Analysis Report: Motorcycle-Involved Crashes in Michigan (2020-2024)

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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. In addition to the changes in roadway usage and exposure, there were also impacts on trends for crash and injury severities.[1]

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. In 2021, the crash count increased from 2020 to 282,640 crashes (still 10.1% less than 2019), and from 2022 to 2024 has only varied slightly between 287,953 (2023) and 293,341 (2022). Despite the lower number of crashes since 2019, the fatality count increased from 985 in 2019, to 1,083 in 2020 (9.9% increase from 2019), 1,131 in 2021 (14.8% increase from 2019), 1,123 in 2022, 1,095 in 2023, and 1,099 in 2024. In 2020 compared to 2019, 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 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 fatalities per 100 million miles – a decrease from the 2020 fatality rate but still much higher than the 2011-2020 average rate (1.01). In 2022, vehicle miles traveled decreased slightly to 95.89 billion miles, and the fatality rate remained at 1.17. In 2023, vehicle miles traveled increased slightly to 98.29 billion miles, and the fatality rate decreased to 1.11. In 2024, vehicle miles traveled increased slightly to 99.39 billion miles, and the fatality rate remained at 1.11.

[1] Peterson, C. M., Leslie, A., Bowman, P. J., & Flannagan, C. A. C. (2024). Unpacking the COVID-19 roadway fatality paradox: an analysis of motor vehicle crashes in Michigan 2019-2022. *Traffic Injury Prevention*, 26(5), 548–556. https://doi.org/10.1080/15389588.2024.2427264

1.0 Executive Summary

This report utilizes police-reported crash data in Michigan from 2020 through 2024 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 on April 13, 2012 that repealed the motorcycle helmet requirement under certain circumstances. Major findings include:

- From 2020-2024, crashes involving motorcycles comprised 1.1% of all crashes but accounted for 15.8% of fatal crashes.
- The proportion of K-level or A-level injuries among motorcyclists increased from 20.7% before the helmet law modification (2010 through April 12, 2012) to 25.4% after the helmet law modification (April 13, 2012 through 2024).
- The fatality percent of crash-involved motorcyclists ranged between 3.2% and 3.8% from 2010 to 2014, but increased after 2014 to range from 3.9% to 5.1% from 2015-2024.
- Compared to non-motorcycle-involved crashes, single-vehicle (46.4% vs. 37.1%) and head-on (6.6% vs. 3.5%) crashes were overrepresented for motorcycle-involved crashes from 2020-2024.
- From 2020-2024, motorcycle-involved crashes more commonly occurred during daylight (70.5% vs. 60.5%) and clear weather conditions (85.7% vs. 64.6%) compared to crashes without motorcycles.
- Crashes involving motorcycles were more likely than crashes without motorcycles to take place from April through September (84.9% vs. 45.7%), on the weekends (35.9% vs. 23.7%), and between 1 PM and 3 AM (90.2% vs. 77.5%).
- Motorcycle operators involved in crashes were more likely to be impaired (6.6% using alcohol and 1.8% using drugs) than non-motorcycle drivers (1.9% using alcohol and 0.6% using drugs).
- Among motorcyclists involved in crashes, 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 proportion of motorcyclists using helmets gradually decreased to a low of 61.0% in 2021, and then gradually increased to 67.4% in 2024.
- Among motorcycle operators involved in crashes between 2020-2024 where helmet use and motorcycle endorsement status were known, 70.1% of motorcycle endorsed operators wore helmets compared to 54.5% of unendorsed motorcycle operators.
- The proportion of crash-involved motorcycle operators with motorcycle endorsements fluctuated between a low of 37.7% in 2020 and a high of 65.1% in 2024.
- 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 2.8 if the motorcycle operator was drinking and by a factor of 10.7 if the operator was using drugs.
- 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% of fatalities (24 per year) and 10.1% of serious injuries (81 per year) 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 2020 through 2024, with data since 2010 also used to explore motorcyclist helmet trends before and after the helmet law modification in Michigan on April 13, 2012 that repealed the motorcycle helmet requirement under certain circumstances. 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 primary areas of focus include: 1) fatality and injury rates and trends for helmeted and unhelmeted motorcyclists; 2) helmet use rates among crash-involved motorcyclists, especially those under 21; 3) risk-taking behavior such as alcohol use and recklessness, as it relates to injury and fatality outcomes; and 4) motorcycle endorsements (CY endorsements) among crash-involved operators.

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 2024. The helmet law modification that repealed the motorcycle helmet requirement under certain circumstances took effect on April 13, 2012.[2] 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 - 12/31/2024).

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

[2] Michigan Legislature. Section 257.658(5). Senate Bill 0291 (2011). Public Act 98 of 2012.
https://www.legislature.mi.gov/(S(jrkgnixwn3nfqgwjvowtf44c))/mileg.aspx?page=getObject&objectName=2011-SB-0291
https://www.legislature.mi.gov/(S(orxiyqo3vfvmacqiifcsq4th))/mileg.aspx?page=GetObject&objectname=mcl-257-658

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 Motorcycle-Involved Crash Trends

4.1 Crash Counts, Proportions, and Severity

Table 1 compares crash severities for crashes involving motorcycles and crashes not involving motorcycles. About 5.2% of motorcycle-involved crashes were fatal and 24.2% involved suspected serious injuries compared to 0.3% fatal and 1.4% suspected serious injury for crashes without a motorcycle involved. Only 22.5% of motorcycle-involved crashes were without injury, compared with 82.5% of crashes that do not involve motorcycles.

Table 1. Crash Severity Distributions by Motorcycle-Involved Status, 2020-2024

Crash Severity – Worst Injury in Crash	Motorcycle-Involved Crashes	No Motorcycle-Involved Crashes
Fatal Injury (K)	816 (5.2%)	4,348 (0.3%)
Suspected Serious Injury (A)	3,760 (24.2%)	20,022 (1.4%)
Suspected Minor Injury (B)	4,967 (31.9%)	73,907 (5.3%)
Possible Injury (C)	2,524 (16.2%)	144,268 (10.4%)
No Injury (O) - Property Damage Only (PDO)	3,497 (22.5%)	1,140,137 (82.5%)
Total	**15,564 (100.0%)**	**1,382,682 (100.0%)**

Figure 1 shows the proportion of motorcycle-involved crashes for both all crashes and fatal crashes. The proportion of crashes that were motorcycle-involved in Michigan had a low in 2023 of 1.06% and a high in 2020 of 1.22%. The proportion of fatal crashes that involved motorcycles has increased each year reaching a five-year high of 16.6% in 2024. From 2020-2024, crashes involving motorcycles comprised 1.1% of all crashes but accounted for 15.8% of fatal crashes. This over-representation of motorcycles in fatal crashes highlights the vulnerability of motorcyclists on roadways.

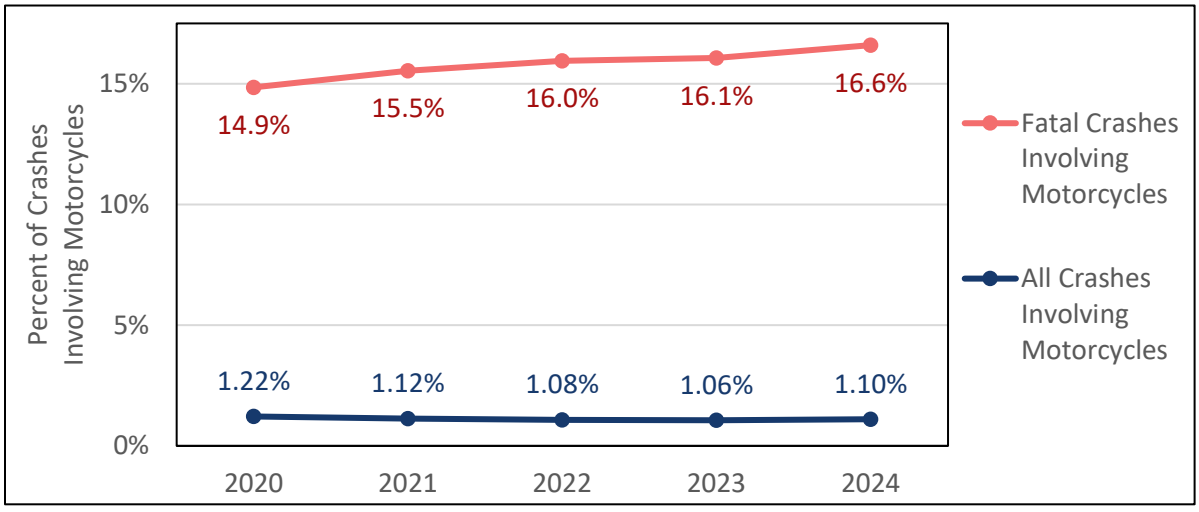

Figure 1 – Proportion of All Crashes and Fatal Crashes Involving Motorcycles by Year

4.2 Crash Rates

This section shows crash rates that account for the statewide exposure data of vehicle miles traveled (VMT) and population to provide a nuanced description of the motorcycle crash data trends (motorcycle-specific VMT data is not available). Focusing on these rates enhances comparisons of data across time periods that have variation in exposure like the decrease in highway usage during the COVID-19 pandemic and the shifting population counts in the state. In Figure 2, the motorcycle-involved crash rate is shown per 100 million vehicle miles traveled (VMT). Crash rates based on VMT had a low of 3.1 in 2023, a high of 3.5 in 2020, and a rate of 3.2 in 2024.

