Analysis Report: Bicycle-Involved Crashes in Michigan (2019-2023)

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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. There were 293,341 crashes in 2022, up 3.8% from 2021, but still 6.7% less than in 2019. Despite the lower amount 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), and 1,123 in 2022 (14.0% 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 fatalities per 100 million miles of travel – a slight decrease from the 2020 fatality rate but still much higher than the 2011-2020 average rate. In 2022, vehicle miles traveled decreased to 95.89 billion miles, with the fatality rate the same as in 2021, at 1.17 fatalities per 100 million miles of travel. In 2023, vehicle miles traveled increased to 98.29 billion miles, and the fatality rate decreased to 1.11 fatalities per 100 million miles of travel.

1.0 Executive Summary

This report provides an analysis of police-reported motor vehicle crashes involving bicyclists on public roadways in Michigan from 2019 through 2023. Key findings include:

- From 2019-2023, crashes involving bicycles comprised 0.5% of all crashes but accounted for 2.9% of fatal crashes.
- From 2019-2023, bicycle-involved crash counts had a high of 1,492 in 2019, a low of 1,224 in 2020, and 1,480 crashes in 2023.
- In 2020, there was a five-year high of 38 bicyclist fatalities, followed by 36 in 2022, 29 in 2021, 24 in 2023, and 21 in 2019.
- About 78.5% of bicycle-involved crashes involved injury or fatality, compared to 17.3% for motor-vehicle-only crashes.
- Bicycle-involved crashes occur most often on clear days, during daylight, during the warmer months of May through October, during weekdays, and generally in the afternoon and early evening.
- About 63.1% of bicycle-involved crashes took place at intersections, but only 47.3% of fatal bicycle-involved crashes took place at intersections.
- Bicycle-involved crashes occur more frequently in urban areas than rural areas (91.9% vs. 8.0%).
- In bicycle-involved crashes that involve alcohol, 70.1% of the bicyclists and 35.0% of the motor-vehicle drivers were reported to have been drinking.
- Males accounted for 79.2% of bicyclists in crashes.
- Among bicyclists with known helmet use and age one and older, 27.5% were wearing a helmet (31.0% of females and 26.5% of males), and bicyclists age 18 to 20 had the lowest proportion of helmet use (12.1%) while bicyclists age 60 and older had the highest proportion of helmet use (44.3%). About 42.2% of bicyclists in crashes had unknown helmet use.

2.0 Introduction

This report analyzes police-reported motor vehicle crashes involving bicyclists on public roadways in Michigan from 2019 through 2023. 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. Bicycle-involved crashes are characterized in terms of severity, temporal patterns, and roadway and environmental variables. Impairment is examined at the crash level as well as according to whether alcohol was used by bicyclists or motor vehicle drivers in these crashes.

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 Crash Trends and Injury Severity

3.1 Crash Counts and Proportions

Table 1 shows the counts of motor vehicle crashes involving bicyclists in Michigan over the past five years for all police-reported crashes and the subset of crashes involving a fatality. The table also indicates the number of fatalities among bicyclists each year. The bicyclist fatality count was 21 in 2019, but increased to 38 in 2020, followed by 29 in 2021, 36 in 2022, and 24 in 2023.

Table 1. Bicycle-Involved Crashes

Year	Bicycle-Involved Crashes	Bicycle-Involved Fatal Crashes	Bicycle Fatalities
2019	1,492	21	21
2020	1,224	37	38
2021	1,248	29	29
2022	1,340	35	36
2023	1,480	24	24
Total	**6,784**	**146**	**148**

Figure 1 shows the five-year trend for bicycle-involved crashes. With a high in 2019 of 1,492 crashes, the number of bicycle-involved crashes decreased to 1,224 crashes in 2020, then slightly rose to 1,248 in 2021, 1,340 in 2022, and 1,480 in 2023. Despite the lower counts of bicycle-involved crashes from 2020 to 2022 compared to 2019 and 2023, bicycle-involved fatal crashes were higher in 2020-2022 between 29 to 37 compared to 21 in 2019 and 24 in 2023.

