Motorcycle-Involved Crashes in Michigan: 2016-2020

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Special Note

The Michigan Office of Highway Safety Planning and the University of Michigan Transportation Research Institute acknowledge the differences in traffic and commuting patterns in 2020 due to the COVID-19 pandemic. Travel restrictions from the "Stay Home, Stay Safe" Executive Order (EO 2020-21) were initially in place starting on March 24, 2020. That order was then extended through additional executive orders. The stay-at-home order was officially lifted June 1, 2020.

Overall, the total number of police-reported crashes on Michigan roadways decreased by 21.93 percent, declining from 314,376 in 2019 to 245,432 in 2020. The 2020 fatality count was 1,083, up 9.95 percent from the 2019 figure of 985. Compared with 2019, people sustaining injuries were down 18.65 percent. Vehicle miles traveled, licensed drivers, and vehicle registrations decreased in 2020: vehicle miles traveled decreased 15.53 percent to 86.31 billion, motor vehicle registrations were down 0.49 percent to 9.04 million, and the number of licensed drivers was down 1.86 percent to 7.12 million. The increased fatality count in combination with the reduction of the exposure factors contributed to the fatality rate of 1.25 per 100 million miles of travel, a 30.16 percent increase from 2019 (0.96 per 100 million miles). The 2020 fatality rate is also above the 10-year (2011-2020) average of 1.01 fatalities per 100 million miles.

1.0 Executive Summary

This report utilizes police-reported crash data in Michigan from 2016 through 2020 to study motorcycle-involved crash trends. Data back to 2010 were used to explore motorcyclist helmet trends before and after the helmet law modification in Michigan in April 2012. Major findings include:

- In the motorcyclist crash population, helmet use dropped from 97.7% in 2011 to 76.2% in 2012 when the helmet law modification took place in April 2012. The helmet use rate has generally decreased gradually since then to a low of 61.8% in 2020.
- Motorcycle operators without motorcycle endorsements involved in crashes are somewhat less likely to wear a helmet, compared to those with motorcycle endorsements. Among motorcycle operators involved in crashes between 2016-2020 where helmet use and motorcycle endorsement status were known, 70.8% of motorcycle endorsed operators wore helmets compared to 61.6% of unendorsed operators.
- Helmet use rates for crash-involved motorcyclists age 16-20 dropped from 97.3% before the modification to 83.0% after, even though helmet use is required by law for motorcyclists in this age group.
- Crash-involved motorcycle operators with motorcycle endorsements on average made up 65.4% of operators with known endorsement status. The rate has changed dramatically with a low in 2020 of 41.0% and a high in 2017 of 80.2%.
- After accounting for other risk factors (e.g., alcohol involvement), the risk of fatality for non-helmeted motorcyclists was 1.6 times the risk for helmeted motorcyclists. The risk of a fatality was multiplied by a factor of 2.9 if the motorcycle operator was drinking and by a factor of 11.4 if the operator was using drugs.
- The fatality rate per crash-involved motorcyclist ranged between 3.2% to 3.8% from 2010 to 2014, but from 2015-2020 has increased to range from 3.9% to 4.7%. The overall rate of fatalities and suspected serious injuries (per crash-involved motorcyclist) increased from 20.7% before the modification to 23.7% after.
- Regression models were used to estimate the number of fatalities and suspected serious injuries attributable to changes in helmet use since the modification. Based on these models, 14.5% (19 per year) of fatalities and 10.9% (69 per year) of serious injuries were estimated to have resulted from reduced helmet use after the helmet law modification.

2.0 Introduction

This report analyzes police-reported motor vehicle crashes involving motorcyclists on public roadways in Michigan from 2016 through 2020. Michigan traffic crashes are defined as taking place on public roadways in Michigan, involving at least one motor vehicle in transport, and resulting in death, injury, or property damage of $1,000 or more. For the purposes of this report, motorcyclists will be grouped into three categories:

- Motorcycle operators: motorcycle drivers
- Motorcycle passengers: non-operators of motorcycles riding on the motorcycle
- Motorcyclists: all motorcycle occupants, including both operators and passengers

The key areas of interest include: 1) fatality and injury rates for helmeted and unhelmeted motorcyclists; 2) helmet use rates among crash-involved motorcyclists, especially those under 21; 3) out-of-state ridership, as it is seen in the crash data; 4) risk-taking behavior such as alcohol use and recklessness, as it relates to injury and fatality outcomes; and 5) motorcycle endorsements (CY endorsements) among crash-involved operators. Since a particular focus is on changes in helmet use after the motorcycle helmet law modification that took effect in Michigan on April 13, 2012, data back to 2010 will be used for that section of the report.

In this report, injury severity of people involved in crashes is frequently categorized according to the KABCO scale:

- K - Fatal Injury
- A - Suspected Serious Injury
- B - Suspected Minor Injury
- C - Possible Injury
- O - No Apparent Injury

Similarly, crashes are sometimes classified according to the most severe injury suffered by anyone involved in the crash. Again, the KABCO scale is used, but for O-level severity this refers to crashes with property damage only (PDO) instead of no injury or fatality.

3.0 Methods

The helmet use section of this analysis covers the period from 2010 through 2020. The helmet law modification took effect on April 13, 2012. Since motorcycle use in the winter months is low, the majority of 2012 motorcycle-involved crashes occurred after the helmet law modification went into effect. To evaluate changes in crash and injury patterns, we compare crashes before the modification (1/1/2010 - 4/12/2012) to those that occurred after the modification (4/13/2012 - 12/31/2020).

Crashes are the combined result of exposure (e.g., miles of riding) and risk. As a result, the data can be used to indicate changes in exposure variables, such as out-of-state ridership, helmet use, and motorcycle endorsements. For example, a large increase in out-of-state ridership resulting from the helmet law modification would be expected to result in an increase in out-of-state motorcycle operators in the crash data, even if they are no more or less risky than Michigan motorcycle operators. In addition,

crash datasets are readily used to look at injury outcome as a function of variables such as alcohol use and helmet use.

4.0 Overall Crash Trends

Table 1 shows the number of motorcyclists involved in any crash as well as motorcyclist fatalities and percentages from 2016-2020, while Figure 1 provides a visualization of the injury severity trends (Figure 1 excludes crashes with unknown injury status). In general, these motorcyclist crash trends have shown normal variation over the past 5 years, with a high of 3,711 motorcyclists in crashes in 2016 and a low of 3,012 in 2018. Motorcyclist fatalities reached a high of 152 in 2020 after a low of 122 in 2019. Fatalities as a percent of all motorcyclists in crashes has ranged from 3.8% to 4.5% with an average of 4.2%.

Table 1. Number of Fatalities among Crash-Involved Motorcyclists

Year	Motorcyclist Fatalities	Motorcyclists in Crashes	Fatality Percent
2016	141	3,711	3.8%
2017	137	3,237	4.2%
2018	134	3,012	4.5%
2019	122	3,083	4.0%
2020	152	3,375	4.5%
Total	**686**	**16,418**	**4.2%**