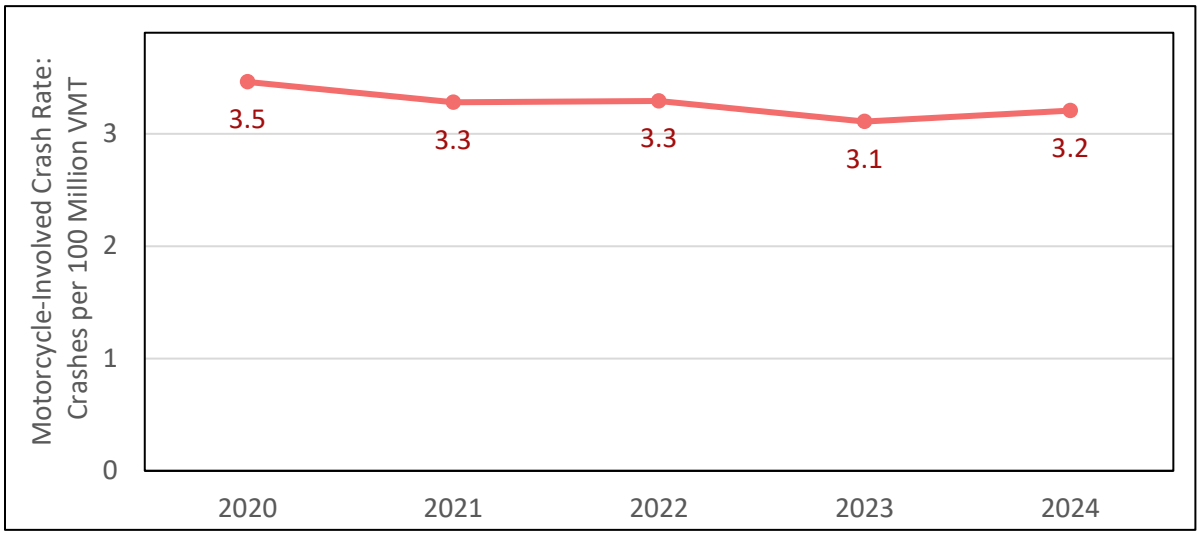

Figure 2 – Motorcycle-Involved Crash Rate by VMT and Year

Figure 3 displays the rate of motorcyclists in crashes per 100,000 population in Michigan. The rate of motorcyclists in crashes by population had a low of 33.5 in 2020, a high of 35.6 in 2021, and a rate of 34.6 in 2024.

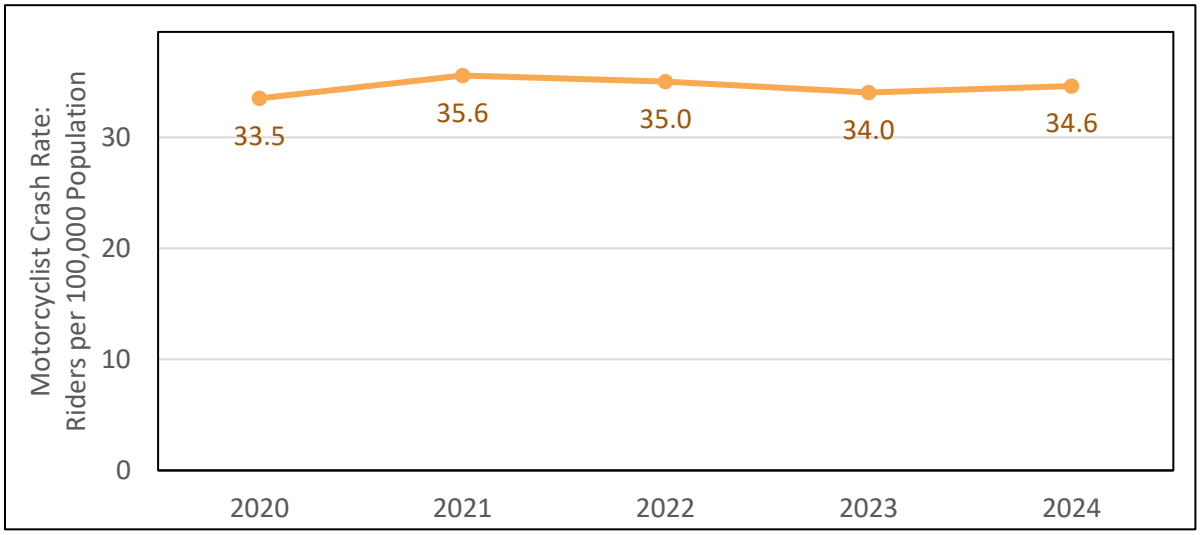

Figure 3 – Motorcyclist Crash Rate by Population and Year

4.3 Injury Severity

Figure 4 displays a visualization of the injury severity counts for motorcyclists by year. While 2021 had the highest count of overall motorcyclists in crashes (3,571) and the most A-level injuries (838) and B-level injuries (1,135), the highest count of motorcyclist fatalities (173) was in 2022.

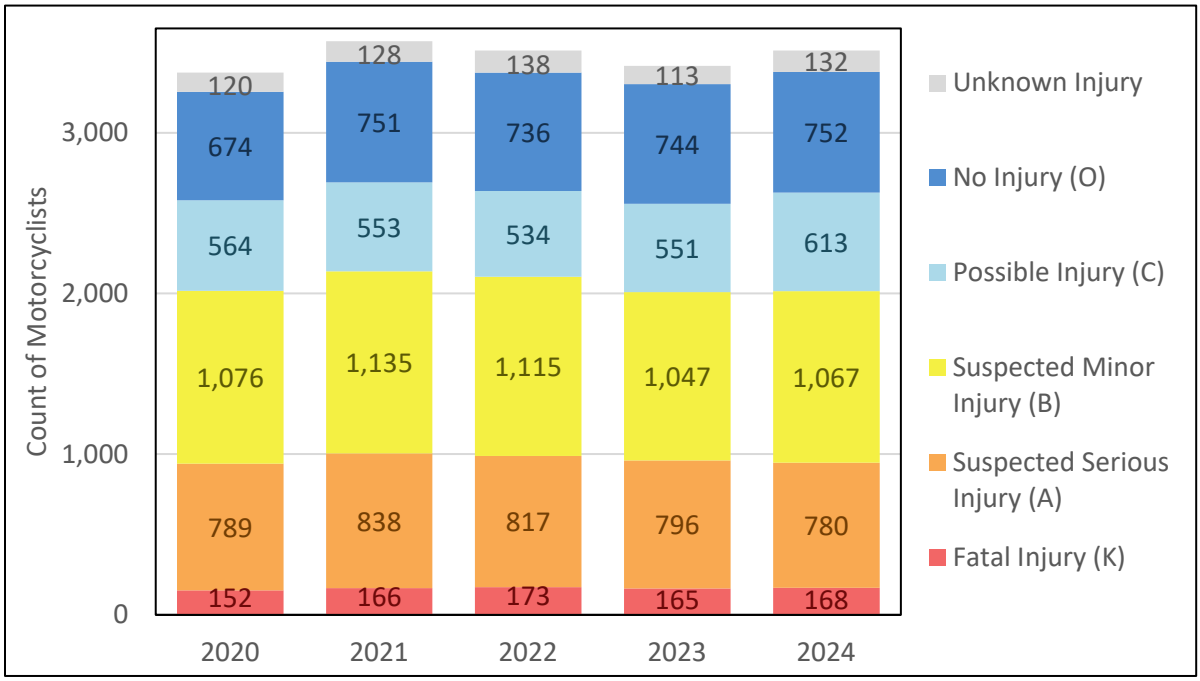

Figure 4 – Injury Severity of Motorcyclists Involved in Crashes

Table 2 shows the number of motorcyclists involved in any crash as well as motorcyclist fatalities and fatality percentages from 2020-2024. In general, these motorcyclist injury 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 3,375 in 2020. Motorcyclist fatalities reached a high of 173 in 2022 and a low of 152 in 2020. The fatality percent of all motorcyclists in crashes has ranged from 4.5% in 2020 to 4.9% in 2022 with a five-year fatality percentage of 4.7%.

Table 2. Number of Fatalities among Crash-Involved Motorcyclists

Year	Motorcyclist Fatalities	Motorcyclists in Crashes	Fatality Percent
2020	152	3,375	4.5%
2021	166	3,571	4.6%
2022	173	3,513	4.9%
2023	165	3,416	4.8%
2024	168	3,512	4.8%
Total	**824**	**17,387**	**4.7%**

5.0 Crash Characteristics

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

5.1 Crash Type

The distribution of crash types by motorcycle involvement is shown in Figure 5. 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 crashes; and sideswipe crashes include both same and opposite direction sideswipe crashes. Single-vehicle crashes (run off road, etc.) account for 46.4% of motorcycle-involved crashes, followed by angle crashes (16.5%) and rear-end crashes (15.2%). Single-vehicle, head-on, and angle 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. Within the motorcycle head-on category group crashes, 78.2% are head-on left turn crashes compared to 67.4% of the head-on crashes with no motorcycle involved.

