Analysis Report: Motorcycle-Involved Crashes in Michigan (2017-2021)

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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 and 2021 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.

The total number of police-reported crashes on Michigan roadways decreased from 2019 to 2020 by 21.9%, declining from 314,376 in 2019 to 245,432 in 2020, and then in 2021 increased slightly to 282,640 crashes which is still 10.1% less than the 2019 crash total. Despite the lower amount of crashes in 2020 and 2021, the fatality count has increased each year from 985 in 2019, to 1,083 in 2020 (9.9% increase from 2019), and 1,131 in 2021 (14.8% increase from 2019). In 2020, there was a decrease in vehicle miles traveled, licensed drivers, and vehicle registrations: vehicle miles traveled decreased 15.5% to 86.31 billion, motor vehicle registrations were down 0.5% to 9.04 million, and the number of licensed drivers was down 1.9% to 7.12 million. The increased 2020 fatality count in combination with the reduction of the exposure factors contributed to a fatality rate of 1.25 per 100 million miles of travel, a 30.2% 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. In 2021, vehicle miles traveled was still 5.3% less than 2019 at 96.74 billion miles, and the fatality rate was 1.17 per million miles of travel – a slight decrease from the 2020 fatality rate but still much higher than the 2011-2020 average rate.

1.0 Executive Summary

This report utilizes police-reported crash data in Michigan from 2017 through 2021 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. Since 2012, the percent of motorcyclists using helmets has gradually decreased to a low of 61.0% in 2021.
- 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 2017-2021 where helmet use and motorcycle endorsement status were known, 70.2% of motorcycle endorsed operators wore helmets compared to 57.6% of unendorsed operators.
- Helmet usage for crash-involved motorcyclists age 16-20 dropped from 97.3% before the 2012 helmet law modification to 82.6% after, even though helmet use is still required by law for motorcyclists in this age group.
- Crash-involved motorcycle operators with motorcycle endorsements on average made up 66.7% 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 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 2015-2021 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 law modification to 24.3% 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, 13.8% (19 per year) of fatalities and 10.7% (71 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 2017 through 2021. 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 2021. 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 - 12/31/2021).

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 2017-2021, while Figure 1 provides a visualization of the injury severity trends. In general, these motorcyclist crash trends have shown normal variation over the past 5 years, with a high of 3,571 motorcyclists in crashes in 2021 and a low of 3,012 in 2018. Motorcyclist fatalities reached a high of 166 in 2021 and a low of 122 in 2019. Fatalities as a percent of all motorcyclists in crashes has ranged from 4.0% to 4.6% with an average of 4.4%.

Table 1. Number of Fatalities among Crash-Involved Motorcyclists

Year	Motorcyclist Fatalities	Motorcyclists in Crashes	Fatality Percent
2017	137	3,237	4.2%
2018	134	3,012	4.4%
2019	122	3,083	4.0%
2020	152	3,375	4.5%
2021	166	3,571	4.6%
Total	**711**	**16,278**	**4.4%**

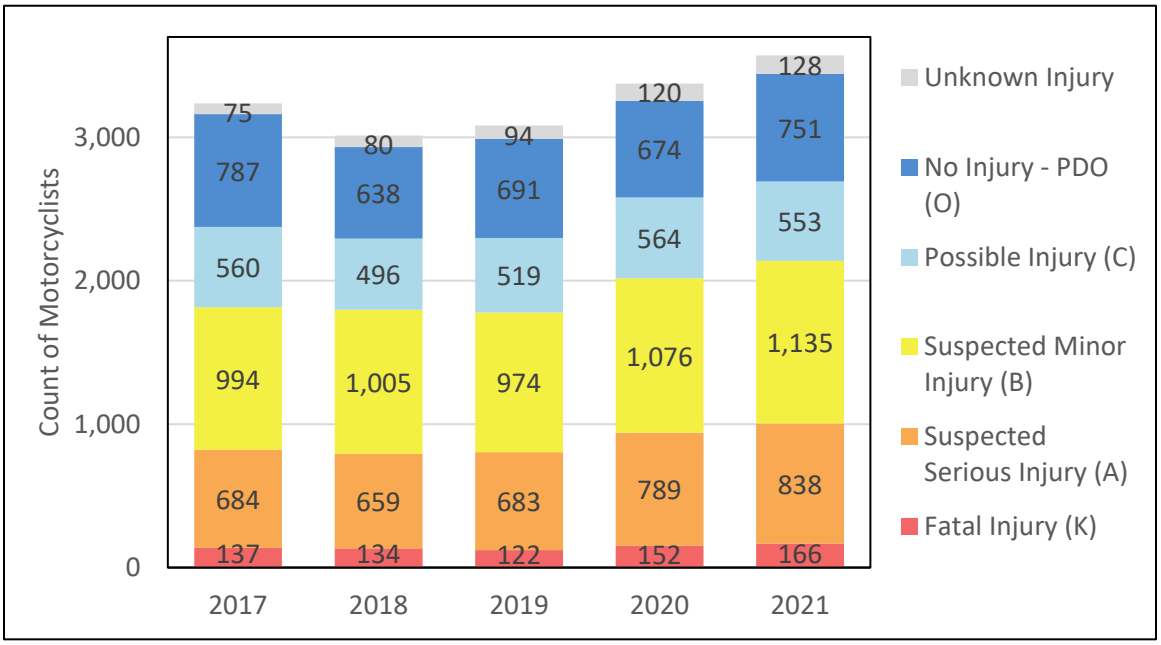

Figure 1 – Injury Severity of Motorcyclists Involved in Crashes, 2017-2021

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 46.1% of motorcycle-involved crashes, followed by rear-end (16.2%) and angle crashes (15.9%). 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 category group crashes, 75.4% are head-on left turn crashes compared to 67.2% of the head-on crashes with no motorcycle involved.