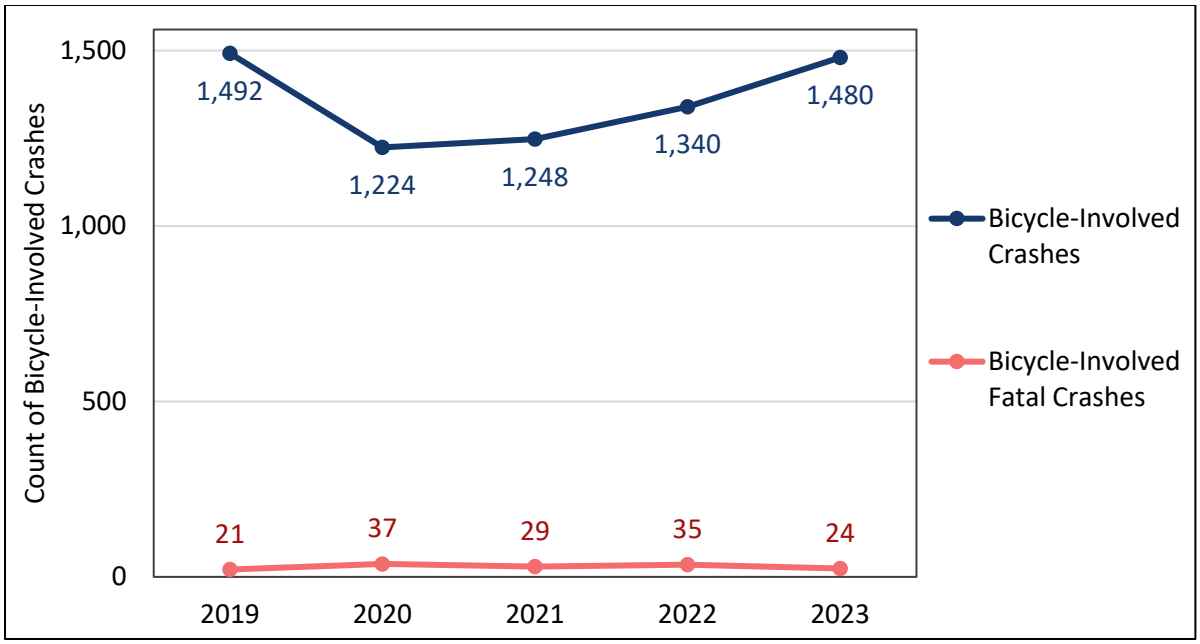

Figure 1 – Bicycle-Involved Crashes by Year

Figure 2 shows the proportion of bicycle-involved crashes for both all crashes and fatal crashes. The proportion of crashes that were bicycle-involved had a low in 2021 of 0.44% and a high in 2023 of 0.51%. The proportion of fatal crashes that involved bicycles reached a five-year high of 3.7% in 2020, a low of 2.3% in 2019, and 2.4% in 2023. From 2019-2023, crashes involving bicycles comprised 0.48% of all crashes but accounted for 2.9% of fatal crashes. This over-representation of bicycles in fatal crashes highlights the vulnerability of bicyclists on roadways.