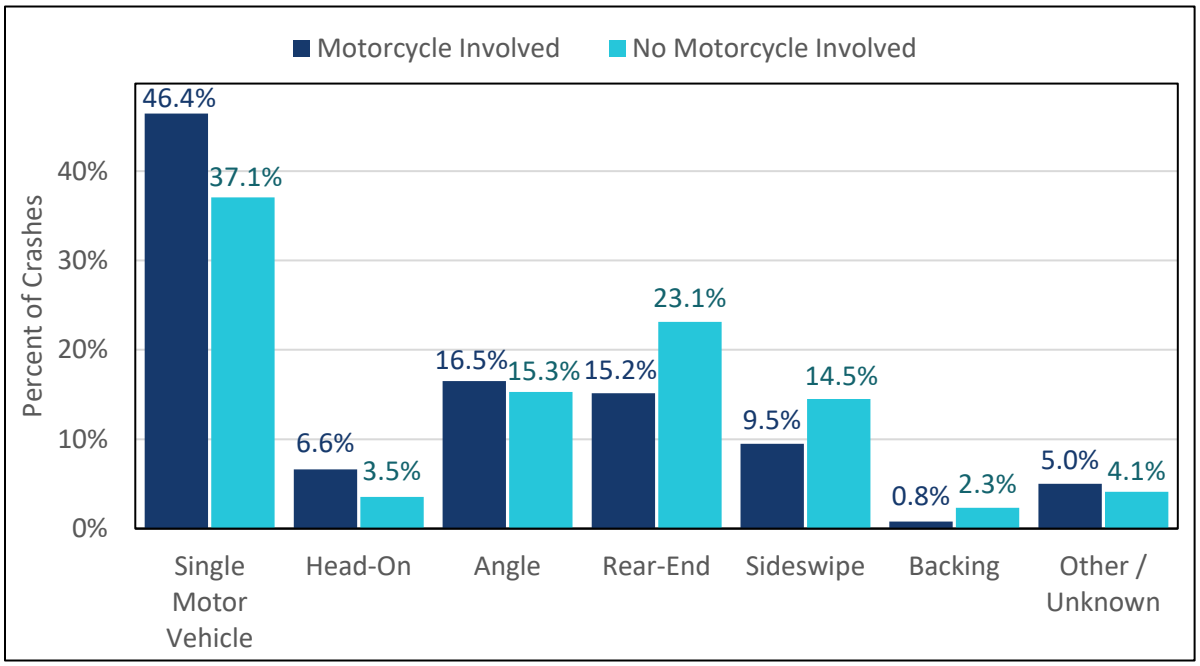

Figure 5 – Crash Type by Motorcycle Involvement, 2020-2024

5.2 Light Condition

Figure 6 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 (70.5% vs. 60.5%). This most likely reflects motorcyclists' riding patterns, which may favor daytime travel.

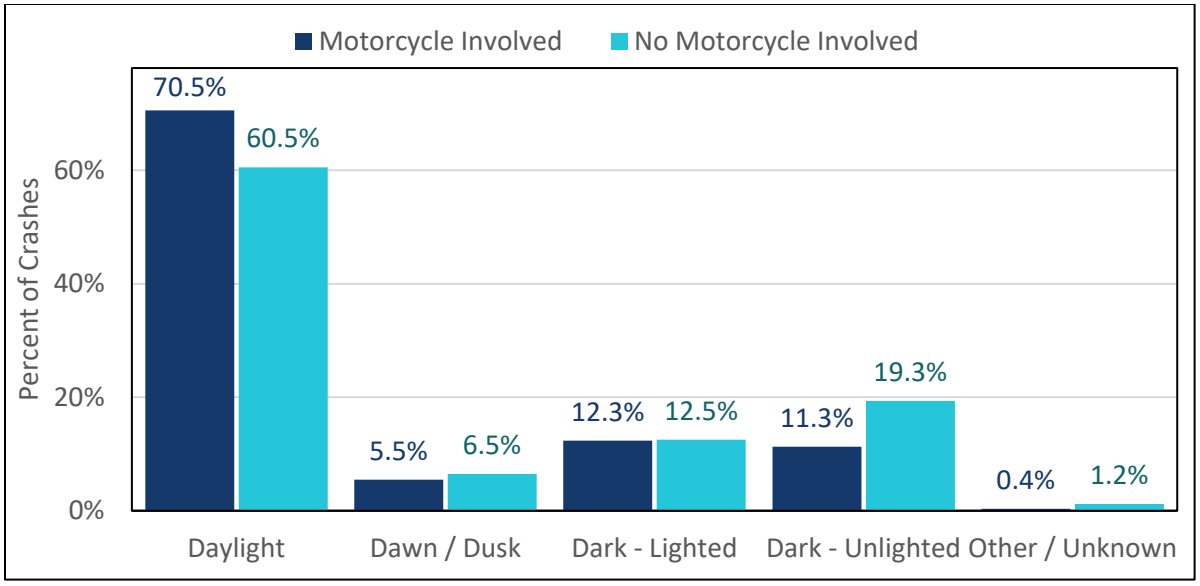

Figure 6 – Light Condition in Crashes by Motorcycle Involvement, 2020-2024

5.3 Weather Condition

A visualization of the distribution of crashes by weather condition for crashes with and without motorcyclists is shown in Figure 7. The condition of "other" includes fog, severe crosswinds, sleet/hail, blowing sand, and smoke, and "snow" includes blowing snow. Motorcycle-involved crashes are substantially more likely to occur in clear conditions (85.7%) compared to non-motorcycle-involved crashes (64.6%) reflecting that motorcyclists probably ride less frequently in inclement weather.

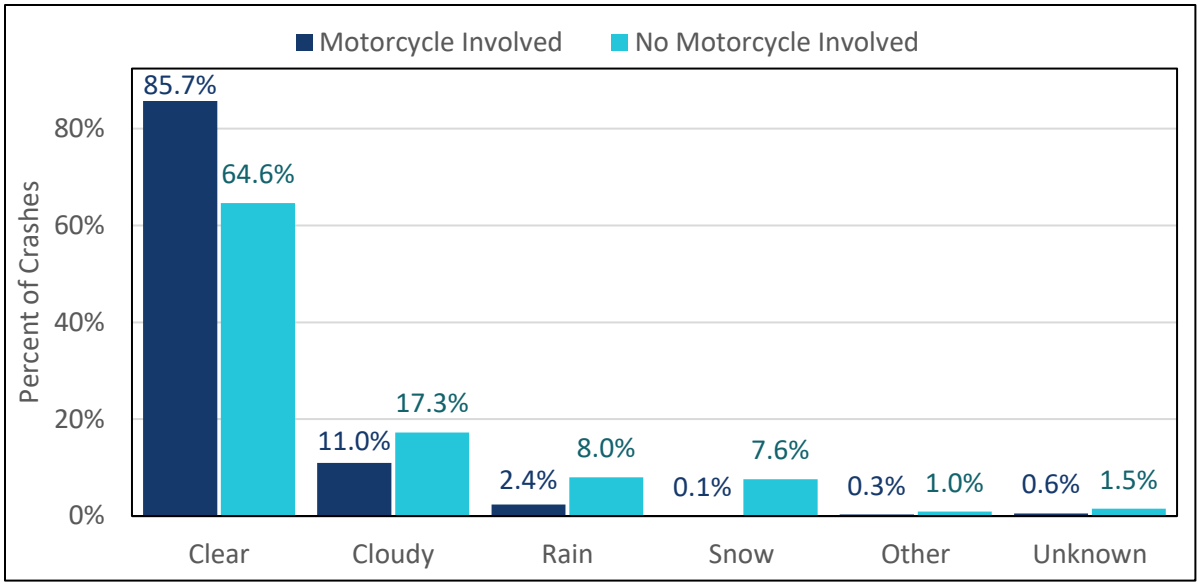

Figure 7 – Weather Condition in Crashes by Motorcycle Involvement, 2020-2024

5.4 Road Factors

Figure 8 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 (60.1% of motorcycle-involved crashes vs. 56.8% of non-motorcycle-involved crashes).

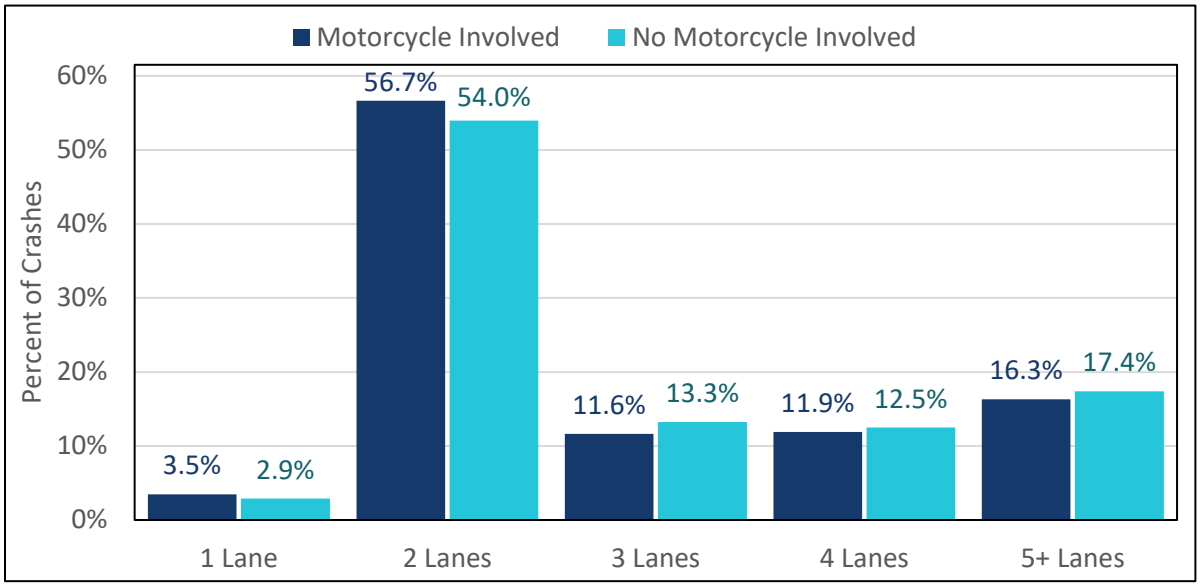

Figure 8 – Number of Traffic Lanes in Crashes by Motorcycle Involvement, 2020-2024

The distribution of crashes with and without motorcyclists by speed limit is shown in Figure 9. Motorcycle-involved crashes are slightly more likely to occur in posted speed limits of 30-35 mph (19.0% vs. 15.9%), 40-45 mph (24.7% vs. 24.1%), and 50-55 mph (36.5% vs. 33.5%).