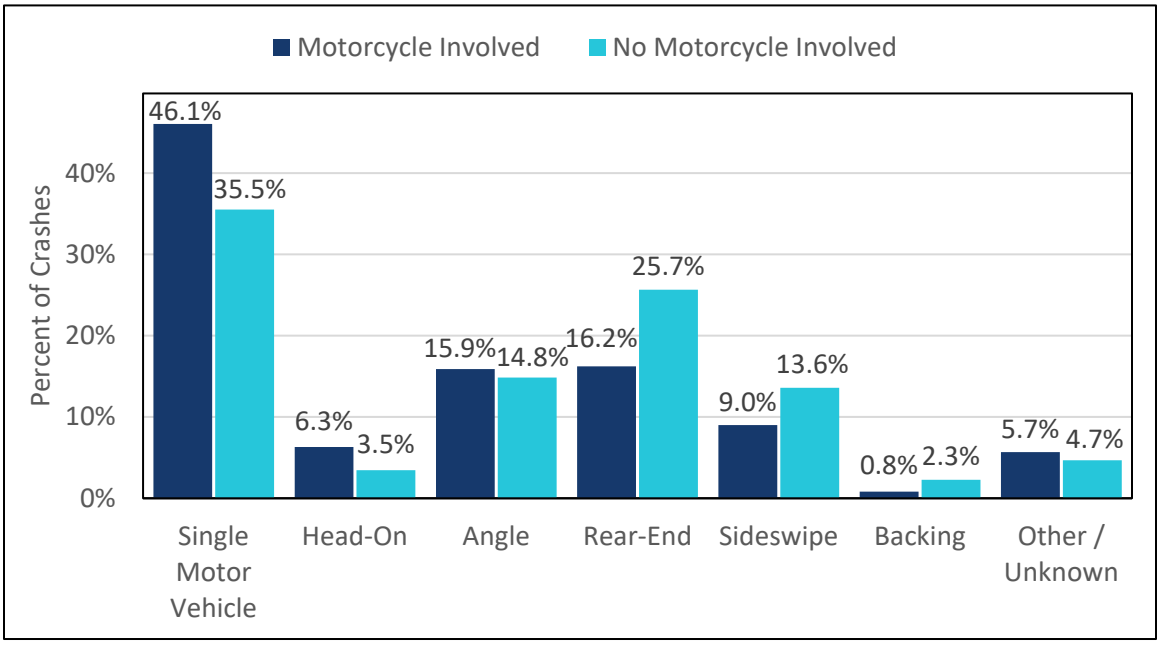

Figure 2 – Crash Type by Motorcycle Involvement, 2017-2021

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.

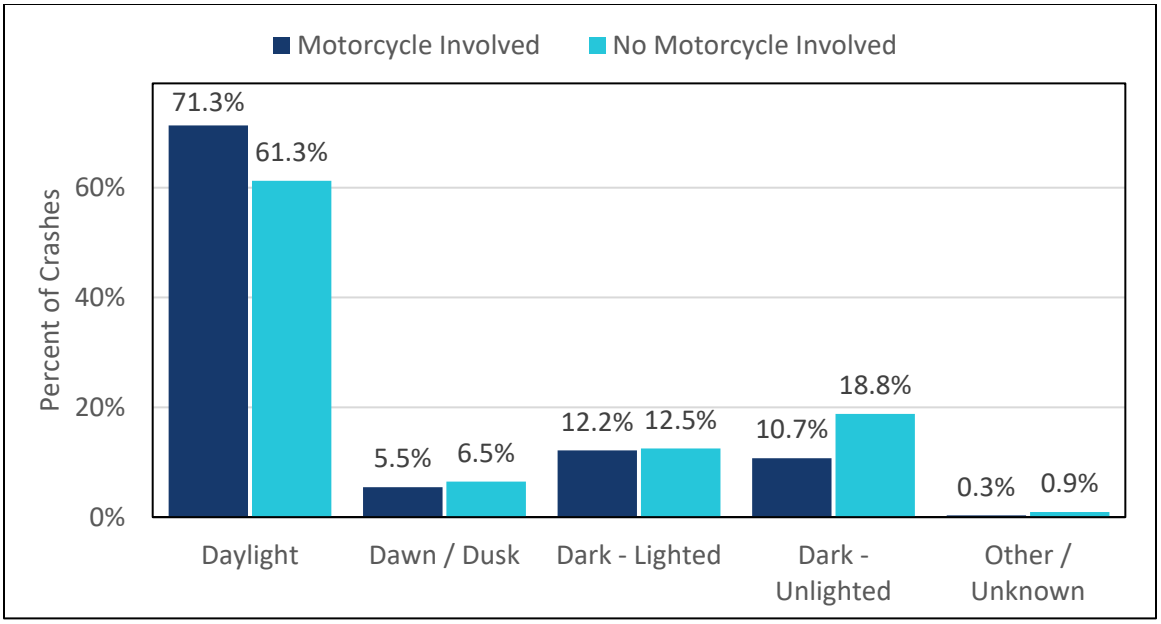

Figure 3 – Light Condition in Crashes by Motorcycle Involvement, 2017-2021

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 (83.6%) compared to non-motorcycle-involved crashes (59.8%). Motorcyclists likely choose to avoid riding in inclement weather, which would contribute to the relatively lower percentage of crashes the other non-clear weather categories.

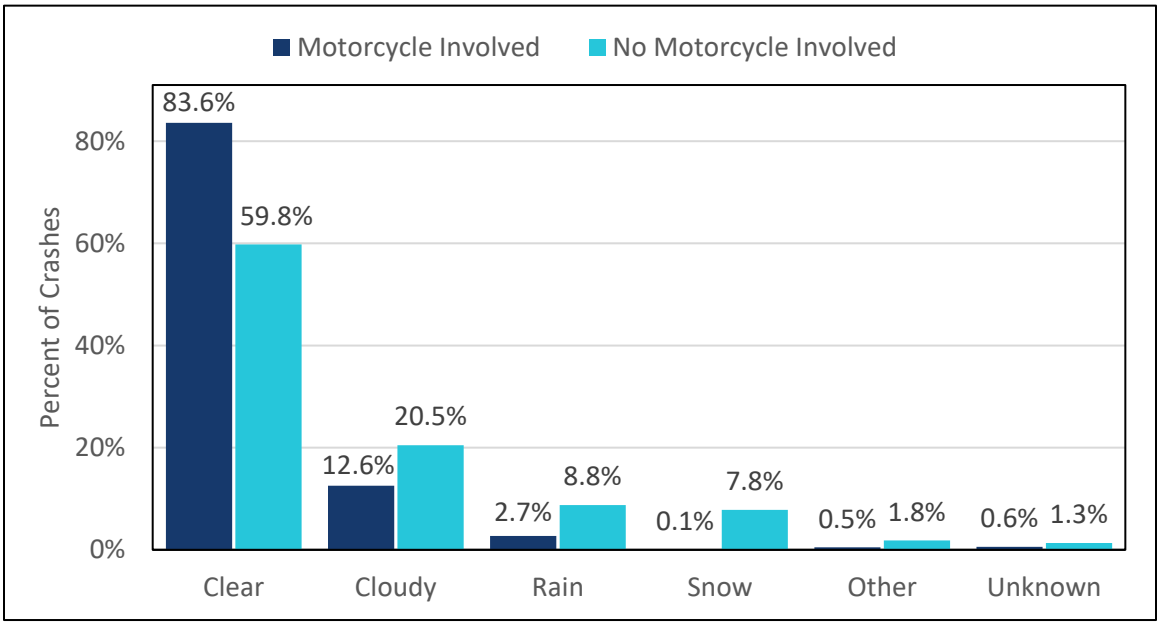

Figure 4 – Weather Condition in Crashes by Motorcycle Involvement, 2017-2021

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 (59.2% of motorcycle-involved crashes vs. 55.7% of non-motorcycle-involved crashes).