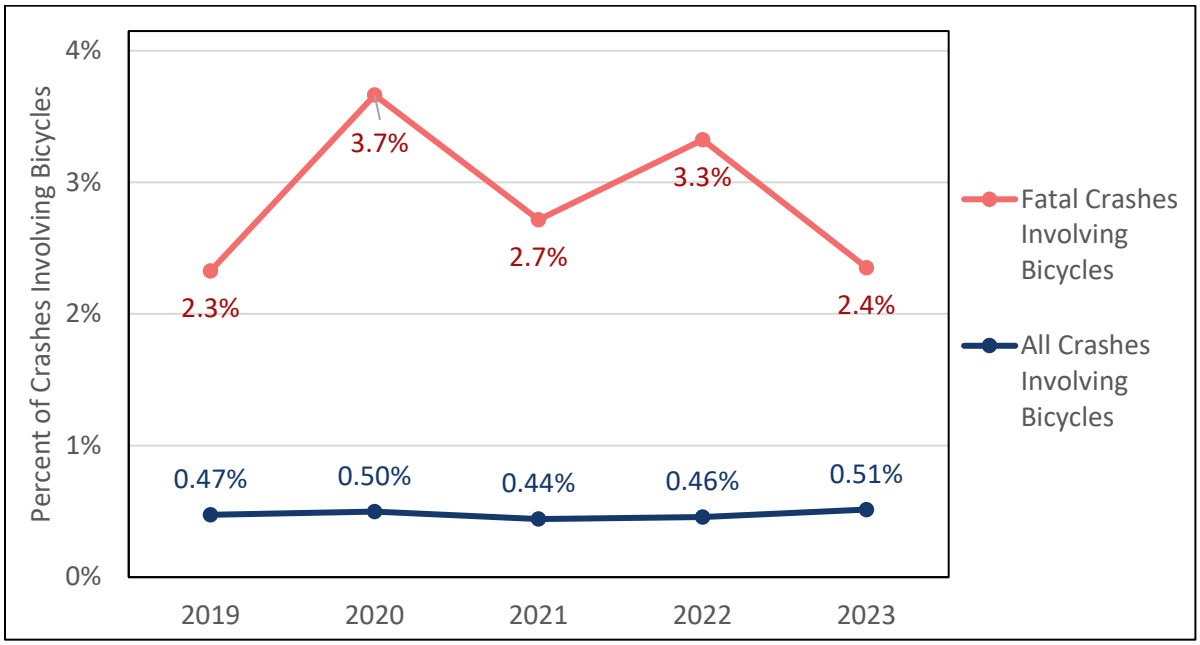

Figure 2 – Proportion of All Crashes and Fatal Crashes Involving Bicycles by Year

3.2 Crash Rates

This section shows crash rates that account for the statewide exposure data of vehicle miles travelled (VMT) and population to provide a nuanced description of the bicycle crash data trends. 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 3, the bicycle-involved crash rate is shown per 100 million VMT. Crash rates based on VMT had a low of 1.3 in 2021 and a high of 1.5 in 2023.

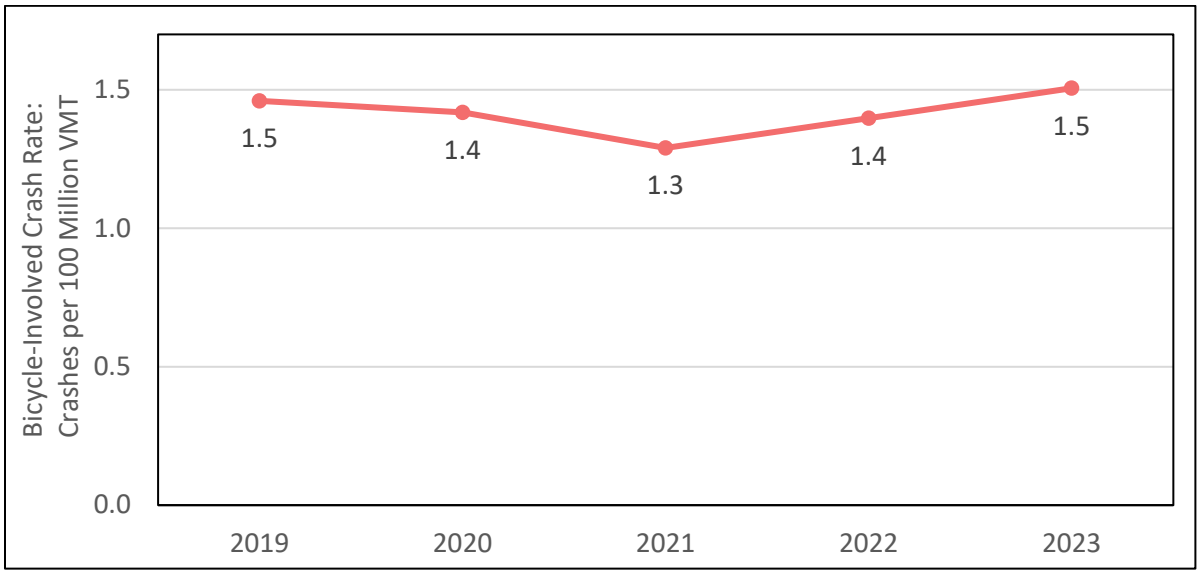

Figure 3 – Bicycle-Involved Crash Rate by VMT and Year

Figure 4 displays the rate of bicyclists in crashes per 100,000 population in Michigan. The rate of bicyclists in crashes by population had a low of 12.3 in 2020, a high of 15.0 in 2019, and a rate of 14.8 in 2023.