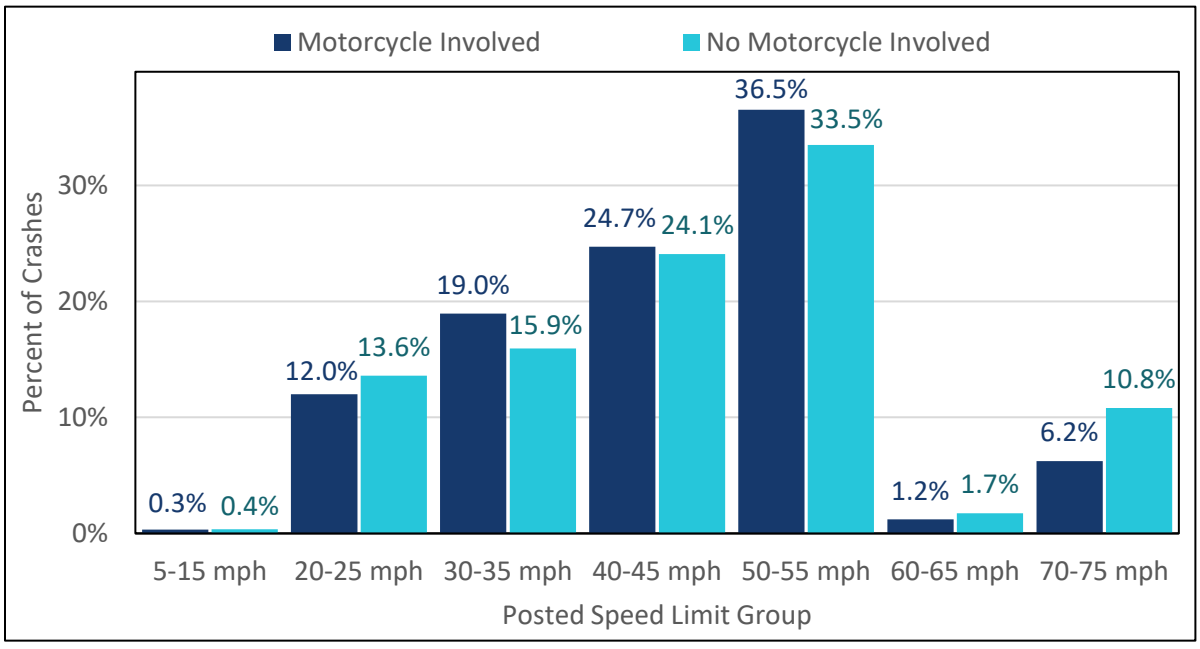

Figure 9 – Posted Speed Limit Crash Percentages by Motorcycle Involvement, 2020-2024

5.5 Rural vs. Urban Areas

Motorcycle-involved crashes had a lower proportion of crashes in urban areas (62.6%) than crashes without motorcycles (66.5%) as shown in Figure 10. In addition, while 1.0% of urban area crashes involved motorcycles, about 1.2% of rural area crashes involved motorcycles.

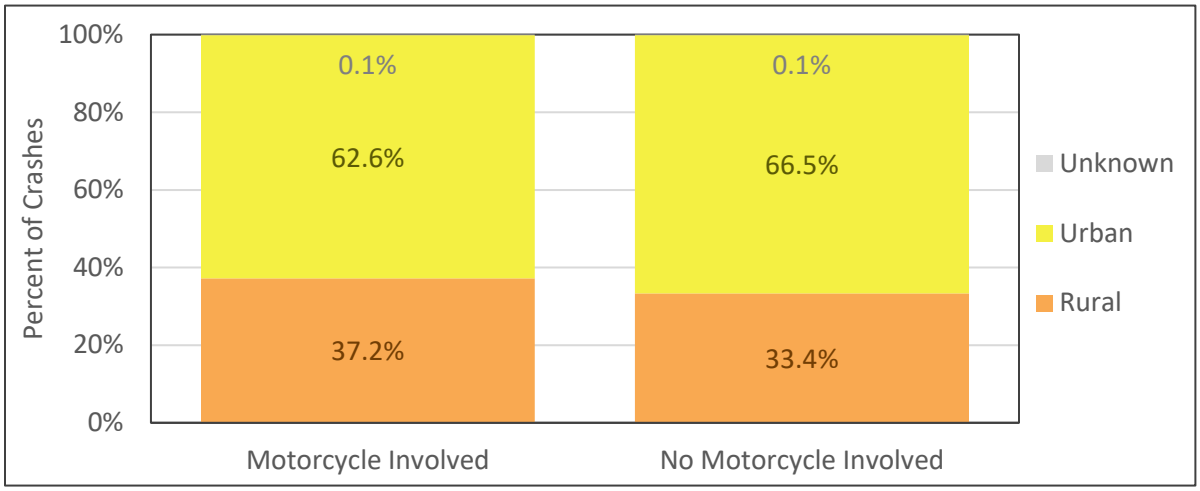

Figure 10 – Distribution of Rural and Urban Areas by Motorcycle-Involved Crash Status, 2020-2024

6.0 Temporal Variables

6.1 Month of Year

The distribution of crashes with and without motorcyclists by month is shown in Figure 11. Motorcycle-involved crashes occur more frequently during the warmer months of the year from April through September (comprising 84.9% of motorcycle-involved crashes vs. 45.7% of non-motorcycle-involved crashes) with a peak in July. As with weather and light conditions, this seasonal difference likely reflects motorcyclists' choice of when to ride rather than a higher risk of crashing in these months.

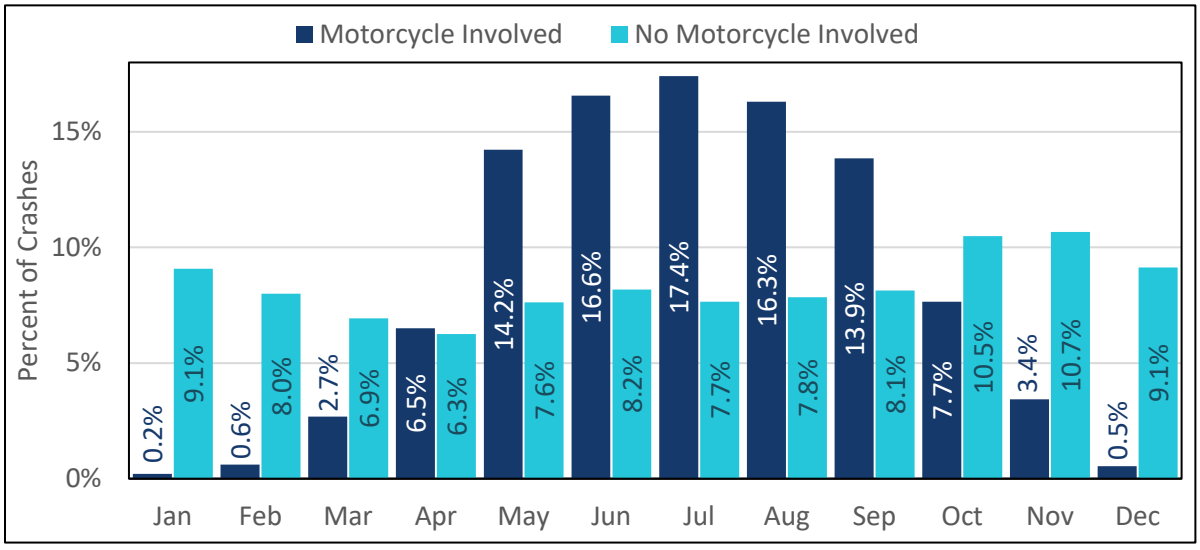

Figure 11 – Crashes by Month and Motorcycle Involvement, 2020-2024

6.2 Day of Week

Figure 12 shows the variation in crashes with and without a motorcyclist by day of week. Motorcycle-involved crashes are more likely than crashes without a motorcycle to happen on the weekends (35.9% vs. 23.7%), while non-motorcycle-involved crashes occur more frequently during weekdays. Saturdays have the highest percentage of motorcycle-involved crashes at 19.5% followed by Sundays at 16.4%.