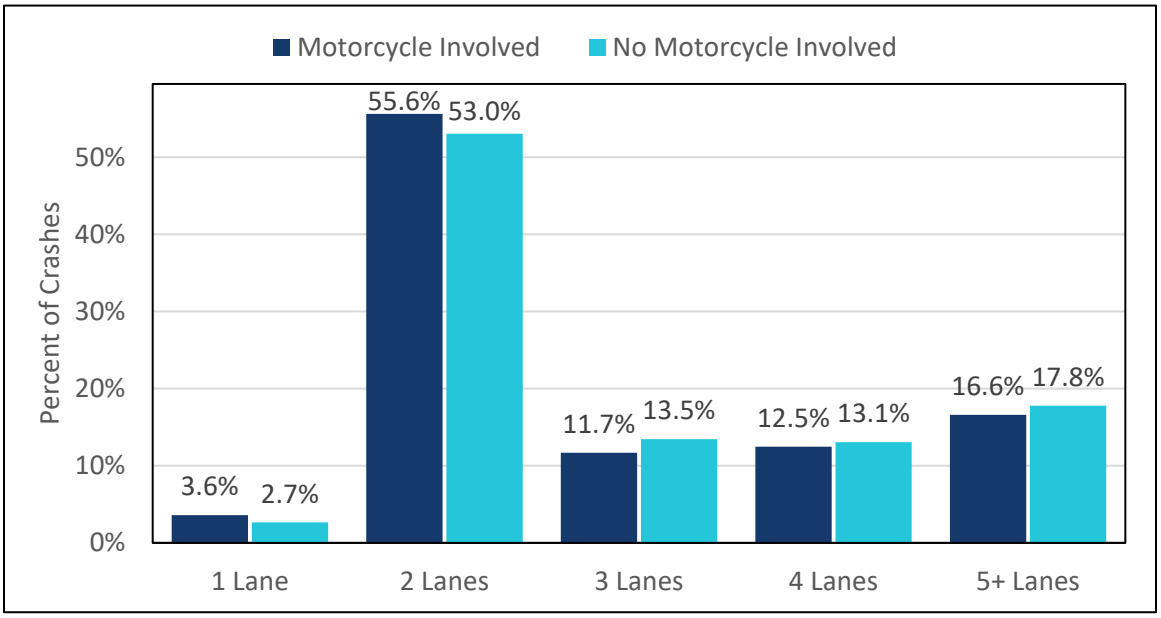

Figure 5 – Number of Traffic Lanes in Crashes by Motorcycle Involvement, 2017-2021

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 (79.3% of motorcycle involved crashes vs. 72.8% of non-motorcycle-involved crashes).

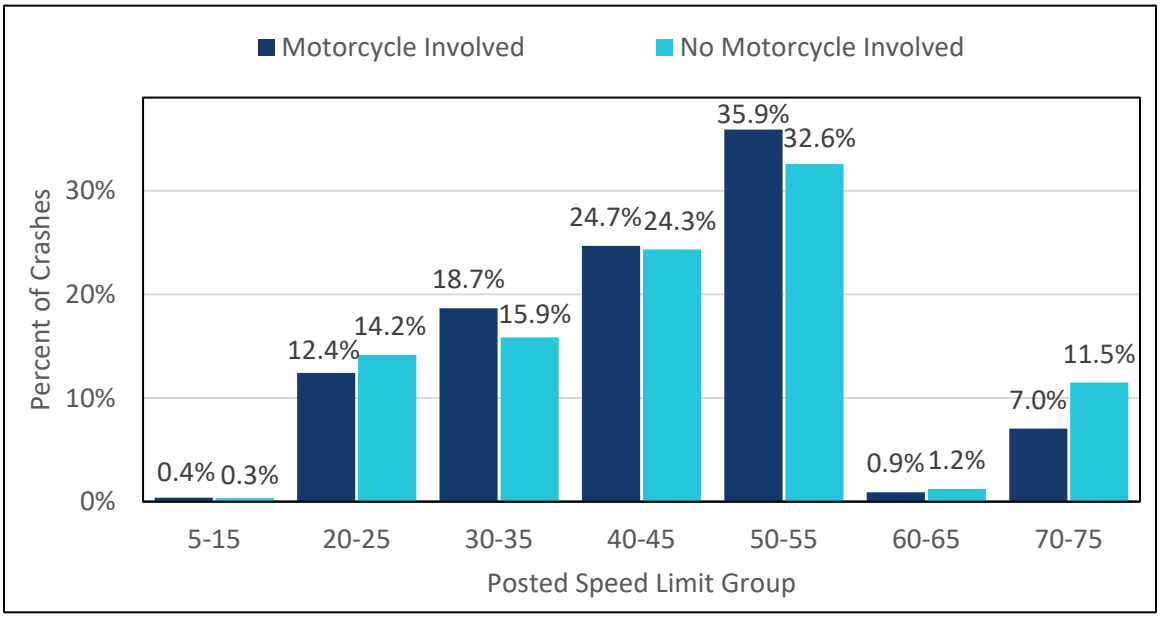

Figure 6 – Posted Speed Limit Crash Percentages by Motorcycle Involvement, 2017-2021

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 18.8% 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.