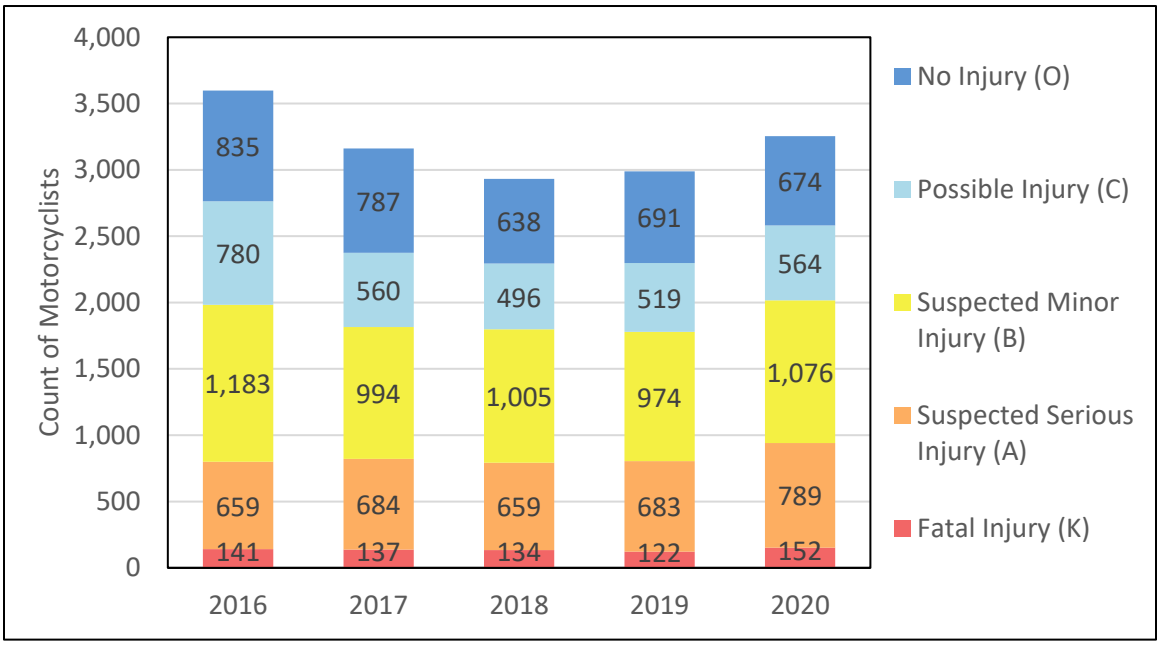

Figure 1 – Injury Severity of Motorcyclists Involved in Crashes, 2016-2020

5.0 Crash Characteristics

In this section, we look at a variety of characteristics for motorcycle-involved crashes. For context, motorcycle-involved crash patterns are compared to patterns in non-motorcycle-involved crashes.

5.1 Crash Type

The distribution of crash types by motorcycle involvement is shown in Figure 2. Head-on includes head-on and head-on - left turn crashes; rear-end includes rear-end, rear-end - left turn, and rear-end – right turn; and sideswipe crashes include both same and opposite direction sideswipe crashes. Single-vehicle crashes (run off road, etc.) account for 46.5% of motorcycle-involved crashes, followed by rear-end (16.7%) and angle crashes (15.2%). Single-vehicle and head-on crashes are more common for motorcycle-involved crashes compared to non-motorcycle-involved crashes while rear-end, sideswipe, and backing crashes are less common for motorcycle-involved crashes. Of the motorcycle head-on crashes, 77.9% are head-on - left turn crashes.

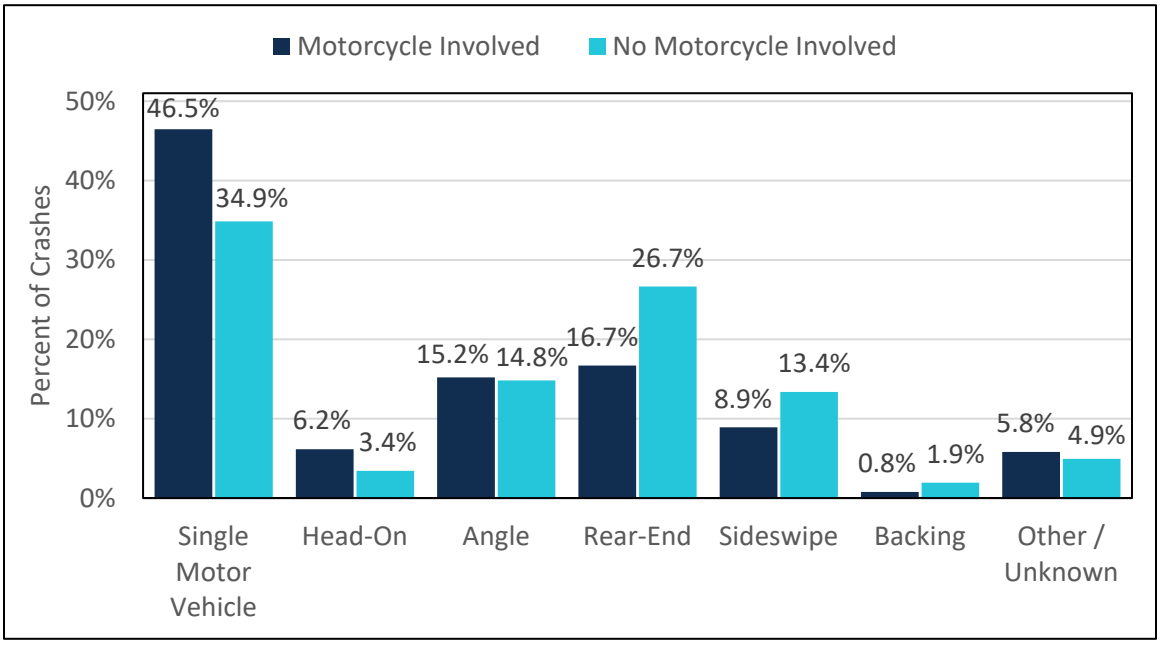

Figure 2 – Crash Type by Motorcycle Involvement, 2016-2020

5.2 Light Condition

Figure 3 highlights the distribution of crashes by light condition and motorcycle involvement. While all crashes are more likely to occur in light than dark conditions, motorcycle-involved crashes are somewhat more likely than other vehicle crashes to occur during daylight. This most likely reflects motorcyclists' riding patterns, which may favor daytime travel.

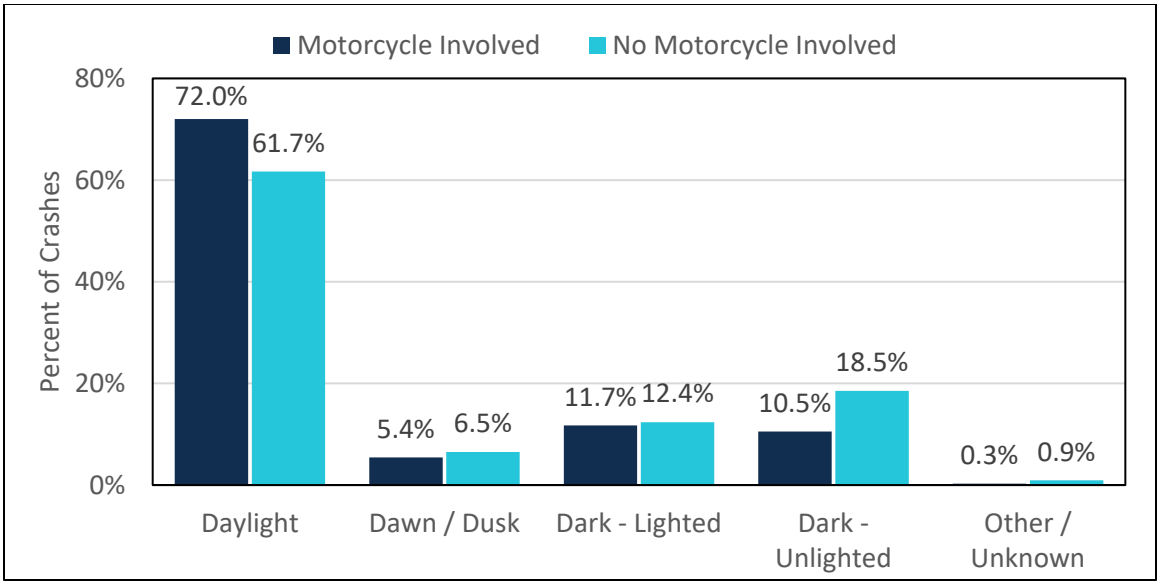

Figure 3 – Light Condition in Crashes by Motorcycle Involvement, 2016-2020

5.3 Weather Condition

A visualization of the distribution of crashes by weather condition for crashes with and without motorcyclists in shown in Figure 4. The condition of "other" includes fog, severe crosswinds, sleet/hail, blowing snow, blowing sand, and smoke. Motorcycle-involved crashes are substantially more likely to occur in clear conditions (82.8%) compared to non-motorcycle-involved crashes (58.7%). Motorcyclists may choose to avoid riding in inclement weather, which would contribute to the relatively lower percentage of crashes the other non-clear categories.