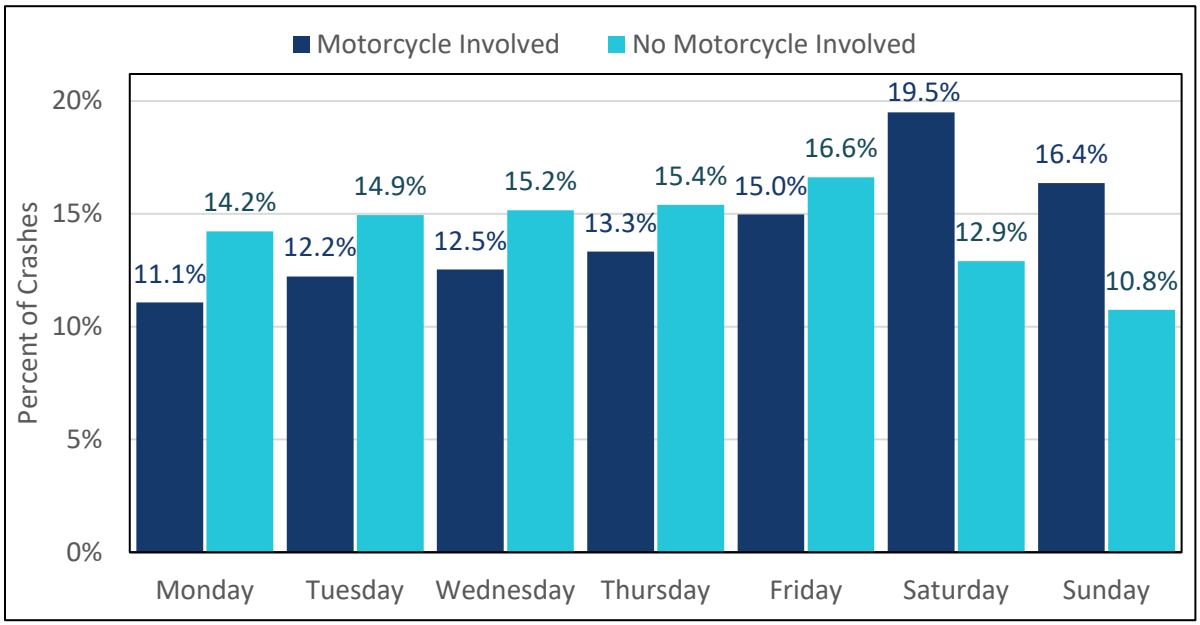

Figure 12 – Crashes by Day of Week and Motorcycle Involvement, 2020-2024

6.3 Time of Day

The proportion of crashes with and without motorcyclists by time of day is shown in Figure 13. The motorcycle-involved crash proportion is higher between 1 PM and 3 AM (90.2% vs. 77.5%) with a peak at 5 PM (8.8% vs. 7.6%). However, the secondary morning peak at 7 AM evident in non-motorcycle-involved crashes is not present for motorcycle-involved crashes (5.7% vs. 1.9%). This pattern, as well as the day-of-the-week pattern in Figure 12, most likely reflects the heavier recreational use of motorcycles compared to the typical commuting patterns of non-motorcycle travel.

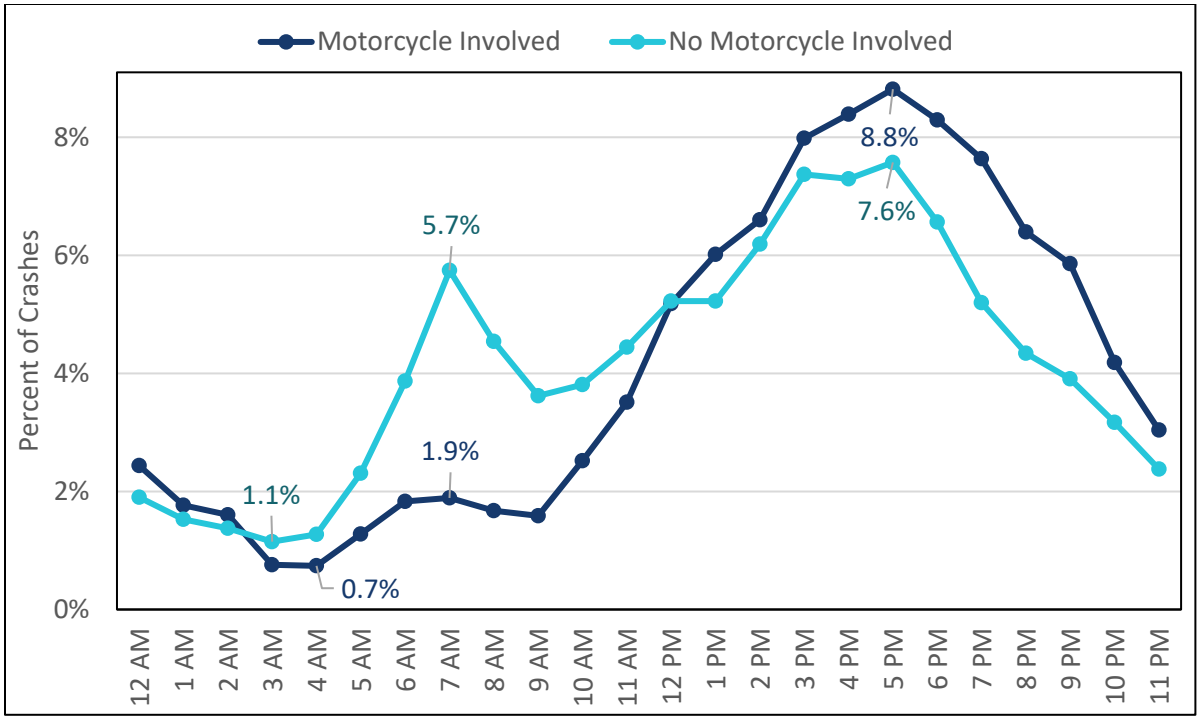

Figure 13 – Crashes by Time of Day and Motorcycle Involvement, 2020-2024

7.0 Motorcycle Classification

Table 3 shows the distribution of the motorcycle classification obtained by decoding the Vehicle Identification Number (VIN) among motorcycles involved in crashes. Out of 16,063 motorcycles involved in crashes from 2020 to 2024, 15,140 motorcycles VINs were decoded while 923 (5.7%) motorcycles had unavailable VIN data and were excluded from Table 3. Cruisers were the predominant type of motorcycle in crashes with 33.4% of known motorcycles involved in crashes, followed by touring at 30.9% and super sport at 11.9%. The year-to-year variation within each classification is fairly low, although the counts have generally been increasing for dual purpose, sport, and unclad sport motorcycle types, and have generally been decreasing for off road and scooter motorcycle types.

Table 3. Motorcycles in Crashes by Motorcycle Classification and Year

Motorcycle Classification	2020	2021	2022	2023	2024	Total	Percent of Total
ATV	0	0	0	0	1	1	0.0%
Autocycle	7	12	19	12	15	65	0.4%
Chopper	6	3	3	5	10	27	0.2%
Cruiser	950	1,098	1,033	991	992	5,064	33.4%
Dual Purpose	73	81	92	106	94	446	2.9%
Incomplete	0	0	1	0	0	1	0.0%
Off Road	42	35	34	26	18	155	1.0%
Other	1	1	2	5	0	9	0.1%
Scooter	58	56	64	42	34	254	1.7%
Sport	219	233	251	249	311	1,263	8.3%
Sport Touring	54	38	53	40	36	221	1.5%
Standard	116	87	102	99	108	512	3.4%
Super Sport	408	382	306	313	388	1,797	11.9%
Touring	870	931	986	961	923	4,671	30.9%
Unclad Sport	87	105	130	166	166	654	4.3%
Total	**2,891**	**3,062**	**3,076**	**3,015**	**3,096**	**15,140**	**100.0%**

Table 4 displays motorcycle classification by fatal and non-fatal crashes. Most motorcycle types have similar proportions for fatal and non-fatal crashes, although there is a higher proportion of fatal crashes than non-fatal crashes for super sport motorcycles (16.5% vs. 11.6%), scooters (2.7% vs. 1.6%), choppers (0.24% vs. 0.17%), and touring motorcycles (31.1% vs. 30.8%).

Table 4. Motorcycles in Fatal and Non-Fatal Crashes by Motorcycle Classification, 2020-2024

Motorcycle Classification	Fatal Count	Fatal Percent	Non-Fatal Count	Non-Fatal Percent
ATV	0	0.0%	1	0.0%
Autocycle	2	0.2%	63	0.4%
Chopper	2	0.2%	25	0.2%
Cruiser	276	33.3%	4,788	33.5%
Dual Purpose	17	2.1%	429	3.0%
Incomplete	0	0.0%	1	0.0%
Off Road	1	0.1%	154	1.1%
Other	0	0.0%	9	0.1%
Scooter	22	2.7%	232	1.6%
Sport	51	6.2%	1,212	8.5%
Sport Touring	8	1.0%	213	1.5%
Standard	21	2.5%	491	3.4%
Super Sport	137	16.5%	1,660	11.6%
Touring	258	31.1%	4,413	30.8%
Unclad Sport	34	4.1%	620	4.3%
Total	**829**	**100.0%**	**14,311**	**100.0%**

8.0 Motorcycle 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 5 shows the total number of motorcycle operators who completed training, skills tests, and received motorcycle endorsements based on data from the Michigan Department of State.

The number of endorsements received has ranged from a low of 616,479 in 2021 to a high of 634,808 in 2020. Due to the COVID-19 pandemic, there was a sharp drop in completed trainings and skills tests in 2020 compared to other years. The number of completed trainings ranged between 9,821 in 2024 to 9,560 in 2023 with an outlier of 5,841 trainings in 2020. Similarly, the number of skills tests completed ranged between 4,140 in 2023 to 4,992 in 2022 with an outlier of 2,535 skills tests in 2020.

Table 5. Number of Motorcycle Operators Trained and Endorsed by Year

Year	Trainings Completed	Skills Tests Completed	Endorsements Received
2020	5,841	2,535	634,808
2021	9,626	4,459	616,479
2022	9,630	4,992	621,812
2023	9,560	4,140	625,877
2024	9,821	4,163	629,372
Average	**8,896**	**4,058**	**625,670**

The proportion of crash-involved motorcycle operators with motorcycle endorsements has generally increased from a low of 37.7% in 2020 to a high of 65.1% in 2024 as shown in Figure 14. The proportion of unknown endorsement status has ranged from 4.1% in 2023 to 8.0% in 2020. It is important to note that the endorsement rate in crashes may not represent the overall riding population.