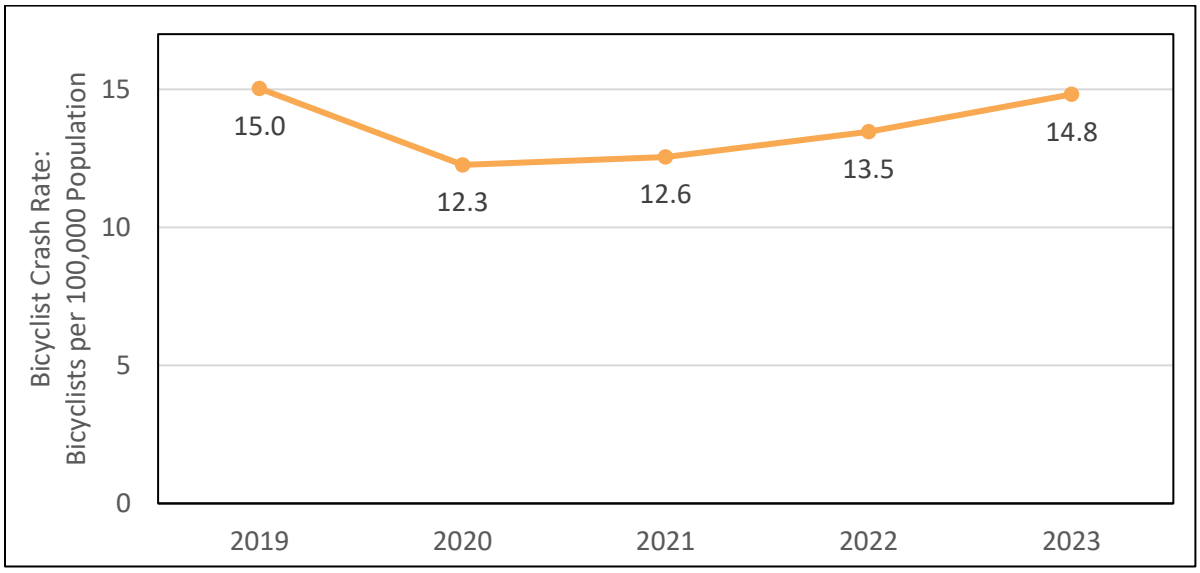

Figure 4 – Bicyclist Crash Rate by Population and Year

3.3 Crash Severity

Table 2 compares crash severities for crashes involving bicyclists and crashes involving only motor vehicles. About 2.2% of bicycle-involved crashes were fatal and 10.7% involved suspected serious injuries. Only 21.5% of bicycle-involved crashes were without injury, compared with 82.7% of crashes involving only motor vehicles.

Table 2. Crash Severity Distributions for Bicycle-Involved and Motor-Vehicle-Only Crashes, 2019-2023

Crash Severity – Worst Injury in Crash	Bicycle-Involved Crashes	Motor Vehicle Only Crashes
Fatal Injury (K)	146 (2.2%)	4,060 (0.3%)
Suspected Serious Injury (A)	729 (10.7%)	21,055 (1.5%)
Suspected Minor Injury (B)	2,406 (35.5%)	72,819 (5.2%)
Possible Injury (C)	2,043 (30.1%)	146,084 (10.4%)
No Injury (O) - Property Damage Only (PDO)	1,460 (21.5%)	1,163,201 (82.7%)
Total	**6,784 (100.0%)**	**1,407,219 (100.0%)**

Figure 5 is a visual comparison showing the high contrast of the crash severity distributions between bicycle-involved crashes and motor-vehicle-only crashes. Both crash types are categorized according to the worst injury in the crash—fatal, injury (suspected serious, suspected minor, and possible injury), or PDO (property damage only). The figure highlights the vulnerability of bicyclists and increased likelihood of death or injury in bicycle-involved crashes compared with crashes involving only motor vehicles.