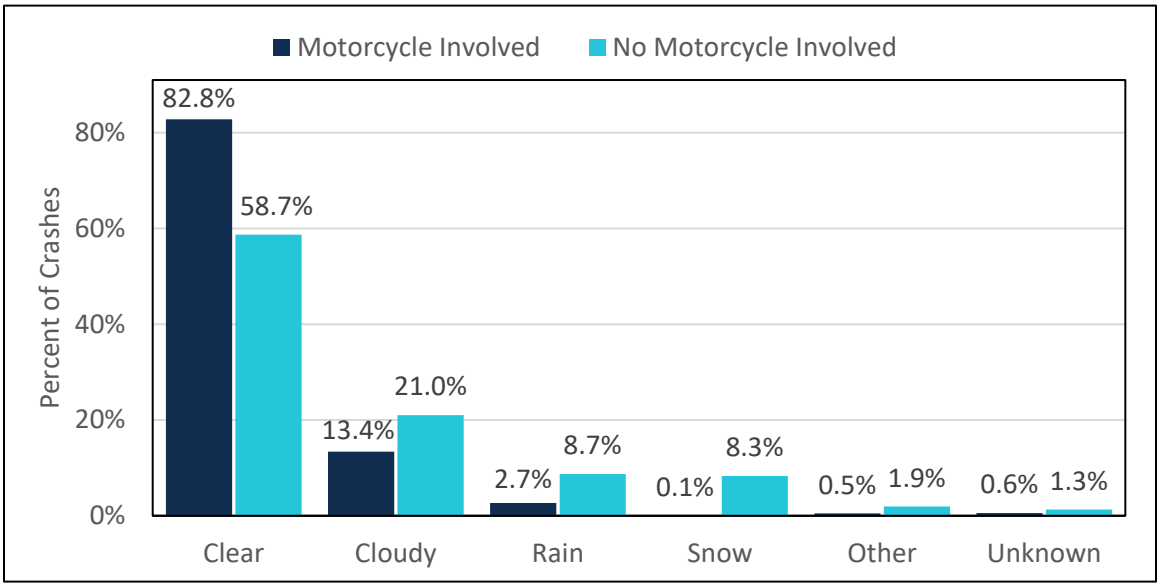

Figure 4 – Weather Condition in Crashes by Motorcycle Involvement, 2016-2020

5.4 Road Factors

Figure 5 shows the proportion of crashes with and without a motorcyclist by number of traffic lanes. Motorcycle-involved crashes are slightly more likely to take place on 1-2 lane roads (59.3% of motorcycle-involved crashes vs. 55.3% of non-motorcycle-involved crashes).

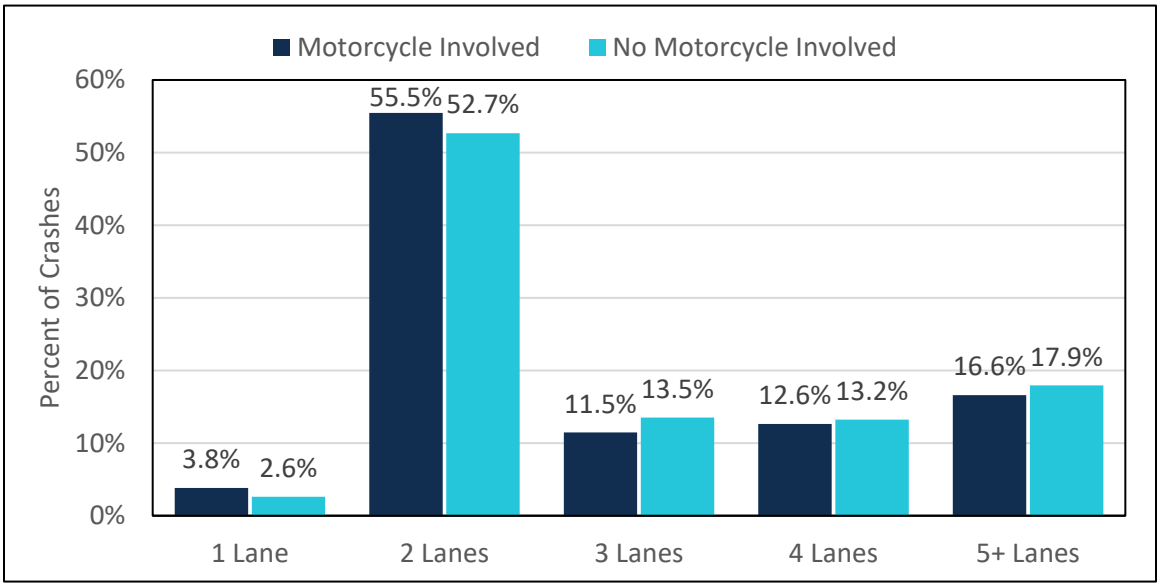

Figure 5 – Number of Traffic Lanes in Crashes by Motorcycle Involvement, 2016-2020

The distribution of crashes with and without motorcyclists by speed limit is shown in Figure 6. Motorcycle-involved crashes are slightly more likely to occur in speed limits of 30-55 mph (79.4 % of motorcycle involved crashes vs. 72.7% of non-motorcycle-involved crashes).

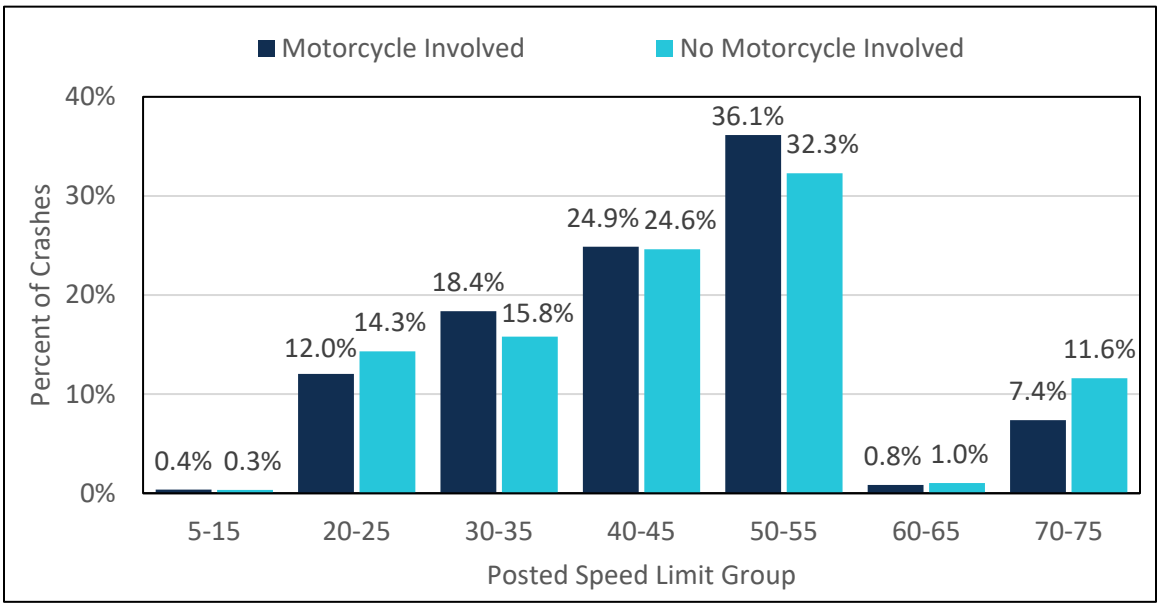

Figure 6 – Posted Speed Limit Crash Percentages by Motorcycle Involvement, 2016-2020

6.0 Temporal Variables

6.1 Month of Year

The distribution of crashes with and without motorcyclists by month of year is shown in Figure 7. As expected, motorcycle-involved crashes are much more frequent during the summer than during the winter and have a relatively higher monthly percent of crashes compared to non-motorcycle-involved crashes from May to September. Motorcycle-involved crashes peak in July with 18.6% of the total crashes. As with weather and light conditions, this difference likely reflects the exposure of motorcyclists rather than a higher risk of crashing during that time.