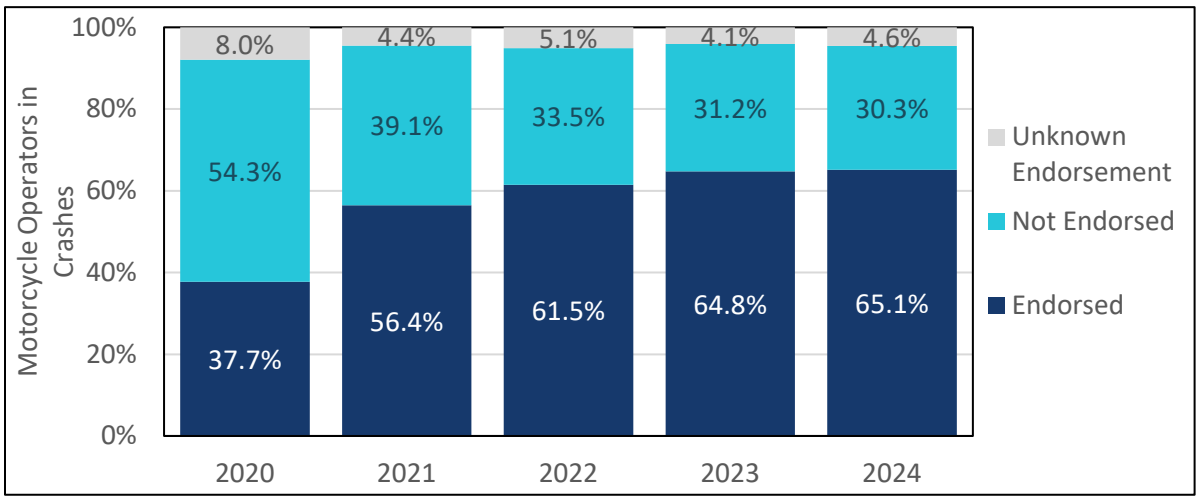

Figure 14 – Motorcycle Operators in Crashes by CY Endorsement Status and Rate

Table 6 shows helmet use counts in crashes by CY endorsement status from 2020 through 2024 where helmet use is known. Unknown or miscoded helmet use values and unknown endorsement status have been removed from the table. Among endorsed motorcycle operators in crashes, the helmet use rate was 70.1% compared to operators with no endorsement at 54.5%.

Table 6. Helmet Use for Motorcycle Operators by CY Endorsement Status, 2020-2024

CY Endorsement Status	Helmet Worn	Helmet Not Worn	Helmet Use Percent
Yes	6,085	2,600	70.1%
No	2,996	2,498	54.5%

9.0 Impairment

Figure 15 shows the proportion of motorcycle operators and non-motorcycle vehicle operators who were using alcohol at the time of the crash. The proportion of motorcycle operators who were impaired by alcohol is 3.4 times the proportion of non-motorcycle operators who were impaired. About 6.6% of motorcycle operators were reported to be drinking, compared with 1.9% of other motor vehicle drivers.

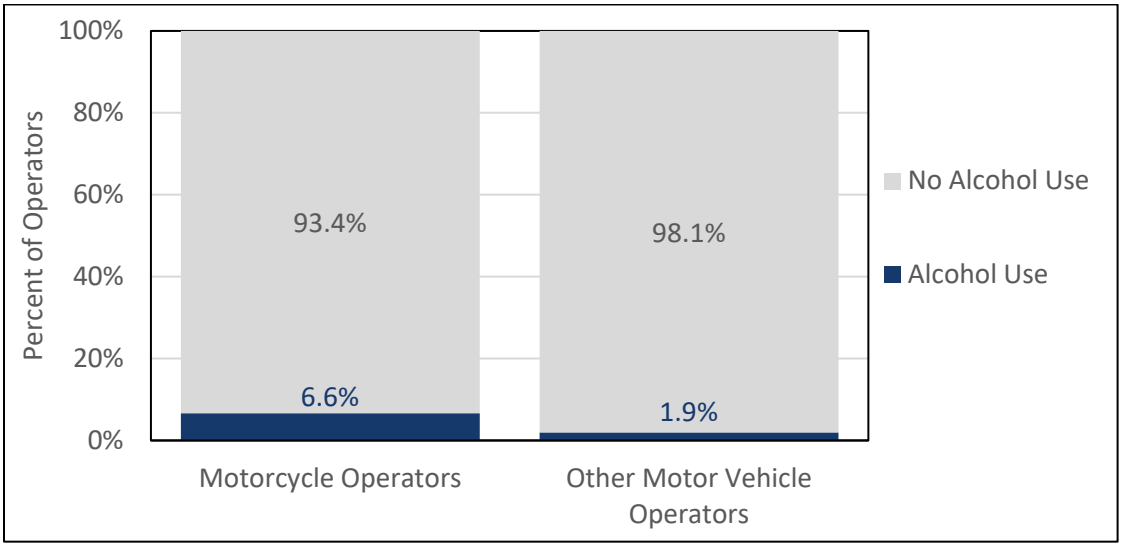

Figure 15 – Distribution of Motor Vehicle Operators by Alcohol Impairment, 2020-2024

The distribution of drug impairment for motorcycle operators and non-motorcycle vehicle operators is shown in Figure 16. The motorcycle operator drug impairment rate is 3.3 times higher than non-motorcycle operators as 1.8% of motorcycle operators were suspected of using drugs, compared with 0.6% of non-motorcycle vehicle operators.

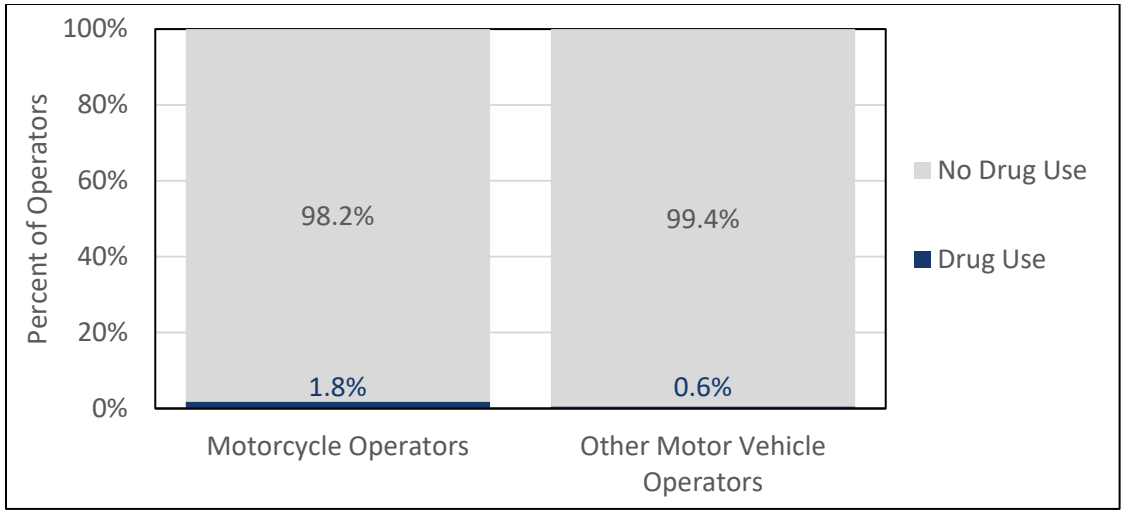

Figure 16 – Distribution of Motor Vehicle Operators by Drug Impairment, 2020-2024

Data collection for multiple drug classifications has improved in recent years. Starting in 2018, drug classification 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). In many cases a positive alcohol test result will lead to no further testing for drugs. Utilizing these recent data collection improvements, this report includes analysis of the top three drug test results if they included a cannabinoid from 2020-2024. The eight drug test result codes related to cannabinoids are Delta-9, hashish oil, hashish, marijuana/marihuana, Marinol, tetrahydrocannabinols (THC), and "cannabinoid, type unknown." 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 7 shows the cannabinoid test results for motorcycle operators from 2020 to 2024 where an operator was using at least one cannabinoid drug. The most common cannabinoid drug codes with positive tests over the five-year period were THC (46.0%) and Delta-9 (37.1%). The count of motorcycle operators with a positive cannabinoid test result had a low of 20 in 2023, and a high of 33 in 2024, while the five-year percentage of operators testing positive is 0.77%.

Table 7. Motorcycle Operators in Crashes with Positive Cannabinoid Test by Year

Year	Operators with Positive Cannabinoid Test	Total Operators	Percent of All Operators
2020	22	3,092	0.71%
2021	24	3,271	0.73%
2022	25	3,267	0.77%
2023	20	3,161	0.63%
2024	33	3,272	1.01%
Total	**124**	**16,063**	**0.77%**

10.0 Helmet Use

10.1 Helmet Usage Percentage

Helmet use percentages in the crash population are not necessarily equivalent to those in the overall riding population. However, the helmet use trends of motorcyclists in crashes may indicate how helmet use patterns are changing, which impacts 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.[3] 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 17 shows the percentage of motorcyclists in crashes using helmets from 2010 to 2024 (excluding unknown helmet use). Helmet use among motorcyclists in crashes was substantially lower after the April 2012 helmet law modification than in previous years. Prior to the helmet law modification, in 2010 and 2011, the crash-involved helmet use percentage was 97.7%. Since 2011, the percentage generally decreased from 76.2% in 2012 to a low of 61.0% in 2021, followed by an increase to 67.4% in 2024.