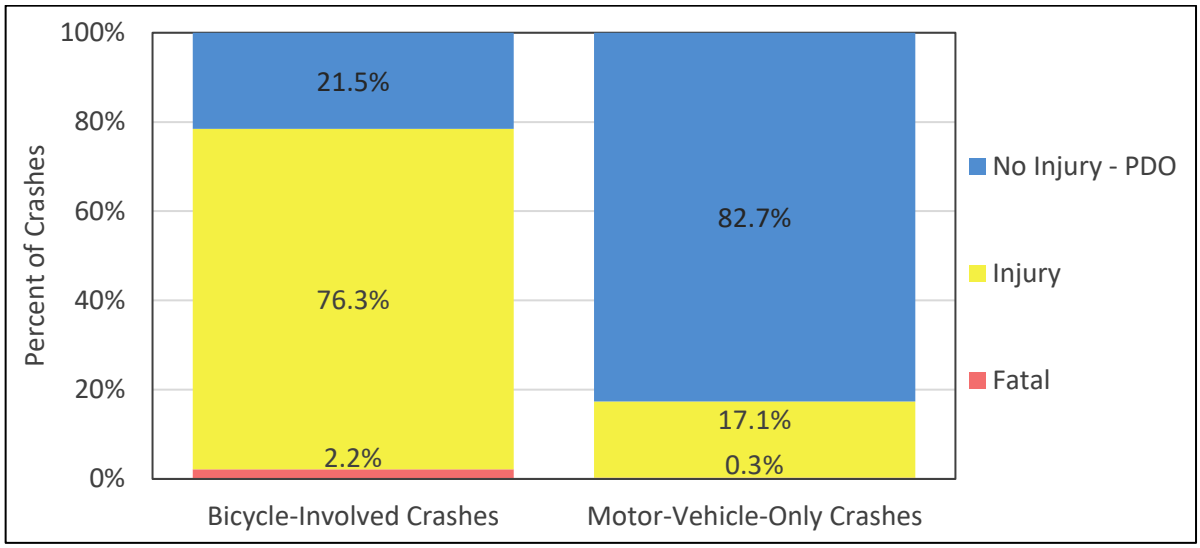

Figure 5 – Crash Severity of Bicycle-Involved and Motor-Vehicle-Only Crashes, 2019-2023

4.0 Temporal Variables

4.1 Month of Year

Figure 6 shows the number of bicycle-involved crashes across different months of the year. About 78.4% of bicycle-involved crashes occurred from May through October, with the top months being July, August, and September. The fewest bicycle-involved crashes occurred in January and February, with a combined

3.8% of the total. The bicycle-involved crash pattern aligns with the cycling season in Michigan, which generally spans from May through October.