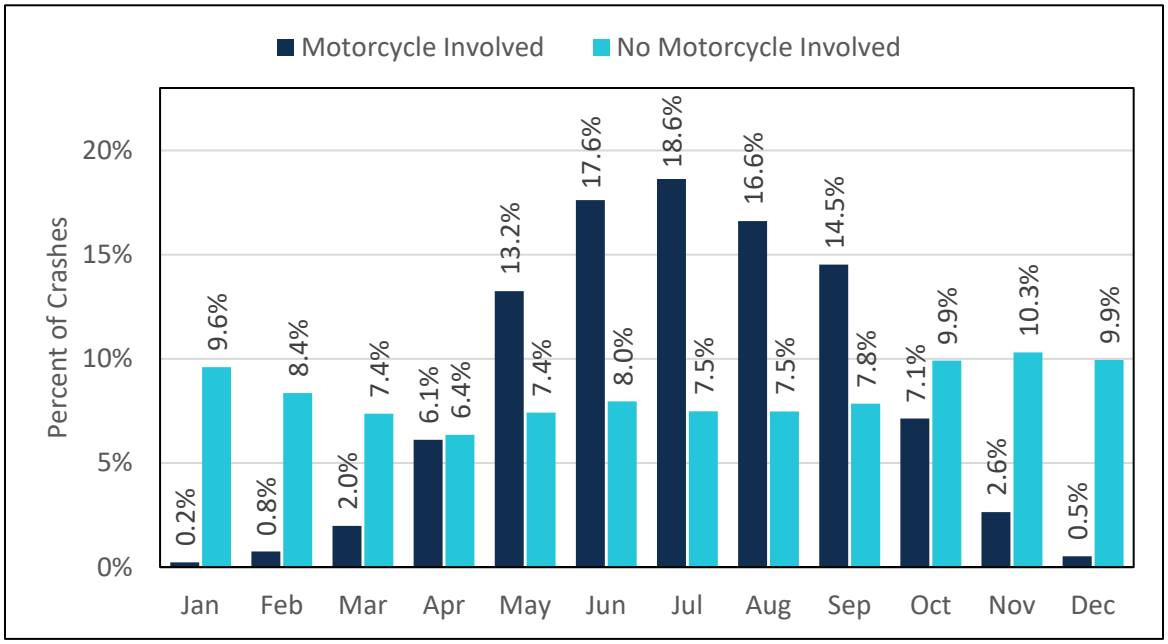

Figure 7 – Crashes by Month and Motorcycle Involvement, 2016-2020

6.2 Day of Week

Figure 8 shows the variation in crashes with and without a motorcyclist by day of week. Motorcycle-involved crashes are more likely to happen on the weekend than during weekdays, in contrast to non-motorcycle-involved crashes which occur more frequently on weekdays. Saturdays account for the highest percentage of motorcycle-involved crashes at 19.6%.

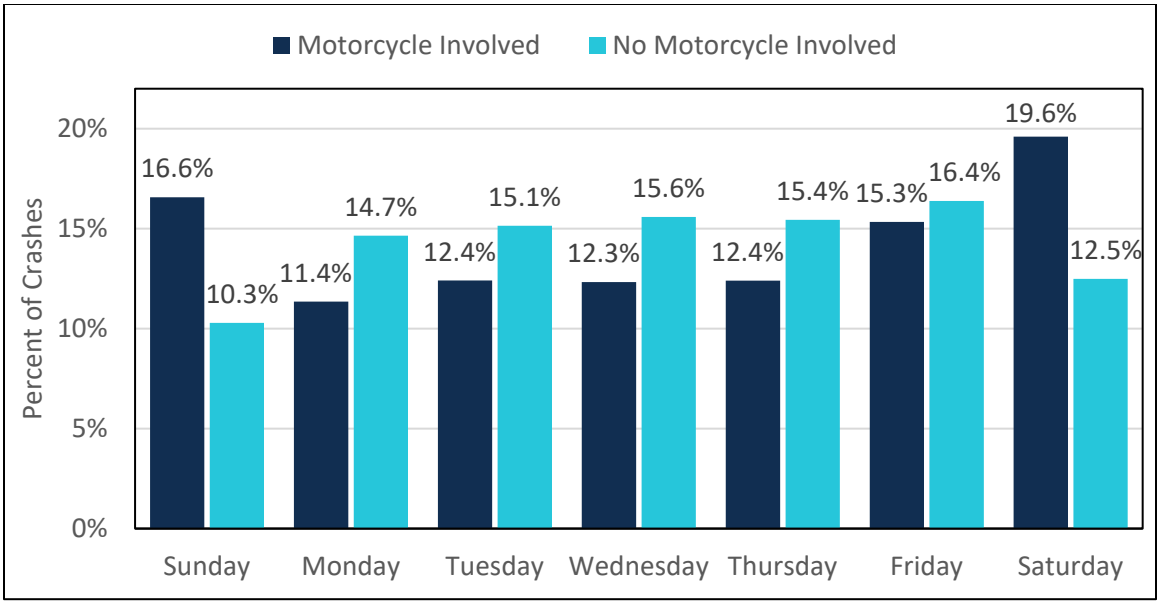

Figure 8 – Crashes by Day of Week and Motorcycle Involvement, 2016-2020

6.3 Time of Day

The proportion of crashes with and without motorcyclists by time of day is shown in Figure 9. A greater proportion of motorcycle-involved crashes occur from 1 PM to 2 AM as compared to non-motorcycle-involved crashes. The peak time for motorcycle-involved crashes occurs at 5 PM (9.5%). In addition, the morning peak seen for non-motorcycle-involved crashes at 7 AM is not present for motorcycle-involved crashes. This pattern, as well as the day-of-the-week pattern in Figure 8, most likely reflects the heavy recreational use of motorcycles compared to the typical commuting patterns that dominate non-motorcycle travel.