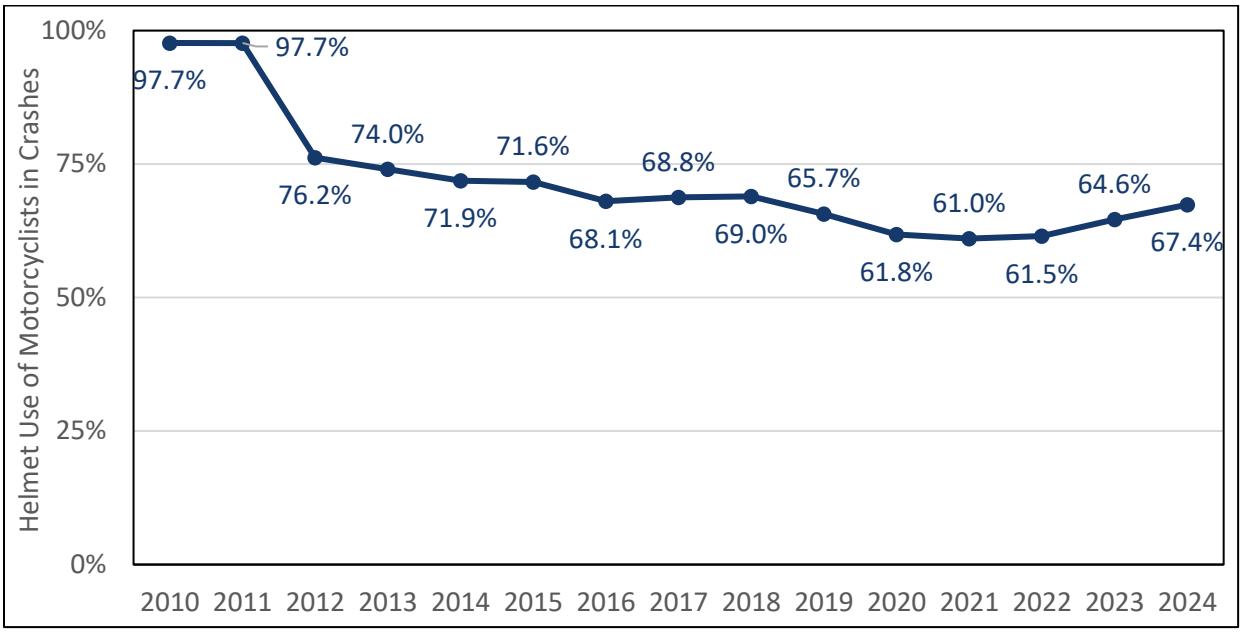

Figure 17 – Helmet Use Rates Among Motorcyclists in Crashes by Year

Table 8 summarizes helmet use percentages and how they have changed in the post helmet law modification period for various rider groups. 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 motorcyclist helmet usage decreased, but women (70.0%) wore helmets at a significantly higher percentage than men (67.3%).

[3] Michigan State University. 2017 Direct Observation Survey of Motorcycle Helmet Use in Michigan. This survey research study was not federally funded. https://www.michigan.gov/-/media/Project/Websites/msp/ohsp/pdfs2/FINAL_REPORT__Michigan_Motorcycle_Helmet_Use.pdf

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 72.6%, motorcyclists age 16-20 (5.8% of the crash population) have a helmet usage of 83.9%, and motorcyclists 21 and over (93.3% of the crash population) have a helmet usage of 66.6%.

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 (64.2%) became significantly lower than that of operators (68.0%).

Table 8. Helmet Use Among Motorcyclists in Crashes by Demographic Group, 2010-2024

Unit	Group		Before Helmet Law Modification (1/1/2010 - 4/12/2012)	After Helmet Law Modification (4/13/2012 - 12/31/2024)
All Motorcyclists	Gender* (sig. after only)	Male	97.5%	67.3%
		Female	98.1%	70.0%
	Age* (sig. after only)	≤ 15 years	93.8%	72.6%
		16-20 years	97.3%	83.9%
		21+ years	97.7%	66.6%
	Seat Position* (sig. after only)	Operator	97.6%	68.0%
		Passenger	98.1%	64.2%
Motorcycle Operators Only	Vehicle Registration State* (sig. after only)	Michigan	97.9%	68.4%
		Other	96.7%	62.8%
	CY Endorsement* (sig. before & after)	Yes	98.7%	71.7%
		No	96.5%	63.1%
	Alcohol Use* (sig. before & after)	Yes	89.2%	37.6%
		No	98.2%	70.3%

** 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, 5.3% of crash-involved motorcycle operators had vehicles registered out of state. Their helmet usage was significantly lower than operators of in-state vehicles (62.8% vs. 68.4%). 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 60.2% of the crash population, and the endorsed motorcycle operators continued to have higher helmet usage (71.7% vs. 63.1%).

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 37.6%. Drinking motorcycle operators made up 6.8% of all motorcycle operators involved in crashes from 2010 through 2024.

10.2 Helmet Usage and Fatalities

Figure 18 shows the percent of motorcyclist fatalities by helmet use and year for motorcyclists with known helmet usage. The 2012 data in this figure includes crashes both before and after the helmet law modification, but only a small proportion of motorcycle crashes occurred prior to April 13th in 2012. These fatality rates have generally shown normal variation over time, and the 15-year fatality percent for motorcyclists not wearing helmets (6.3%) is almost double that of motorcyclists wearing helmets (3.3%). The overall fatality rate has gradually risen, with a high in 2022 of 5.1% and a low of 3.2% in 2011. The fatality rate of motorcyclists without helmets also reached a high in 2022 of 7.5%.

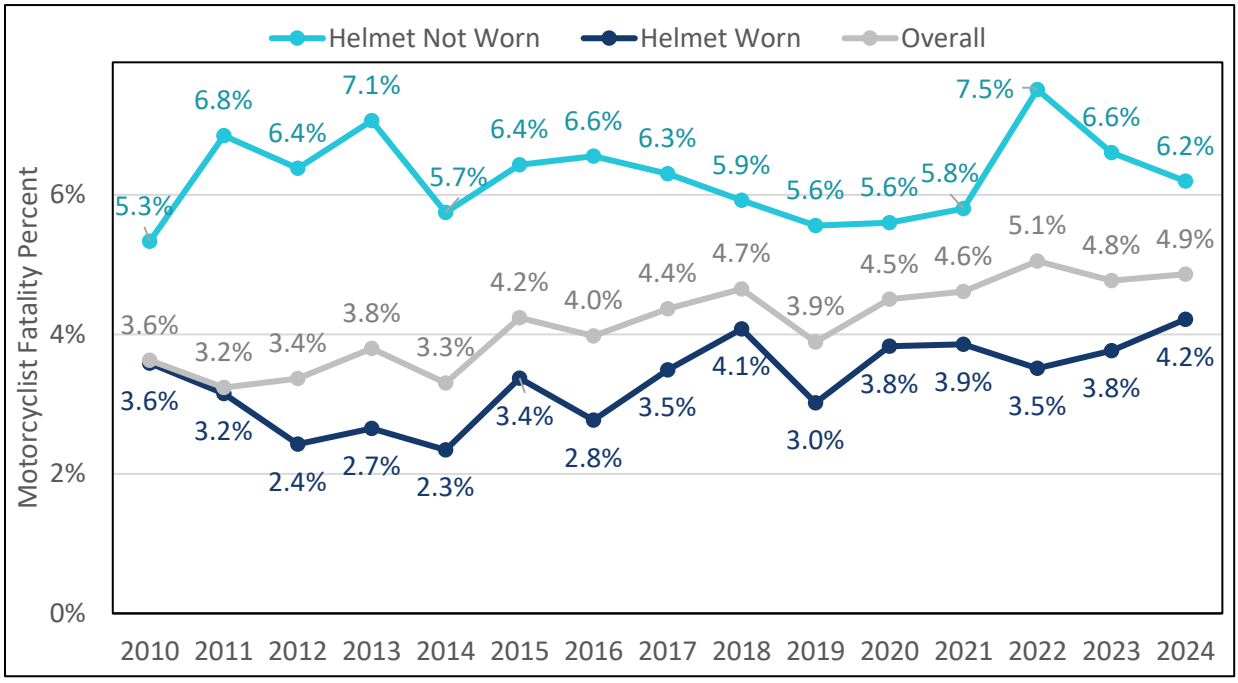

Figure 18 – Motorcyclist Fatality Percent by Helmet Use and Year

Figure 19 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, and since 2012 it has varied between a low of 42.8% helmet usage in 2022 and a high of 60.5% in 2018.