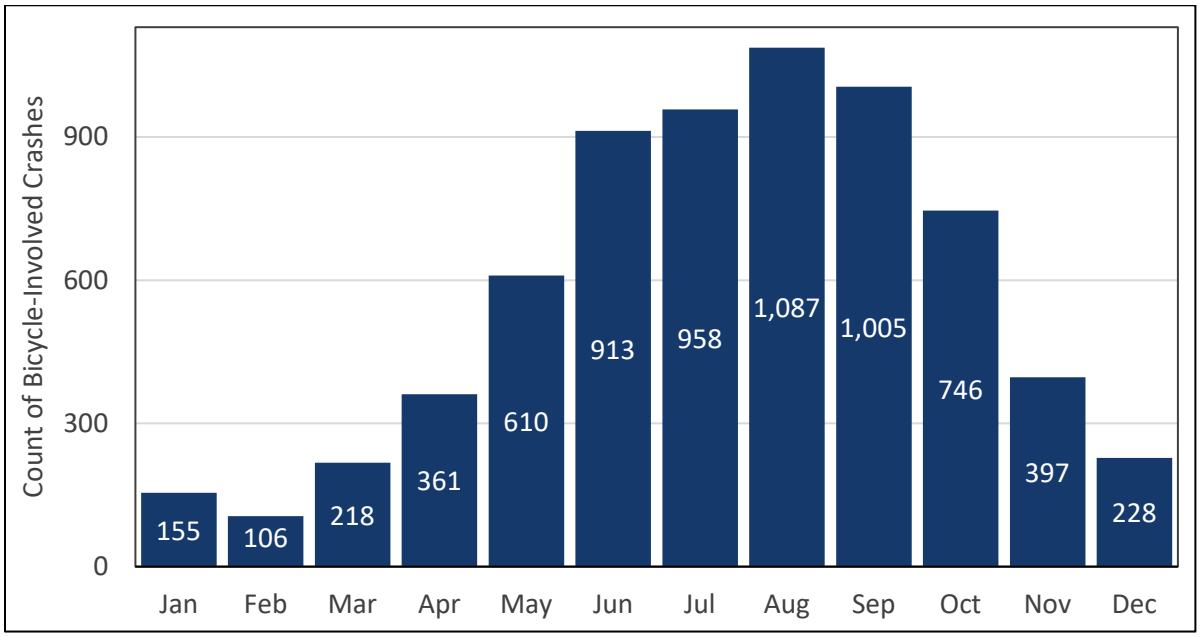

Figure 6 – Bicycle-Involved Crashes by Month, 2019-2023

4.2 Day of Week

Figure 7 shows the number of bicycle-involved crashes on each day of the week. Counts were higher on the weekdays compared to weekends, which may reflect travel by bicycle to work and school, and this trend is similar in crash counts for motor vehicles. The percent of bicycle-involved crashes on each weekday ranged from 13.9% to 16.7%, compared with 9.6% on Sunday and 11.6% on Saturday.

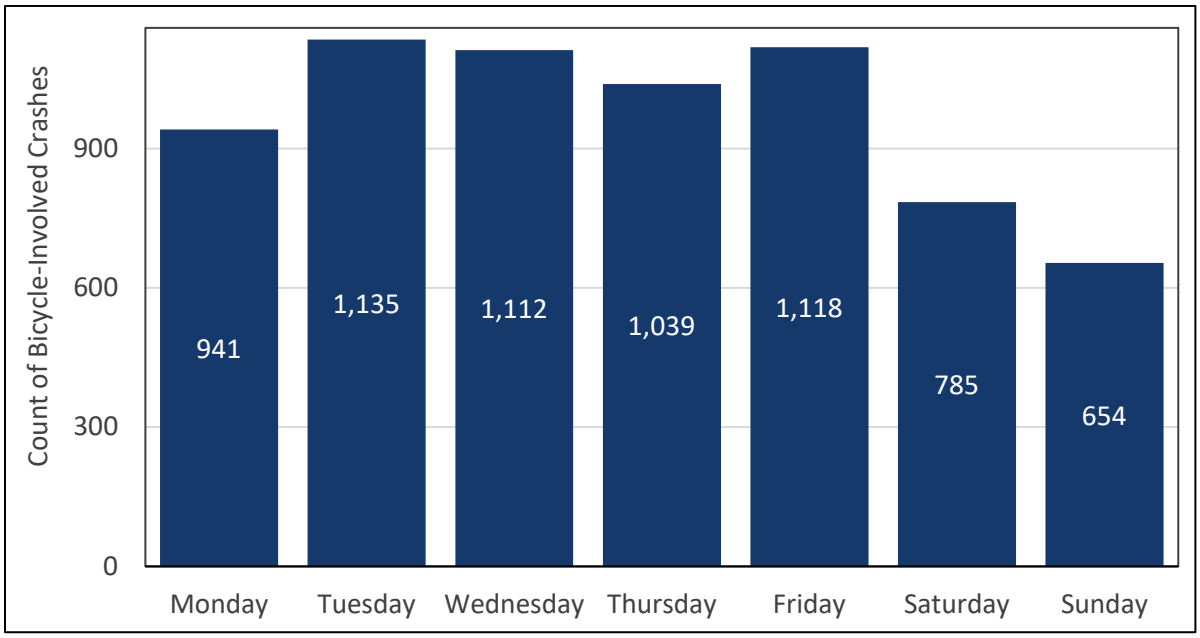

Figure 7 – Bicycle-Involved Crashes by Day of Week, 2019-2023

4.3 Time of Day

Figure 8 shows the number of bicycle-involved crashes across the hours of the day. We see that the number of bicycle-involved crashes generally rose from the 8:00 a.m. hour through the 4:00 p.m. hour, when 10.3% of bicycle-involved crashes occurred. The number then declined each hour, reaching the low point during the 3:00 a.m. hour, when just 17 bicycle-involved crashes (0.3%) occurred over the five-year period.