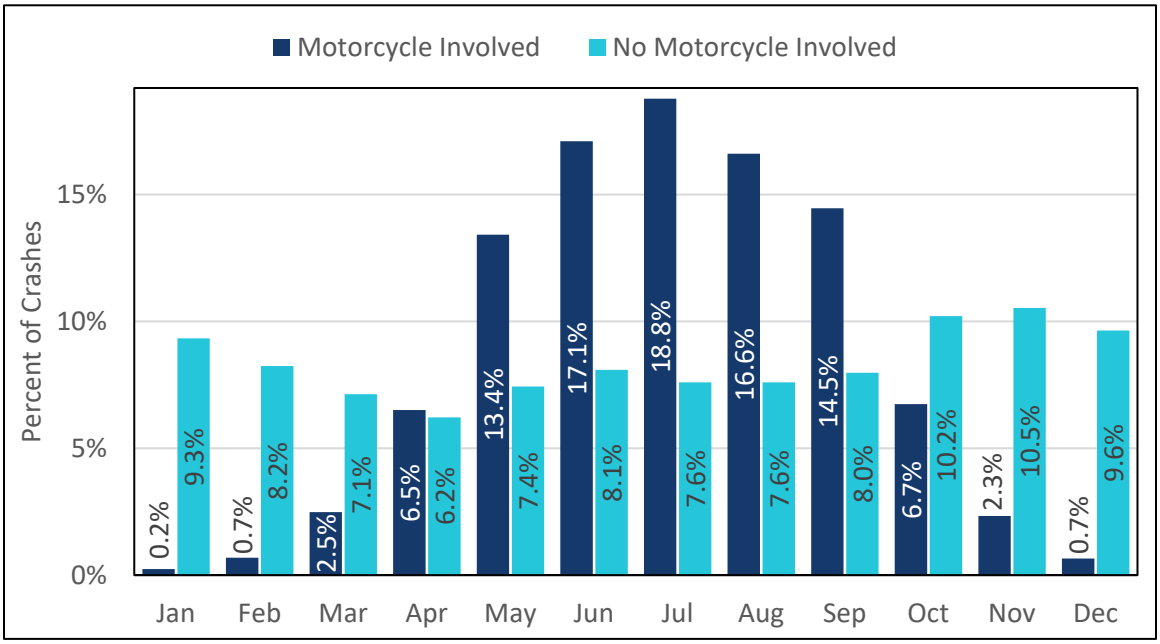

Figure 7 – Crashes by Month and Motorcycle Involvement, 2017-2021

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 20.0%.

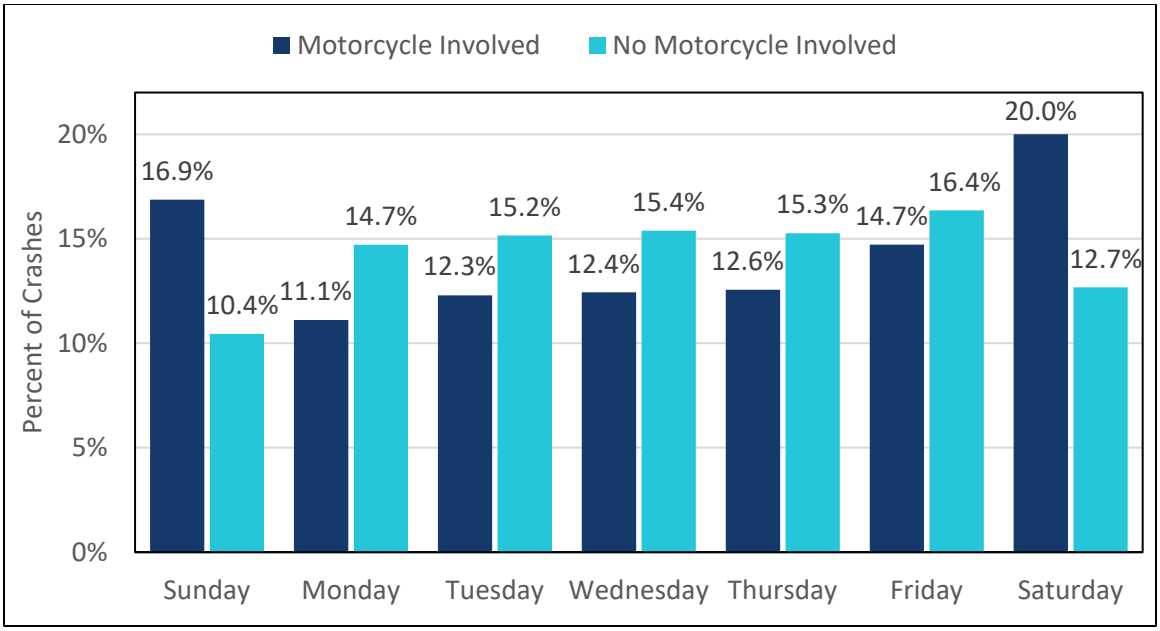

Figure 8 – Crashes by Day of Week and Motorcycle Involvement, 2017-2021

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 (9.1%). 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 of non-motorcycle travel.

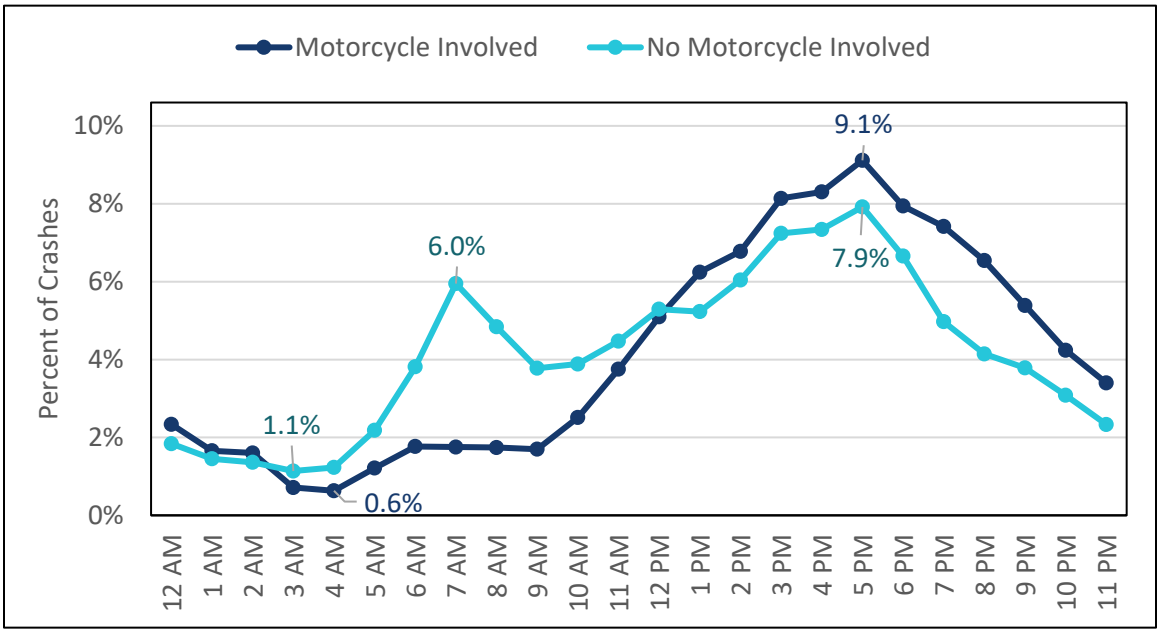

Figure 9 – Crashes by Time of Day and Motorcycle Involvement, 2017-2021

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 910 (6.5%) motorcycles involved in crashes from 2017 to 2021 with unavailable VIN data that were excluded from Table 2. Cruisers were the predominant type of motorcycle in crashes with 35.2% of known motorcycles involved in crashes, followed by touring at 30.8% and super sport at 13.2%. The year-to-year variation within each classification is fairly low.