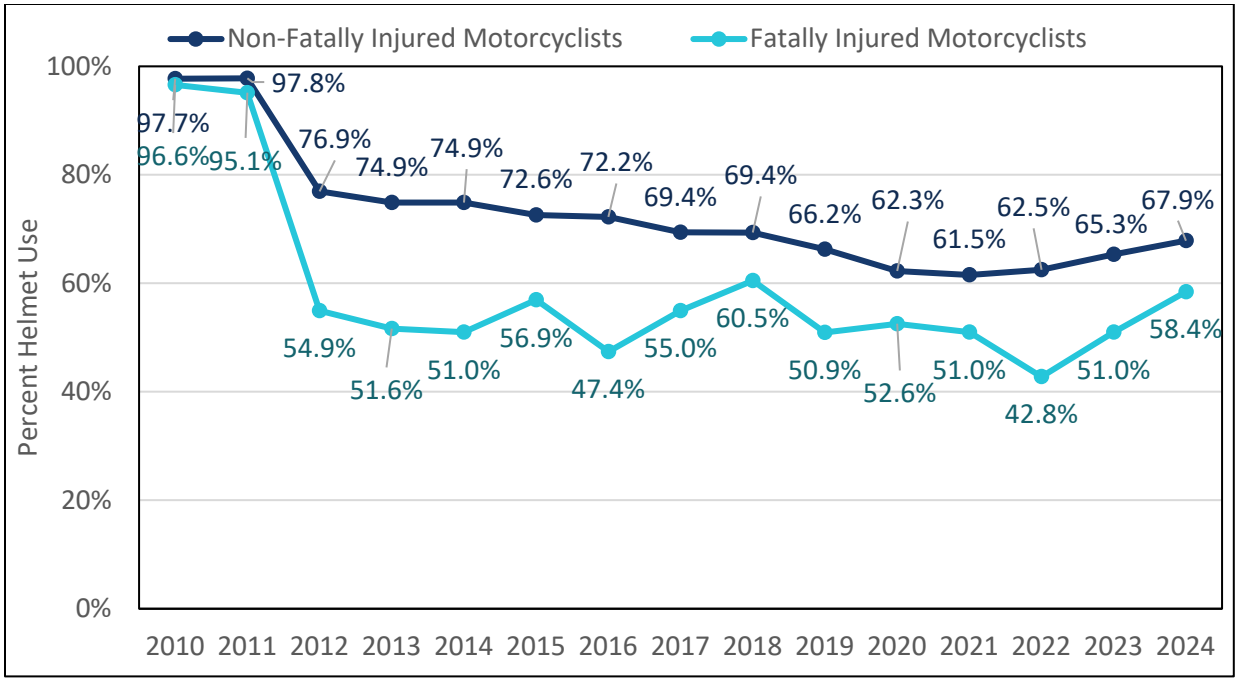

Figure 19 – Helmet Use Among Motorcyclists by Fatality Status and Year

10.3 Helmet Usage and Injuries

Table 9 shows the count of motorcyclists who were injured at each injury severity level by helmet use and year. Starting in the 2012 column, each row in Table 9 has cells shaded on a scale of red (highest value) to blue (lowest value) within that row (injury status category). For motorcyclists wearing helmets, the less severe injury counts had 15-year lows in 2019 (617 B-level), 2020 (400 O-level), and 2021 (336 C-level). In 2024, both the K-level (90) and A-level (461) injuries had 15-year highs. For motorcyclists not wearing helmets, the counts of K-level and B-level injuries had 15-year highs in 2022 (91 K-level and 421 B-level injuries), and A-level and O-level injuries had 15-year highs in 2021 (367 A-level and 217 O-level). These trends are likely impacted by the gradual decrease in helmet use among all motorcyclists from 2012 to 2021 followed by a slight increase in helmet use from 2021 to 2024.

Table 9. Injury Severity Counts by Helmet Use and Year

Helmet Use	Injury Status	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Helmet Worn	Fatal Injury (K)	113	98	67	63	50	74	63	72	78	56	72	75	68	75	90
	Suspected Serious Injury (A)	556	519	439	350	308	310	367	392	387	366	409	418	442	425	461
	Suspected Minor Injury (B)	1,029	1,088	950	780	716	705	779	665	658	617	649	666	640	649	654
	Possible Injury (C)	740	728	684	608	532	551	541	404	350	354	351	336	341	366	438
	No Injury (O)	713	676	621	576	528	555	526	530	439	463	400	450	445	476	492
	K + A Injury Total	**669**	**617**	**506**	**413**	**358**	**384**	**430**	**464**	**465**	**422**	**481**	**493**	**510**	**500**	**551**
Helmet Not Worn	Fatal Injury (K)	4	5	55	59	48	56	70	59	51	54	65	72	91	72	64
	Suspected Serious Injury (A)	20	23	196	194	172	178	263	261	241	291	344	367	341	321	291
	Suspected Minor Injury (B)	27	21	284	277	273	288	344	301	306	309	378	404	421	361	366
	Possible Injury (C)	13	15	179	171	182	172	182	131	122	141	175	181	157	147	138
	No Injury (O)	11	9	148	134	160	177	209	184	141	176	199	217	202	189	174
	K + A Injury Total	**24**	**28**	**251**	**253**	**220**	**234**	**333**	**320**	**292**	**345**	**409**	**439**	**432**	**393**	**355**

Table 10 shows the proportion of motorcyclists within each injury severity level by helmet use status and year. The higher severity K-level and A-level injury rows in Table 10 have cells shaded on a scale of red (highest proportion) to blue (lowest proportion) within that row (injury status category). The lower severity C-level and O-level injury rows in Table 10 have cells shaded on a scale of red (lowest proportion) to blue (highest proportion) within that row (injury status category). The proportion of motorcyclists in crashes wearing helmets with K-level injuries had a 15-year high in 2024 of 4.2%, and the proportion with combined K-level and A-level injuries had a 15-year high in 2022 of 26.3%. The proportion of motorcyclists in crashes not wearing helmets with K-level injuries had a 15-year high in 2022 at 7.5%, and the proportion with combined K-level and A-level injuries of 36.1% in 2023 was the highest since 2011. The proportion of K-level or A-level injuries among motorcyclists increased from 20.7% before the helmet law modification (2010 through April 12, 2012) to 25.4% after the helmet law modification (April 13, 2012 through 2024).

Table 10. Injury Severity Percentages by Helmet Use and Year

Helmet Use	Injury Status	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Helmet Worn	Fatal Injury (K)	3.6%	3.2%	2.4%	2.7%	2.3%	3.4%	2.8%	3.5%	4.1%	3.0%	3.8%	3.9%	3.5%	3.8%	4.2%
	Suspected Serious Injury (A)	17.6%	16.7%	15.9%	14.7%	14.4%	14.1%	16.1%	19.0%	20.2%	19.7%	21.7%	21.5%	22.8%	21.3%	21.6%
	Suspected Minor Injury (B)	32.7%	35.0%	34.4%	32.8%	33.6%	32.1%	34.2%	32.2%	34.4%	33.2%	34.5%	34.2%	33.1%	32.6%	30.6%
	Possible Injury (C)	23.5%	23.4%	24.8%	25.6%	24.9%	25.1%	23.8%	19.6%	18.3%	19.1%	18.7%	17.3%	17.6%	18.4%	20.5%
	No Injury (O)	22.6%	21.7%	22.5%	24.2%	24.7%	25.3%	23.1%	25.7%	23.0%	24.9%	21.3%	23.1%	23.0%	23.9%	23.0%
	K + A Injury Total	**21.2%**	**19.8%**	**18.3%**	**17.4%**	**16.8%**	**17.5%**	**18.9%**	**22.5%**	**24.3%**	**22.7%**	**25.6%**	**25.3%**	**26.3%**	**25.1%**	**25.8%**
Helmet Not Worn	Fatal Injury (K)	5.3%	6.8%	6.4%	7.1%	5.7%	6.4%	6.6%	6.3%	5.9%	5.6%	5.6%	5.8%	7.5%	6.6%	6.2%
	Suspected Serious Injury (A)	26.7%	31.5%	22.7%	23.2%	20.6%	20.4%	24.6%	27.9%	28.0%	30.0%	29.6%	29.6%	28.1%	29.4%	28.2%
	Suspected Minor Injury (B)	36.0%	28.8%	32.9%	33.2%	32.7%	33.1%	32.2%	32.2%	35.5%	31.8%	32.6%	32.6%	34.7%	33.1%	35.4%
	Possible Injury (C)	17.3%	20.5%	20.8%	20.5%	21.8%	19.7%	17.0%	14.0%	14.2%	14.5%	15.1%	14.6%	13.0%	13.5%	13.4%
	No Injury (O)	14.7%	12.3%	17.2%	16.0%	19.2%	20.3%	19.6%	19.7%	16.4%	18.1%	17.1%	17.5%	16.7%	17.3%	16.8%
	K + A Injury Total	**32.0%**	**38.4%**	**29.1%**	**30.3%**	**26.3%**	**26.9%**	**31.2%**	**34.2%**	**33.9%**	**35.5%**	**35.2%**	**35.4%**	**35.6%**	**36.1%**	**34.4%**

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

To separate other 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. The model indicates that after controlling for these other risk factors, helmet non-use multiplies the risk of a fatal injury (K) by a factor of 1.6 (i.e., a 60% increase in the risk of a fatality when not wearing a helmet). If the motorcycle operator is drinking, their risk of a fatality is multiplied by a factor of 2.8, and operator drug use multiplies the risk by 10.7.

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 24 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 10.1%, or about 81 fewer A-level injured motorcyclists annually.

11.0 Summary

From 2020-2024, crashes involving motorcycles comprised 1.1% of all crashes but account for 15.8% of fatal crashes. Compared to crashes without motorcycles, motorcycle-involved crashes more commonly occur during daylight (70.5% vs. 60.5%) and clear weather conditions (85.7% vs. 64.6%). Single-vehicle (46.4% vs. 37.1%) and head-on (6.6% vs. 3.5%) crashes are overrepresented for motorcycle-involved

crashes compared to non-motorcycle-involved crashes. Crashes involving motorcyclists are more likely than crashes without motorcycles to take place from April through September (84.9% vs. 45.7%), on the weekends (35.9% vs. 23.7%), and between 1 PM and 3 AM (90.2% vs. 77.5%).

Motorcycle operators involved in crashes were more likely to be impaired than non-motorcycle drivers. About 6.6% of motorcycle operators were reported to be drinking, compared with 1.9% of other motor vehicle operators. Similarly, 1.8% of motorcycle operators were suspected of using drugs, compared with 0.6% of other motor vehicle operators. Before the helmet law modification in 2012, about 89.2% of drinking motorcycle operators in crashes were wearing a helmet, but this dropped to about 37.6% after the helmet law modification.

Since the modification of Michigan's mandatory helmet law in April 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 5.1%. The proportion of K-level or A-level injuries among motorcyclists increased from 20.7% before the helmet law modification to 25.4% after the helmet law modification. Using a regression modeling approach and adjusting for risk factors other than helmet use, 14.5% of fatalities (24 per year) and 10.1% of serious injuries (81 per year) were estimated to have resulted from reduced helmet use after the helmet law modification.