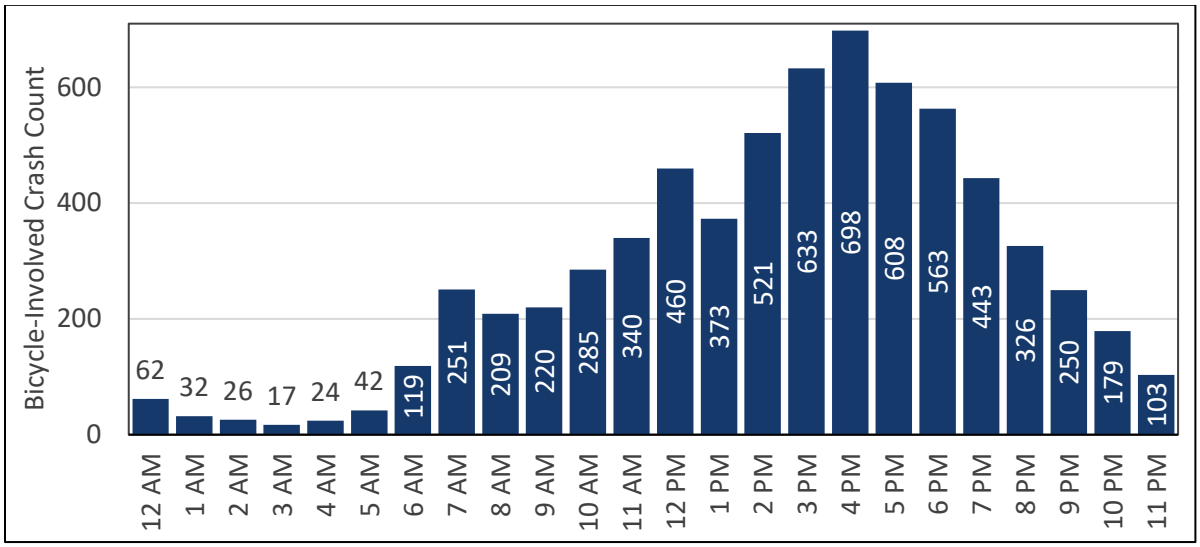

Figure 8 – Bicycle-Involved Crashes by Time of Day, 2019-2023

5.0 External/Environmental Conditions

5.1 Light Conditions

Figure 9 shows crash counts by light condition for bicycle-involved crashes. About 77.2% of bicycle-involved crashes occurred in daylight conditions, 12.7% in dark-lighted conditions, and 5.0% in dark-unlighted conditions. This distribution is likely related to exposure since bicyclists are more likely to be out during the daytime than at night.

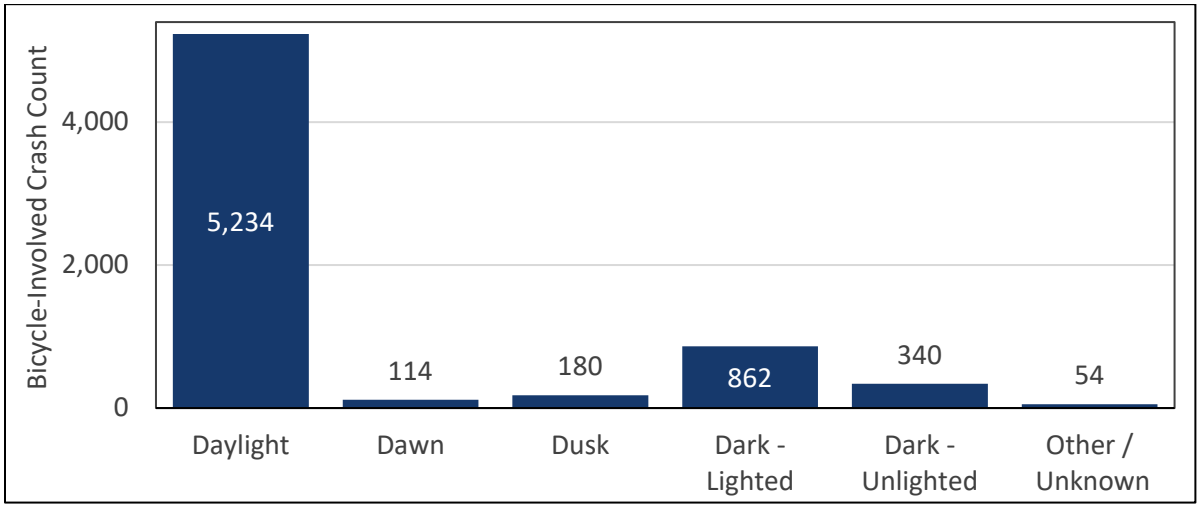

Figure 9 – Bicycle-Involved Crashes by Light Condition, 2019-2023

5.2 Weather Conditions

Figure 10 depicts weather conditions at the time of bicycle-involved crashes. Favorable weather was the norm, with 92.4% of the crashes occurring during clear or cloudy conditions and just 5.5% of the bicycle-involved crashes taking place when it was raining. Again, these weather-related crash patterns are likely related to exposure, with bicyclists less likely to be riding during bad weather.