Table 2. Motorcycles in Crashes by Motorcycle Classification and Year

Motorcycle Classification	2017	2018	2019	2020	2021	Total	Percent of Total
Autocycle	6	1	5	7	12	31	0.2%
Chopper	9	9	5	6	3	32	0.2%
Cruiser	1,003	921	941	950	1,098	4,913	35.2%
Dual Purpose	56	69	63	73	81	342	2.5%
Incomplete	0	0	1	0	0	1	0.0%
Off Road	28	22	25	42	35	152	1.1%
Other	0	0	0	1	1	2	0.0%
Scooter	35	38	37	58	55	223	1.6%
Sport	219	189	173	219	233	1,033	7.4%
Sport Touring	27	29	32	54	38	180	1.3%
Standard	98	72	75	116	87	448	3.2%
Super Sport	385	336	335	408	382	1,846	13.2%
Touring	831	804	866	870	931	4,302	30.8%
Unclad Sport	86	77	94	87	105	449	3.2%
Total	**2,783**	**2,567**	**2,652**	**2,891**	**3,061**	**13,954**	**100.0%**

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 percentages in fatal crashes than in non-fatal crashes, with 19.0% in fatal crashes and 12.9% in non-fatal crashes.

Table 3. Motorcycles in Fatal and Non-Fatal Crashes by Motorcycle Classification, 2017-2021

Motorcycle Classification	Fatal Count	Fatal Percent	Non-Fatal Count	Non-Fatal Percent
Autocycle	1	0.1%	30	0.2%
Chopper	3	0.4%	29	0.2%
Cruiser	223	32.3%	4,690	35.4%
Dual Purpose	10	1.4%	332	2.5%
Incomplete	1	0.1%	0	0.0%
Off Road	2	0.3%	150	1.1%
Other	0	0.0%	2	0.0%
Scooter	19	2.7%	204	1.5%
Sport	46	6.7%	987	7.4%
Sport Touring	6	0.9%	174	1.3%
Standard	16	2.3%	432	3.3%
Super Sport	131	19.0%	1,715	12.9%
Touring	214	31.0%	4,088	30.8%
Unclad Sport	19	2.7%	430	3.2%
Total	**691**	**100.0%**	**13,263**	**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. Typically, to receive a motorcycle endorsement a skills test is required. 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 and passed, the skills test required to receive an endorsement is waived. 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.

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. Due to the COVID-19 pandemic there was a sharp drop in completed trainings and skills tests in 2020 compared to previous years, so 2020 results should be interpreted cautiously. The number of completed trainings from 2017 to 2019 had ranged between 8,883 and 9,589 then dropped in 2020 to 5,841 and rebounded in 2021 to 9,626. The number of skills tests completed had decreased from a high of 6,798 in 2017, to 4,496 in 2019 and then a low of 2,535 in 2020, followed by 4,949 in 2021. The number of endorsements received has ranged from a low of 608,898 in 2021 to a high of 656,160 in 2017.

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

Year	Trainings Completed	Skills Tests Completed	Endorsements Received
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
2021	9,626	4,949	608,898
Average	**8,625**	**4,769**	**636,091**

From 2017 to 2021, the overall CY endorsement rate for motorcycle operators in crashes with a known endorsement status was 66.7%. 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.

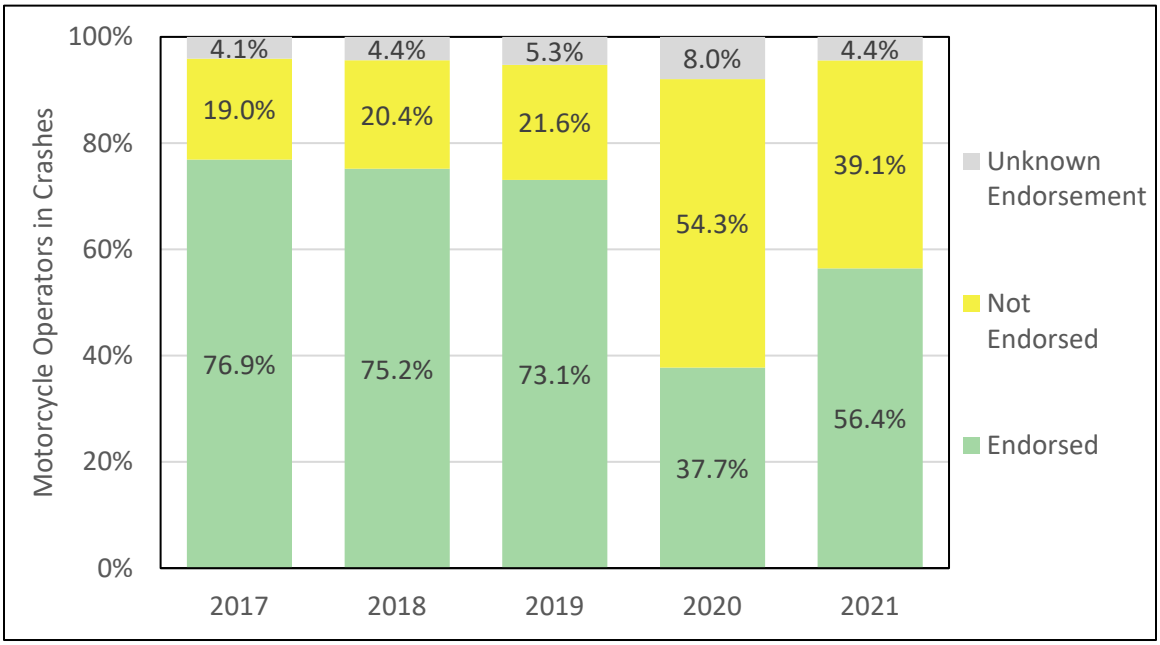

Figure 10 – Motorcycle Operators in Crashes by CY Endorsement Status and Rate

Table 5 shows helmet use counts by CY endorsement status from 2017 through 2021 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 70.2% compared to operators with no endorsement at 57.6%.