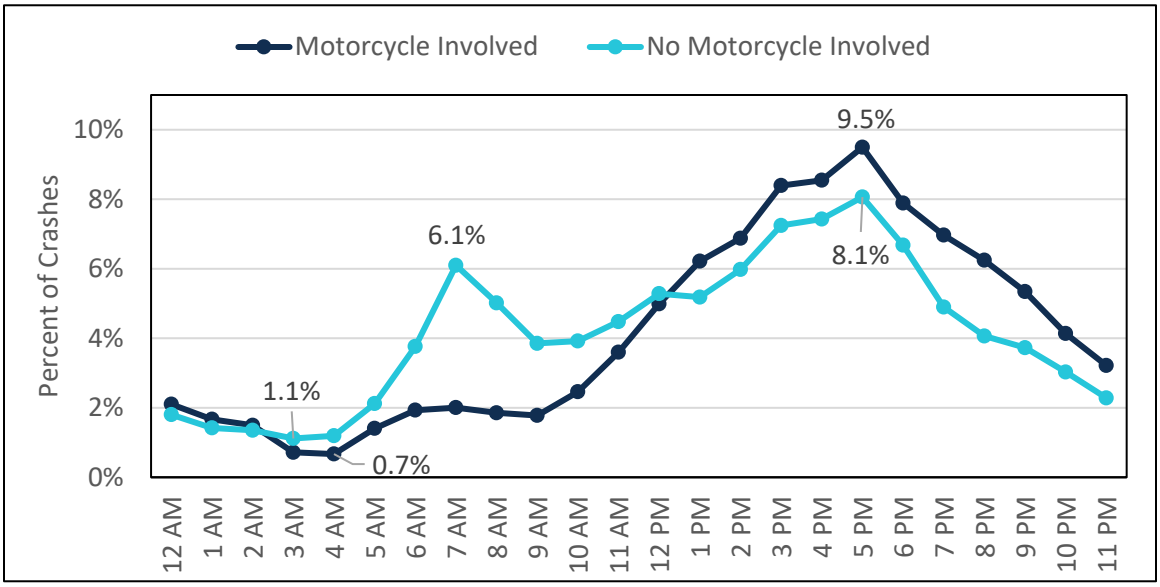

Figure 9 – Crashes by Time of Day and Motorcycle Involvement, 2016-2020

7.0 Motorcycle Classification

Table 2 shows the distribution of motorcycle classification within motorcycles involved in crashes. This data was obtained by decoding the Vehicle Identification Number (VIN). There were 934 (6.2%) motorcycles involved in crashes from 2016 to 2020 with unavailable VIN data that were excluded from Table 2. Cruisers were the predominant type of motorcycle in crashes with 35.7% of known motorcycles involved in crashes, followed by touring at 30.0% and super sport at 14.0%. The year-to-year variation within each classification is fairly low.

Table 2. Motorcycles in Crashes by Motorcycle Classification and Year

Motorcycle Classification	2016	2017	2018	2019	2020	Total	Percent of Total
ATV	1	0	0	0	0	1	0.0%
Autocycle	7	6	1	5	7	26	0.2%
Chopper	6	9	9	5	6	35	0.2%
Cruiser	1,204	1,003	921	941	950	5,019	35.7%
Dual Purpose	73	56	69	63	72	333	2.4%
Incomplete	0	0	0	1	0	1	0.0%
Off Road	22	28	22	25	43	140	1.0%
Other	0	0	0	0	1	1	0.0%
Scooter	45	35	38	37	58	213	1.5%
Sport	230	219	189	173	219	1,030	7.3%
Sport Touring	42	27	29	32	54	184	1.3%
Standard	71	98	72	75	116	432	3.1%
Super Sport	495	385	336	335	408	1,959	14.0%
Touring	848	831	804	866	870	4,219	30.0%
Unclad Sport	106	86	77	94	87	450	3.2%
Total	**3,150**	**2,783**	**2,567**	**2,652**	**2,891**	**14,043**	**100%**

Table 3 displays motorcycle classification by fatal and non-fatal crashes. Most motorcycle types have similar rates for fatal and non-fatal crashes, with the exception of super sport motorcycles. Super sport motorcycles occur at higher rates in fatal crashes than in non-fatal crashes, with 18.1% in fatal crashes and 13.7% in non-fatal crashes.

Table 3. Motorcycles in Fatal and Non-Fatal Crashes by Motorcycle Classification, 2016-2020

Motorcycle Classification	Fatal Count	Fatal Percent	Non-Fatal Count	Non-Fatal Percent
ATV	0	0.0%	1	0.0%
Autocycle	2	0.3%	24	0.2%
Chopper	1	0.2%	34	0.3%
Cruiser	219	33.0%	4,800	35.9%
Dual Purpose	8	1.2%	325	2.4%
Incomplete	1	0.2%	0	0.0%
Off Road	2	0.3%	138	1.0%
Other	0	0.0%	1	0.0%
Scooter	20	3.0%	193	1.4%
Sport	45	6.8%	985	7.4%
Sport Touring	6	0.9%	178	1.3%
Standard	15	2.3%	417	3.1%
Super Sport	120	18.1%	1,839	13.7%
Touring	202	30.4%	4,017	30.0%
Unclad Sport	23	3.5%	427	3.2%
Total	**664**	**100.0%**	**13,379**	**100.0%**

8.0 Motorcycle (CY) Endorsements, Training, and Skills Tests

To legally operate a motorcycle on public roadways in the state of Michigan, a driver must obtain a motorcycle endorsement (CY endorsement) in addition to their Michigan driver's license. Table 4 shows the number of motorcycle operators who completed training, skills tests, and received motorcycle endorsements based on data from the Michigan Department of State. While training is not required for Michigan motorcycle operators over the age of 18 to receive a motorcycle endorsement, it is encouraged, and if training is completed, the skills test required to receive an endorsement is waived. It is worth noting that motorcycle operator endorsement counts were not collected in the same month each year, but these counts still provide an idea of changes over time if endorsements are kept current. In 2020, due to the COVID-19 pandemic there was a sharp drop in completed trainings and skills tests compared to previous years so 2020 results should be interpreted cautiously. The number of completed trainings had ranged in 2016 to 2019 between 8,883 and 10,158 then dropped in 2020 to 5,841. The number of skills tests completed has decreased each year from a high of 7,299 in 2016 to 4,496 in 2019 and then a low of 2,535 in 2020. The number of endorsements received each year has been fairly steady between 634,808 and 656,160.

Table 4. Number of Motorcycle Operators Trained and Endorsed by Year

Year	Trainings Completed	Skills Tests Completed	Endorsements Received
2016	10,158	7,299	655,159
2017	8,883	6,798	656,160
2018	9,185	5,065	639,079
2019	9,589	4,496	641,511
2020	5,841	2,535	634,808
Average	**8,731**	**5,239**	**645,343**

From 2016 to 2020, the overall CY endorsement rate for motorcycle operators in crashes with a known endorsement status was 65.4%. It is important to note that the endorsement rate in the crash population may not be the same as in the overall riding population. As shown in Figure 10, the endorsement rate including unknown endorsement status has shown large variation with a high of 76.9% in 2017 and a low of 37.7% in 2020.

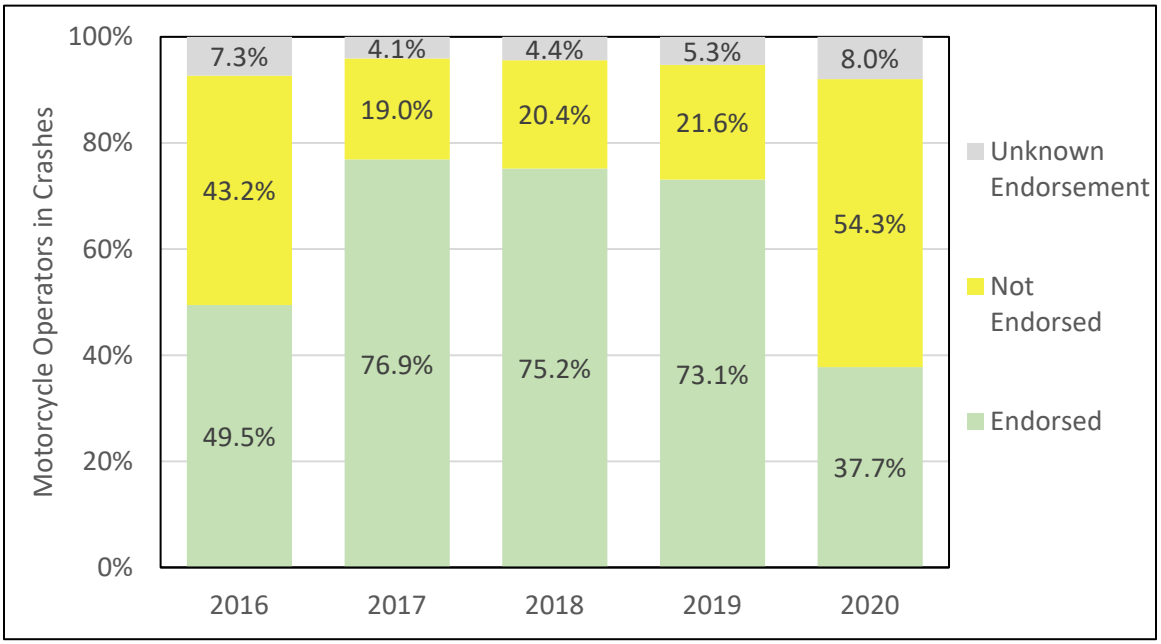

Figure 10 – Motorcycle Operators in Crashes by CY Endorsement Status and Rate

Table 5 shows helmet use counts by CY endorsement status from 2016 through 2020 where helmet use is known. Unknown or miscoded helmet use values and unknown endorsement status have been removed from the table. Among motorcycle endorsed motorcycle operators, the helmet use rate was 70.8% compared to operators with no endorsement at 61.6%.

