FARS. The extent of any potential under-reporting is unknown.

Table 2 reports the total number of fatal crashes at intersections with traffic lights, the number of those crashes involving red light running violations (as defined above), and the percent of intersection crashes involving violations. As can be seen, the number and percent of fatal crashes involving violations at intersections with traffic control devices has steadily decreased since 2005. In 2005, over 36% of fatal crashes at intersections involved red light violations while in 2009 just over 32% involved a red light violation. The decrease of 256 red light running violation fatal crashes represents 58% of the total decrease in fatal crashes at intersections over this time frame.

Table 2. Fatal crashes involving red light running violations, United States, 2005-2009

	Fatal Crashes at Intersections with Traffic Lights		
	Total fatal crashes at intersections with traffic lights	Fatal crashes with red-Light running violations	Percent of crashes
2009	2,175	699	32.1%
2008	2,374	833	35.1%
2007	2,627	964	36.7%
2006	2,601	943	36.3%
2005	2,619	955	36.5%

Violation data is coded somewhat differently in the GES system than in the FARS system. First of all, the GES system only includes the Police-Reported Violations variable and does not track driver related factors. Second, GES includes only one type of violation that pertains to red light violations (running signal). Finally, GES codes violations as a vehicle variable, not a crash variable. Because of this difference, only the number of vehicles/drivers with violations can be tracked, not the number of crashes. Because of these differences, the data regarding violations in nonfatal crashes is less complete than is the violation data for fatal crashes and should be used with caution.

Looking at the number of vehicles with red light running violations involved in nonfatal crashes (Table 3), no clear trend is evident. On average slightly less than 4% of vehicles involved in nonfatal crashes are charged with red light violations. However, because of the limitations listed above regarding nonfatal data, this estimate is likely an undercount.

Table 3. Vehicles involved with red light running violations, United States, 2005-2009

	Vehicles Involved in Nonfatal Crashes at Intersections with Traffic Lights		
	Number of vehicles involved in nonfatal crashes at intersections with traffic lights	Number of vehicles with running red light violations	Percent of vehicles involved
2009	2,278,100	89,100	3.9%
2008	2,372,200	87,700	3.7%
2007	2,409,900	101,900	4.2%
2006	2,337,200	84,800	3.6%
2005	2,442,300	102,400	4.2%

Note: Because nonfatal data is based on estimates and are rounded, the individual components may not sum to the total.

Manner of Multiple Vehicle Collisions

The major types of crashes involving two or more vehicles at an intersection are crossing-path crashes, head-on collisions, and rear-end collisions. Crossing-path crashes have been defined in prior research as those that involve the type of traffic conflict where one moving vehicle cuts across the path of another, when they were initially approaching from either lateral or opposite directions, in such a way that they collide at or near a junction (Najm et. al. 2001). While the details of multiple vehicle crashes are currently not coded in FARS or GES, manner of collision classified as sideswipe or right angle is roughly equivalent to crossing-path crashes.

Right angle crash is the most prevalent type of intersection fatal crash. In 2009, there were 826 right angle collisions in intersections with traffic lights followed by 190 sideswipe (opposite direction) collisions. The third most prevalent type of crash is rear-end, with 162 fatal collisions occurring in 2009. Unlike most fatal collisions

that tend to occur within the intersection, fully 57% of the fatal rear-end collisions at intersections occurred while entering or exiting.

The most prevalent type of nonfatal intersection collision is rear-end. There were 545,300 nonfatal rear-end collisions at intersections with lights and 417,500 nonfatal right angle collisions. Interestingly, these two types of collisions tend to occur in different sections of the intersection. Nonfatal right angle collisions tend to occur inside the intersection (approximately 90% of the time) while nonfatal rear-end collisions tend to occur while entering or exiting the intersections (over 90%).

Crashes with Moving Objects

Overwhelmingly, vehicles in collisions involving intersections with traffic lights are most likely to collide with other motor vehicles. In 2009 there were 1,377 fatal collisions involving other motor vehicles compared to 494 collisions with pedestrians and 95 with pedalcycles. Collisions with other motor vehicles at intersections represent about 13% of all fatal collisions with other motor vehicles. Collisions with pedalcycles at intersections generally represent about 15% of all fatal pedalcycle collisions.

A similar trend is found regarding nonfatal crashes with moving objects. In 2009 there were 1,048,700 nonfatal collisions at intersections with traffic lights involving other motor vehicles, 15,100 involving pedestrians, and 14,700 involving pedalcycles. These three types of intersection crashes represent about 28% of these types of nonfatal crashes.

Conclusions

Overall results show that although the number of fatal and nonfatal crashes at intersections has decreased over the last several years, the change is in proportion to the overall motor vehicle traffic crash trends. As a percentage of total crashes, crashes at intersections with traffic control lights have been very stable over the last five years of available data.

Over the last five years, the number and percent of fatal crashes involving red light running violations has steadily decreased since 2005. Because of data limitations, it is not clear if nonfatal crashes have been impacted in the same way.

Fatal intersection crashes tend to occur within intersections while nonfatal crashes tend to occur while entering or exiting intersections. In addition, over the last five years the proportion of nonfatal intersection crashes occurring while entering or exiting intersections has slowly been increasing.

Many of the other crash variables explored in this report showed very stable findings across the years studied, with the percent of crashes that occur at intersections changing very little from one year to the next.

Definitions

The definitions provided below are from the American National Standards Institute (ANSI) D-16 Manual on the classification of motor vehicle traffic crashes:

incapacitating injury: An incapacitating injury is any injury, other than a fatal injury, which prevents the injured person from walking, driving or normally continuing the activities the person was capable of performing before the injury occurred.

Inclusions:

- Severe lacerations
- Broken or distorted limbs
- Skull or chest injuries
- Abdominal injuries
- Unconsciousness at or when taken from the accident scene
- Unable to leave the accident scene without assistance
- And others

Exclusions:

- Momentary unconsciousness
- And others

injury: An injury is bodily harm to a person.

Exclusions:

- Effects of diseases such as stroke, heart attack, diabetic coma, epileptic seizure
- And others

pedalcyclist: A pedalcyclist is any occupant of a pedalcycle in transport.

pedestrian: A pedestrian is any person who is not an occupant.

possible injury: A possible injury is any injury reported or claimed which is not a fatal injury, incapacitating injury or nonincapacitating evident injury.

- Momentary unconsciousness
- Claim of injuries not evident
- Limping, complaint of pain, nausea, hysteria
- And others