Table 5. Helmet Use for Motorcycle Operators by CY Endorsement Status, 2017-2021

CY Endorsement Status	Helmet Worn	Helmet Not Worn	Helmet Use Percent
Yes	6,232	2,643	70.2%
No	2,484	1,831	57.6%

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 7.3% of motorcycle operators were reported to be drinking, compared with 1.9% of other drivers.

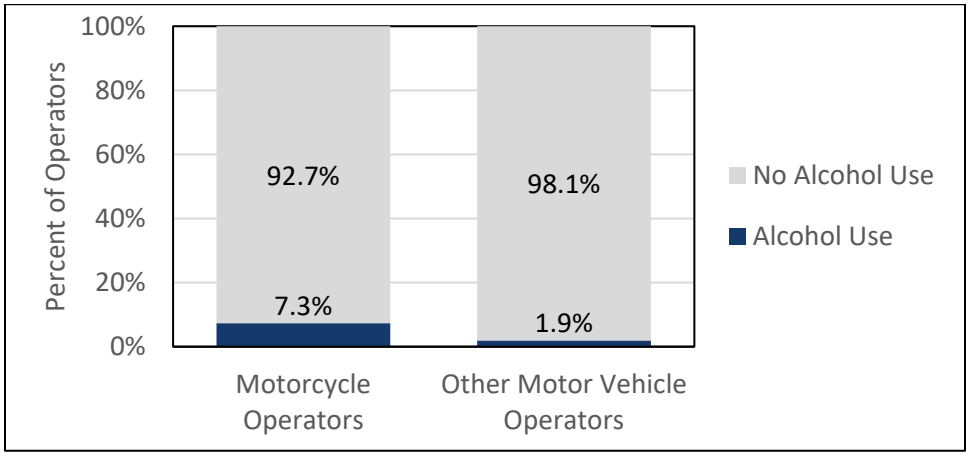

Figure 11 – Distribution of Motor Vehicle Operators by Alcohol Involvement, 2017-2021

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 3.3 times higher than non-motorcycle operators where 1.9% of motorcycle operators were suspected of using drugs, compared with 0.6% of other motor vehicle operators.

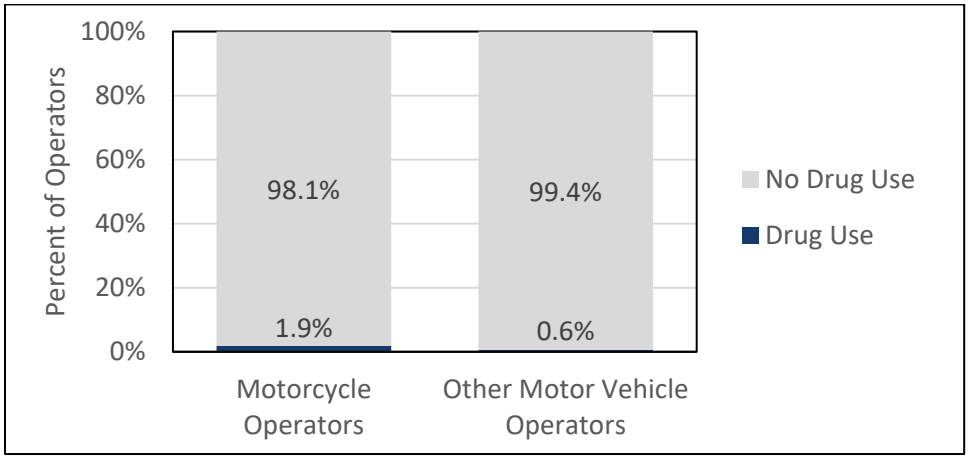

Figure 12 – Distribution of Motor Vehicle Operators by Drug Involvement, 2017-2021

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 2017-2021. 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 2017 to 2021 where an operator was using at least one cannabinoid drug. The most common cannabinoid drug codes with positive tests over the five-year period are THC (56.1%) and Delta 9 (31.6%). The count of motorcycle operators with a positive cannabinoid test result has been gradually increasing over the last 5 years with a low of 13 in 2017 and a high of 24 in 2021 while the five-year average percentage of operators testing positive is 0.66%.

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

Year	Operators with Positive Cannabinoid Test	Total Operators	Percent of All Operators
2017	13	2,964	0.44%
2018	19	2,728	0.70%
2019	20	2,809	0.71%
2020	22	3,092	0.71%
2021	24	3,271	0.73%
Total	**98**	**14,864**	**0.66%**

10.0 Helmet Use

10.1 Helmet Usage Percentage

Helmet use percentages in the crashing population are not necessarily equivalent to those in the riding population. However, the helmet use trends of motorcyclists in crashes may indicate how helmet use patterns are changing as well as impacting the risk of injury due to a crash. A direct observation survey of motorcycle helmet use for all motorcyclists on Michigan roadways was conducted in Michigan in 2017 by Michigan State University[1]. The study concluded that the motorcycle helmet usage was 71.4%, which is slightly higher than the crash-based 2017 motorcyclist helmet usage result of 68.8%.

Figure 13 shows the percentage of motorcyclists in crashes using helmets from 2010 to 2021 (excluding unknown helmet use). Helmet use among motorcyclists in crashes was substantially lower after the 2012 helmet law modification than in previous years. Prior to the helmet law modification, in 2010 and

[1] Michigan State University. 2017 Direct Observation Survey of Motorcycle Helmet Use in Michigan. https://www.michigan.gov/-/media/Project/Websites/msp/ohsp/pdfs2/FINAL_REPORT__Michigan_Motorcycle_Helmet_Use.pdf

2011, the crash-involved helmet use percentage was 97.7%. Since 2011, the percentage has decreased steadily to a low of 61.0% in 2021.