Table 5. Helmet Use for Motorcycle Operators by CY Endorsement Status, 2016-2020

CY Endorsement Status	Helmet Worn	Helmet Not Worn	Helmet Use Percent
Yes	6,163	2,545	70.8%
No	2,777	1,729	61.6%

9.0 Impairment

Figure 11 shows the proportion of motorcycle operators and non-motorcycle vehicle operators who were drinking. The proportion of motorcycle operators who were impaired by alcohol is 3.8 times the proportion of non-motorcycle operators who were impaired. About 7.1% of motorcycle operators were reported to be drinking, compared with 1.9% of other drivers.

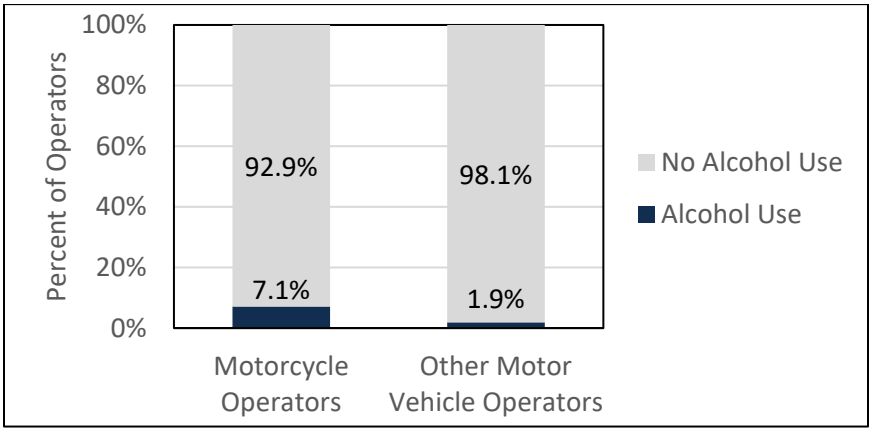

Figure 11 – Distribution of Motor Vehicle Operators by Alcohol Involvement, 2016-2020

The distribution of drug impairment for motorcycle operators and non-motorcycle vehicle operators is shown in Figure 12. Although drug impairment is less common overall, the motorcycle operator drug impairment rate is 3.1 times higher than non-motorcycle operators where 1.7% of motorcycle operators were suspected of using drugs, compared with 0.5% of other motor vehicle operators.

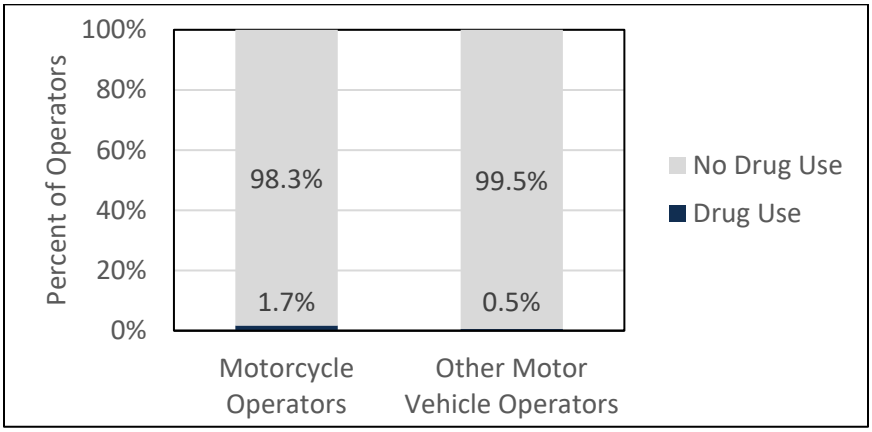

Figure 12 – Distribution of Motor Vehicle Operators by Drug Involvement, 2016-2020

Data collection for drug classifications has not been comprehensive in previous data years. Starting in 2018, data for polydrug use has been included in the crash database. Polydrug impairment occurs when a driver is under the influence of more than one drug (including alcohol). It is important to note that in many cases a positive alcohol result will lead to no further testing for drugs. Law enforcement has up to three years to add drug test results to existing police reports. Utilizing these recent data collection improvements, this report includes analysis of the top three cannabinoid drug test results from 2016-2020. The eight drug test result codes related to cannabinoids are delta 9, hashish oil, hashish, marijuana/marihuana, marinol, tetrahydrocannabinols (THC), and "cannabinoid, type unknown." This cannabinoid data was added to the official "closed" Michigan crash dataset, and it is possible some of this data will be updated in the future. It is worth noting that medical marijuana facilities first opened in Michigan in 2016, and the first recreational marijuana facilities opened to the public in December 2019.

Table 6 shows the cannabinoid test results for motorcycle operators from 2016 to 2020 where an operator was using at least one cannabinoid drug. The primary cannabinoid drug from each test is displayed in the table. The greatest number of positive cannabinoid test results occurred in 2020, at 22. THC (55.9%) and Delta 9 (30.1%) are the most common cannabinoid type with positive tests over the five-year period.

Table 6. Motorcycle Operators in Crashes with Positive Cannabinoid Test by Year

Year	Operators with Positive Cannabinoid Test	Total Operators	Percent of All Operators
2016	19	3,384	0.56%
2017	13	2,964	0.44%
2018	19	2,728	0.70%
2019	20	2,809	0.71%
2020	22	3,092	0.71%
Total	**93**	**14,977**	**0.62%**

10.0 Helmet Use

10.1 Helmet Usage Rates

Helmet use rates in the crashing population may or may not be equal to those in the riding population. However, the crash population can indicate how helmet use patterns have changed, and it is relevant to those at risk of injury due to a crash. Figure 13 shows the number of motorcyclists in crashes with known helmet use for each year. Helmet use among crashing motorcyclists was substantially lower after the helmet law modification than in previous years. Prior to the helmet law modification, in 2010 and 2011, the crash-involved helmet use rate was 97.7%. Since then, the rate has decreased slowly but steadily to 61.8% in 2020, the lowest in the 11-year timespan. A direct observation survey of motorcycle helmet use for all motorcyclists on Michigan roadways was conducted in Michigan in 2017 by Michigan State University. The study concluded that the motorcycle helmet use rate was 71.4%, which is slightly higher than the 2017 helmet use rate in crashes at 68.8%.