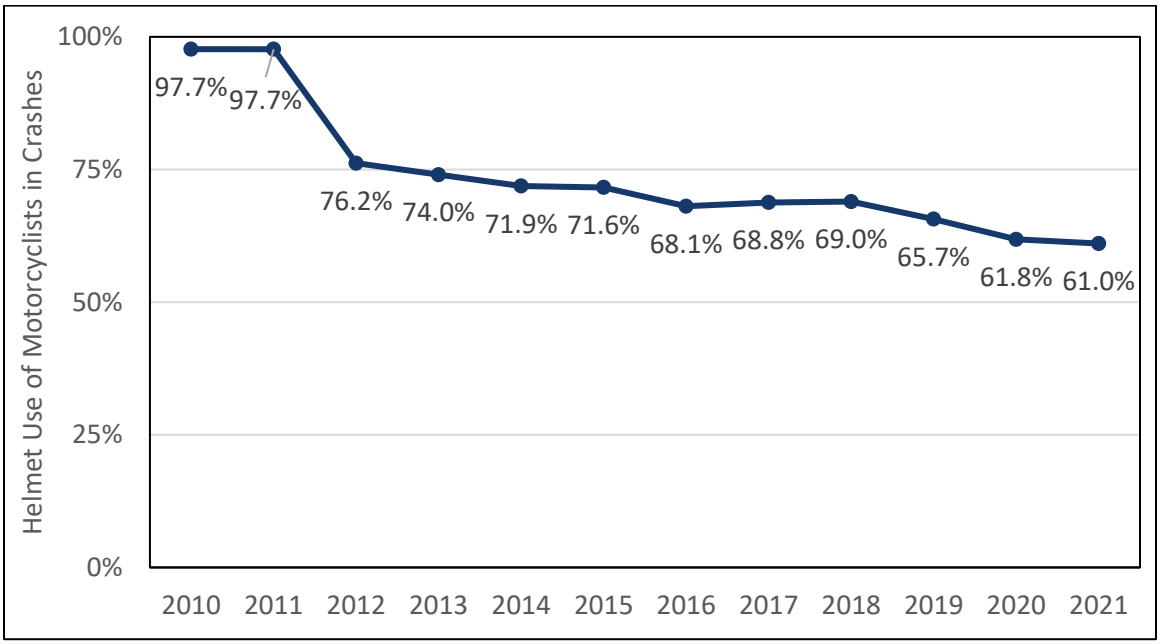

Figure 13 – Helmet Use Rates Among Motorcyclists in Crashes by Year

Table 7 summarizes helmet use percentages and how they have changed in the post helmet law modification period. All group percentage 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 female (98.1%) and male (97.5%) motorcyclists helmet usage was not significantly different. After the helmet law modification, both male and female helmet usage decreased, but women (71.2%) wore helmets at a significantly higher percentage than men (68.2%).

Helmet use percentages as a function of motorcyclist age also differ significantly after the helmet law modification. After the helmet law modification, helmet usage among all motorcyclist age groups decreased sharply, even though the law still requires helmets for motorcyclists under the age of 21. Motorcyclists age 15 and under (0.9% of the crash population) have a helmet usage of 74.0%, motorcyclists age 16-20 (5.4% of the crash population) have a helmet usage of 82.6%, and motorcyclists 21 and over (93.6% of the crash population) have a helmet usage of 67.8%.

Helmet use percentages as a function of seat position are significantly different between operator and passenger seat position after the helmet law modification. Both groups used helmets about equally before the helmet law modification, but afterwards, passengers' usage (65.8%) became significantly lower than that of operators (68.9%).

Table 7. Helmet Use Among Motorcyclists in Crashes by Demographic Group, 2010-2021

Unit	Group		Before Helmet Law Modification (1/1/2010 - 4/12/2012)	After Helmet Law Modification (4/13/2012 - 12/31/2021)
All Motorcyclists	Gender* (after only)	Male	97.5%	68.2%
		Female	98.1%	71.2%
	Age* (after only)	≤ 15 years	93.8%	74.0%
		16-20 years	97.3%	82.6%
		21+ years	97.7%	67.8%
	Seat Position* (after only)	Operator	97.6%	68.9%
		Passenger	98.1%	65.8%
Motorcycle Operators Only	Vehicle Registration State* (after only)	Michigan	97.9%	69.2%
		Other	96.7%	64.4%
	CY Endorsement* (before & after)	Yes	98.7%	71.9%
		No	96.5%	65.6%
	Alcohol Use* (before & after)	Yes	89.2%	38.7%
		No	98.2%	71.3%

** Indicates significantly different helmet use percentages among demographic groups (p<0.05). All percentage 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 usage was 96.7%, which is not significantly lower than those with vehicles registered in Michigan (97.9%). After the modification, 5.2% of crash-involved motorcycle operators had vehicles registered out of state. Their helmet usage of 64.4% was significantly lower than operators of in-state vehicles at 69.2%. 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 58.1% of the crash population.

Finally, motorcyclists who were coded as drinking at the time of the crash showed the largest change in helmet usage 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 percentage fell to 38.7%. Drinking motorcycle operators made up 6.9% of all motorcycle operators involved in crashes from 2010 through 2021.

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. (Note: 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 12-year average fatality percent for motorcyclists not wearing helmets (6.1%) is almost double that of motorcyclists wearing helmets (3.2%). The overall fatality rate has slowly risen, with rates from 2015 to 2021 fluctuating between 3.9% and 4.7%, while from 2010 to 2014 the rates were between 3.2% and 3.8%.