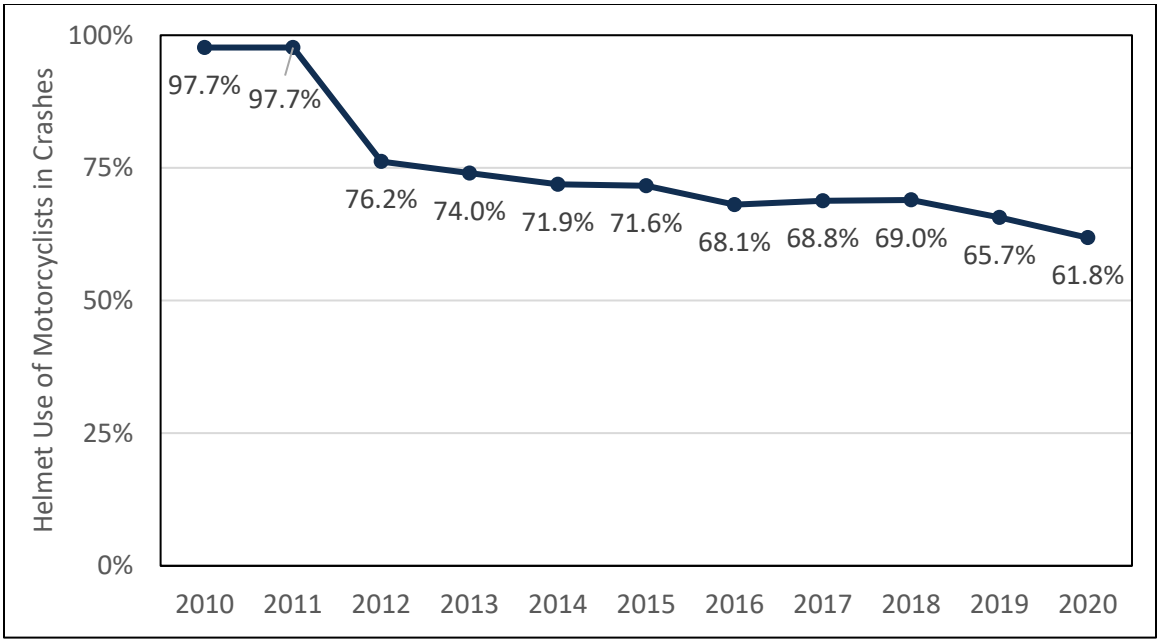

Figure 13 – Helmet Use Rates Among Motorcyclists in Crashes by Year

Table 7 summarizes helmet rate relationships and how they have changed in the post helmet law modification period. All group rate differences between the time periods before and after the helmet law modification are statistically significant ($p < 0.05$). Prior to the helmet law modification, crash-involved male and female motorcyclists both used helmets at a similar rate, where the small difference is not significant (97.5% vs. 98.1%, respectively). After the modification, both male and female use rates dropped, but females wear helmets at a significantly higher rate than males (71.9% vs. 69.1%). Helmet use rates as a function of motorcyclist age also differ significantly after the helmet law modification. After the helmet law modification, use rates among all age groups dropped, even though the law requires helmets for motorcyclists under the age of 21. The youngest motorcyclists, under age 16 (who make up about 0.9% of the crash population), use a helmet 75.8% of the time; motorcyclists age 16-20 (who make up about 5.6% of the crash population) use a helmet 83.0% of the time; and motorcyclists 21 and over (about 93.5% of the crash population) use a helmet 68.7% of the time. Helmet-use rates as a function of seat position are significantly different between operator and passenger seat position after the helmet law modification. Both groups used helmets at a non-significantly different rate before the helmet law modification, but afterwards, passengers' use rates (66.9%) became somewhat lower than that of operators (69.8%).

Table 7. Helmet Use Among Motorcyclists in Crashes by Demographic Group, 2010-2020

Unit	Group		Before Helmet Law Modification (Jan 1, 2010 - Apr 12, 2012)	After Helmet Law Modification (Apr 13,2012 - Dec 31, 2020)
All Motorcyclists	Gender* (after only)	Male	97.5%	69.1%
		Female	98.1%	71.9%
	Age* (after only)	≤ 15 years	93.8%	75.8%
		16-20 years	97.3%	83.0%
		21+ years	97.7%	68.7%
	Seat Position* (after only)	Operator	97.6%	69.8%
		Passenger	98.1%	66.9%
Motorcycle Operators Only	Vehicle Registration State* (after only)	Michigan	97.9%	70.1%
		Other	96.7%	65.6%
	CY Endorsement* (before and after)	Yes	98.7%	72.5%
		No	96.5%	67.0%
	Alcohol Use* (before and after)	Yes	89.2%	39.0%
		No	98.2%	72.2%
** Indicates significantly different helmet use rates among demographic groups (p<0.05). All differences between the periods before and after modification are significant.*				

Prior to the helmet law modification, 4.6% of crash-involved motorcycle operators rode vehicles registered out of state. Their helmet use rate was 96.7%, which is not significantly lower than those with vehicles registered in Michigan, with a rate of 97.9%. After the modification, 5.1% of crash-involved motorcycle operators had vehicles registered out of state. Their helmet use rate of 65.6% was significantly lower than operators of in-state vehicles at 70.1%. Motorcycle operators in crashes with motorcycle endorsements made up 55.2% of the crash population prior to the helmet law modification. They wore helmets slightly (but significantly) more often than those without motorcycle endorsements (98.7% vs. 96.5%). After the modification, the proportion of motorcycle endorsed operators increased to 58.3% of the crash population. It is worth noting that in 2017, the motorcycle endorsement rate jumped to 80.2% from 53.8% the prior year. A change that big is unlikely to be due to a true increase in endorsements and may indicate a change in how the data are coded or collected. The 2018 motorcycle endorsement rate was 79.3% and the 2019 endorsement rate was 77.6%, but the rate dropped again in 2020 to 41.3%. Finally, motorcyclists who were coded as drinking at the time of the crash showed the largest change in helmet use rates of all groups. Prior to the helmet law modification, crash-involved operators who had been drinking wore a helmet 89.2% of the time. However, after the modification, this rate fell to 39.0%. Drinking motorcycle operators made up 7.1% of all motorcycle operators involved in crashes from 2010 through 2020.

10.2 Helmet Usage and Fatalities

Figure 14 shows the percent of motorcyclist fatalities by helmet use and year for motorcyclists whose helmet use is known (please note that 2012 data in this figure includes crashes both before and after the helmet law modification, but only a very small proportion of motorcycle crashes occurred prior to April 13th in 2012). These fatality rates have generally shown normal variation over time, and the 11-year

average fatality percent for motorcyclists not wearing helmets (6.2%) is double that of motorcyclists wearing helmets (3.1%). The overall fatality rate has slowly risen with rates between 2015-2020 fluctuating between 3.9% and 4.7%, while from 2010 to 2014 the rates were between 3.2% and 3.8%.

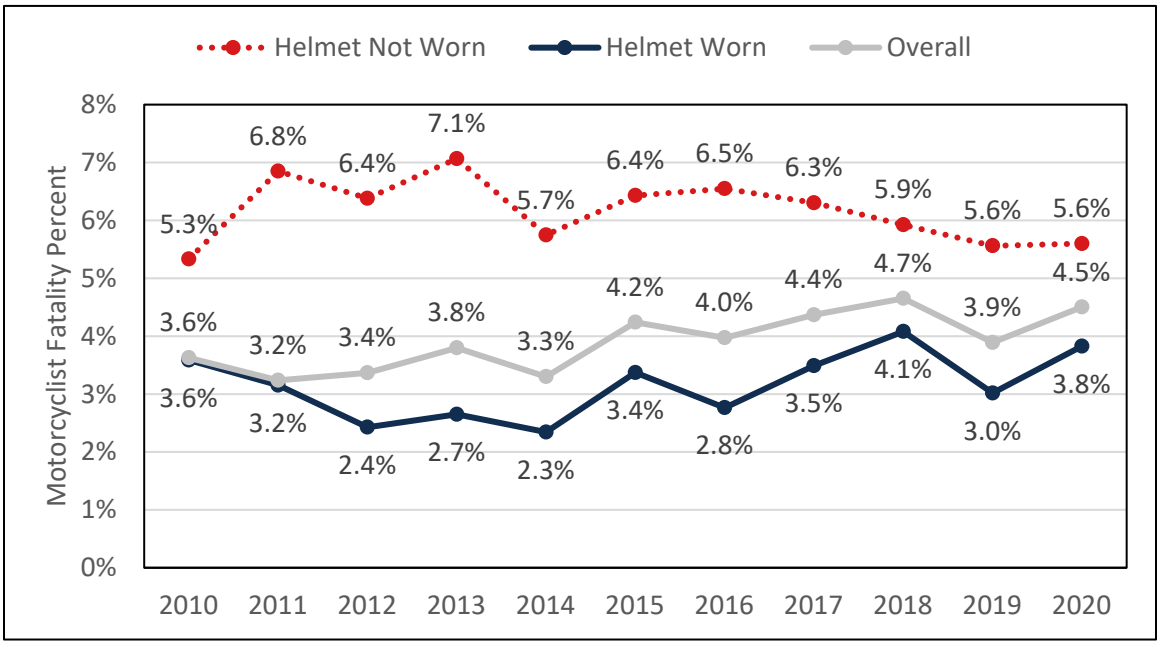

Figure 14 – Motorcyclist Fatality Percent by Helmet Use and Year

Figure 15 shows the helmet use percentage of fatally injured motorcyclists in crashes. Helmet use among fatalities decreased sharply from 95.1% in 2011 before the helmet law modification to 54.9% in 2012. The helmet usage rate among fatally injured motorcycle riders varied year to year from 2013 through 2020, with a low of 47.4% in 2016 and a high of 60.5% in 2018. The 2020 helmet usage rate among fatalities in crashes was 52.6%.

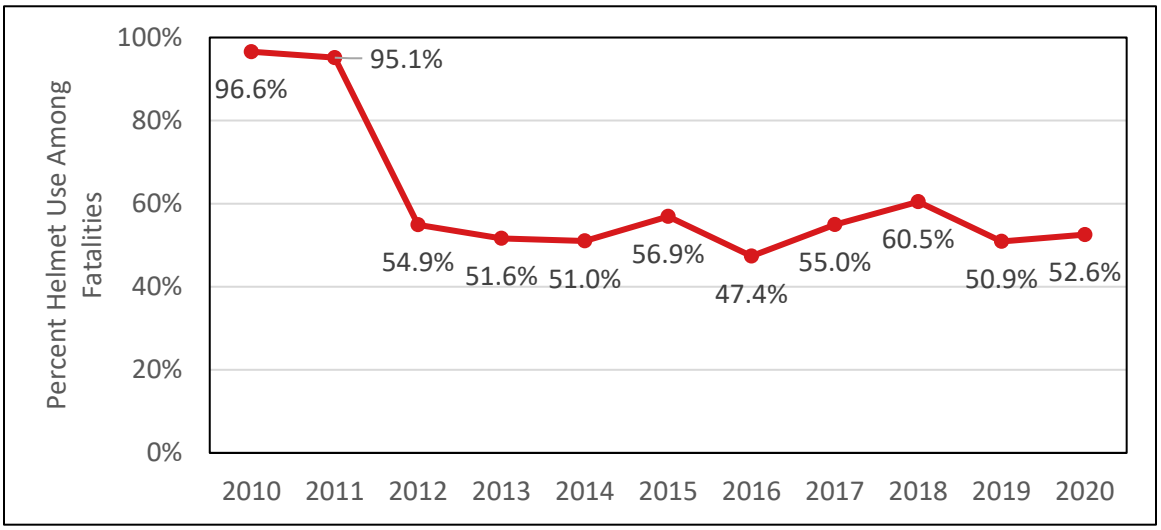

Figure 15 – Helmet Use Rate Among Motorcyclist Fatalities by Year

10.3 Helmet Usage and Injuries

Table 8 shows the count of motorcyclists who were injured at each injury severity level by helmet use and year. For motorcyclists wearing helmets, the less severe injury counts (B-level, C-level, and O-level) generally decreased with 11-year injury count lows in either 2019 or 2020. While for motorcyclists not wearing helmets the count of A-level and B-level injuries appears to be gradually increasing (11-year high in 2020 of 344 A-level and 378 B-level injuries), yet this trend is likely impacted by the general increase in motorcyclists not wearing helmets over the same period.

Table 8. Injury Severity Counts by Helmet Use and Year

Helmet Use	Injury Status	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Helmet Worn	Fatal Injury (K)	113	98	67	63	50	74	63	72	78	56	72
	Suspected Serious Injury (A)	556	519	439	350	308	310	367	392	387	366	409
	Suspected Minor Injury (B)	1,029	1,088	950	780	716	705	779	665	658	617	649
	Possible Injury (C)	740	728	684	608	532	551	541	404	350	354	351
	No Injury (O)	713	676	621	576	528	555	526	530	439	463	400
	K + A Injury	669	617	506	413	358	384	430	464	465	422	481
Helmet Not Worn	Fatal Injury (K)	4	5	55	59	48	56	70	59	51	54	65
	Suspected Serious Injury (A)	20	23	196	194	172	178	263	261	241	291	344
	Suspected Minor Injury (B)	27	21	284	277	273	288	344	301	306	309	378
	Possible Injury (C)	13	15	179	171	182	172	182	131	122	141	175
	No Injury (O)	11	9	148	134	160	177	209	184	141	176	199
	K + A Injury	24	28	251	253	220	234	333	320	292	345	409

To separate risky behavior from helmet use as contributors to fatality risk, we developed a regression model to account for the effects of alcohol use, drug use, posted speed limit, and other factors that are not related to the helmet law modification itself. The model indicates that after controlling for other risk factors, helmet non-use multiplies the risk of a fatal injury (K) by a factor of 1.6. If the motorcycle operator was drinking, the risk of a fatality is multiplied by a factor of 2.9, and operator drug use multiplies the risk by 11.4. We then used the model to estimate the number of fatalities that would have occurred if helmet use rates were at 2011 levels (97.7%). We estimate that fatalities would have been reduced by 14.5%, or about 19 motorcyclists per year.

The regression modeling approach was repeated for A-level injuries to estimate the reduction in injuries if helmet use were the same as in previous years. Adjusting for risk factors other than helmet use, we estimate that if helmet use were at 2011 levels (97.7%), the reduction in A-level injuries would be 10.9%, or about 69 fewer A-level injured motorcyclists annually.

11.0 Summary

Compared to crashes without motorcycles, motorcycle-involved crashes more commonly occur during daylight and clear weather conditions. Single-vehicle and head-on crashes are overrepresented for motorcycle-involved crashes compared to non-motorcycle-involved crashes. In terms of temporal

factors, crashes involving motorcyclists are more likely to take place from May through September, on the weekends, and from 1 PM to 2 AM, compared to crashes without motorcycles.

Motorcycle operators involved in crashes were more likely to be impaired than non-motorcycle drivers. About 7.1% of motorcycle operators were reported to be drinking, compared with 1.9% of other motor vehicle operators. Similarly, 1.7% of motorcycle operators were suspected of using drugs, compared with 0.5% of other motor vehicle operators. Furthermore, before the helmet law modification about 89.2% of drinking motorcycle operators in crashes were wearing a helmet, but this dropped to about 39.0% after the helmet law modification.

Since the modification of Michigan's mandatory helmet law in 2012, the percent of fatally-injured motorcyclists has generally increased (with all rates from 2015-2020 between 4.0% and 4.7% and rates from 2010-2014 between 3.2% and 3.8%). The rate of K+A injuries among motorcyclists has gone up from 20.7% before the helmet law modification to 23.7% after the helmet law modification. Using a regression modeling approach and adjusting for risk factors other than helmet use, we estimate that if helmet use were at 2011 levels (97.7%), there would be about 19 fewer fatalities and 69 fewer A injuries annually.