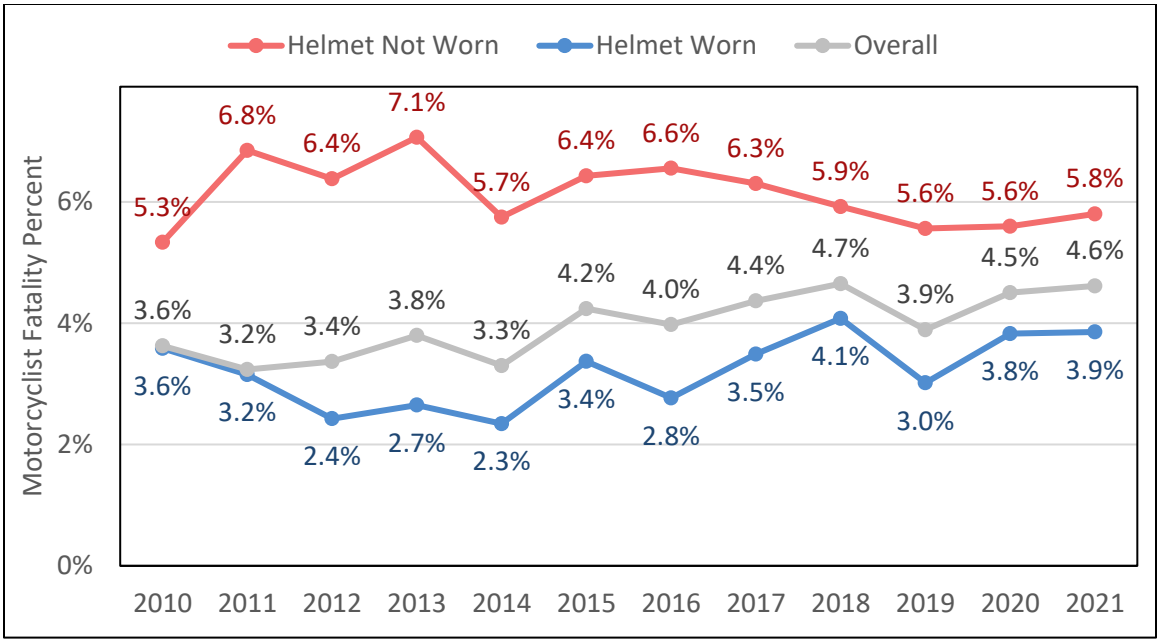

Figure 14 – Motorcyclist Fatality Percent by Helmet Use and Year

Figure 15 shows the helmet usage of fatally injured motorcyclists compared to non-fatally injured motorcyclists in crashes. Helmet usage in motorcyclist fatalities is consistently lower than non-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 has shown relatively normal variation since 2012 ranging from a low of 47.4% in 2016 to a high of 60.5% in 2018.

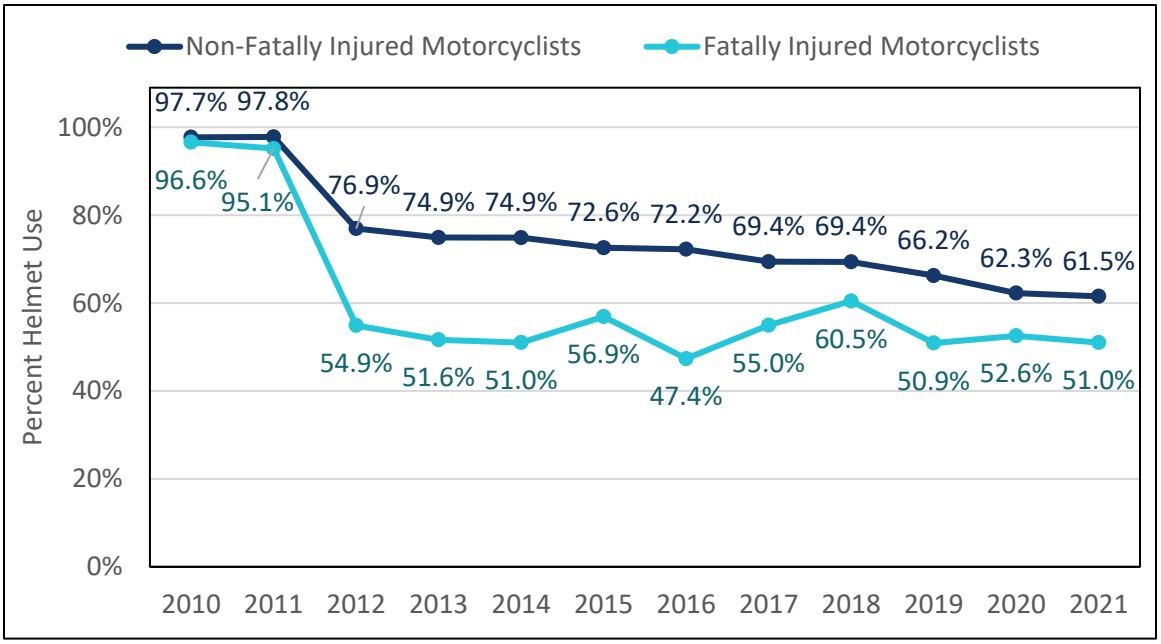

Figure 15 – Helmet Use Among Motorcyclists by Fatality Status and Year

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 (C-level, and O-level) have generally decreased with 12-year lows in 2020 or 2021. While for motorcyclists not wearing helmets the counts of K-level, A-level, and B-level injuries appear to be gradually increasing with 12-year highs in 2021 of 72 K-level, 367 A-level, and 404 B-level injuries. These trends are likely impacted by the gradual decrease in helmet use among all motorcyclists over the last 10 years.

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	2021
Helmet Worn	Fatal Injury (K)	113	98	67	63	50	74	63	72	78	56	72	75
	Suspected Serious Injury (A)	556	519	439	350	308	310	367	392	387	366	409	418
	Suspected Minor Injury (B)	1,029	1,088	950	780	716	705	779	665	658	617	649	666
	Possible Injury (C)	740	728	684	608	532	551	541	404	350	354	351	336
	No Injury (O)	713	676	621	576	528	555	526	530	439	463	400	450
	K or A Injuries	669	617	506	413	358	384	430	464	465	422	481	493
Helmet Not Worn	Fatal Injury (K)	4	5	55	59	48	56	70	59	51	54	65	72
	Suspected Serious Injury (A)	20	23	196	194	172	178	263	261	241	291	344	367
	Suspected Minor Injury (B)	27	21	284	277	273	288	344	301	306	309	378	404
	Possible Injury (C)	13	15	179	171	182	172	182	131	122	141	175	181
	No Injury (O)	11	9	148	134	160	177	209	184	141	176	199	217
	K or A Injuries	24	28	251	253	220	234	333	320	292	345	409	439

10.4 Estimate of Lives Saved and Suspected Serious Injuries Reduced by Helmet Use

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. 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 13.8%, 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 10.7%, or about 71 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 April 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 7.3% of motorcycle operators were reported to be drinking, compared with 1.9% of other motor vehicle operators. Similarly, 1.9% of motorcycle operators were suspected of using drugs, compared with 0.6% of other motor vehicle operators. Before the helmet law modification in 2021, about 89.2% of drinking motorcycle operators in crashes were wearing a helmet, but this dropped to about 38.7% after the helmet law modification.

Since the modification of Michigan's mandatory helmet law in 2012, the percentage of fatally-injured motorcyclists has generally increased (from 2010-2014, percentages ranged between 3.2% and 3.8%, and since 2015, have ranged between 3.9% and 4.7%). The frequency of K-level or A-level injuries among motorcyclists has gone up from 20.7% before the helmet law modification to 24.3% after the helmet law modification. Using a regression modeling approach and adjusting for risk factors other than helmet use, we estimate that if helmet usage was at 2011 levels (97.7%), there would be about 19 fewer fatalities and 71 fewer A-level injuries annually.