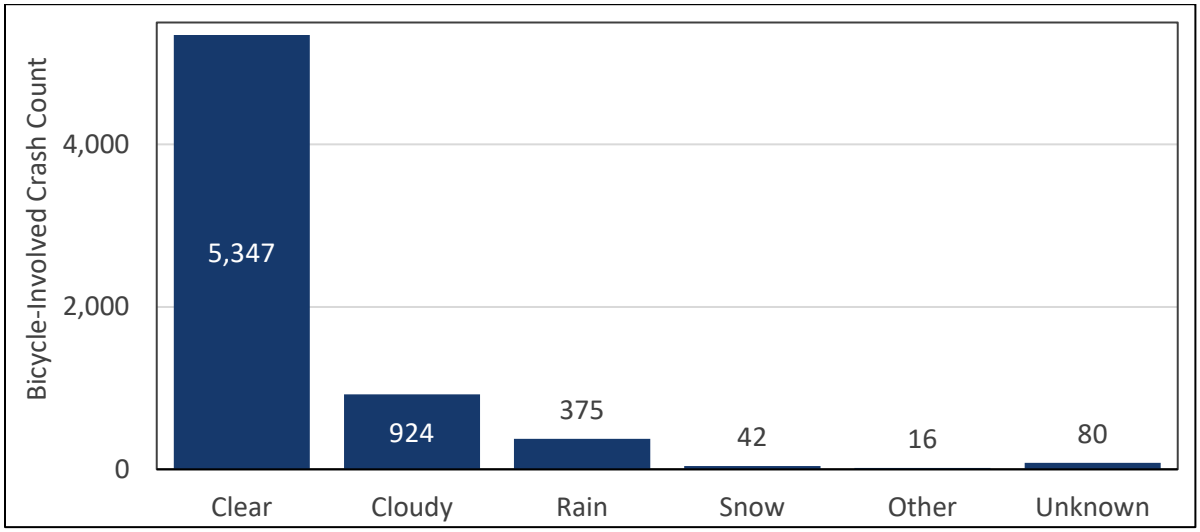

Figure 10 – Bicycle-Involved Crashes by Weather Condition, 2019-2023

6.0 Road Factors

6.1 Relation to Intersection

Table 3 shows the frequency of bicycle-involved crashes at intersections. Bicycle-involved crashes occurring at intersections accounted for 63.1% of all crashes but only 47.3% of fatal crashes.

Table 3. Bicycle-Involved Crashes by Relation to Intersection, 2019-2023

Relation to Intersection	Fatal Bicycle-Involved Crashes	All Bicycle-Involved Crashes
Intersection Crash	69 (47.3%)	4,282 (63.1%)
Non-Intersection Crash	77 (52.7%)	2,502 (36.9%)
Total	**146 (100.0%)**	**6,784 (100.0%)**

6.2 Speed Limit

To examine speed limit at the crash site, bicycle-involved crashes were split into three groups according to levels of the KABCO scale of crash severity: fatal injury (K), all injuries (suspected serious - A, suspected minor - B, possible - C), and no injury with property damage only (O). Figure 11 shows the percentage of these three groups of crashes according to posted speed limit ranges at the crash site. Crashes with an unknown speed limit, about 2.5% of the total, were excluded. There are relatively few crashes at posted speed limits of 15 mph or less (1.7%) or at 60 mph or more (0.3%). Most crashes occur within 20-35 mph (65.0%) and 40-55 mph (33.0%) posted speed limits.

In general, the percentage of fatalities increased with increases in posted speed limits except for in the very few cases of crashes at 60+ mph: 0.7% of crashes at posted speeds of 25 mph or less involved a fatal injury, 3.1% of crashes at posted speeds of 30 mph or higher involved a fatality, and 7.8% of crashes involved a fatality at speeds of 50 mph or higher. For the O-level crashes, 74.2% occurred at posted speeds of 35 mph or less. In contrast, 65.5% of A/B/C-level crashes and just 35.7% of crashes involving a fatality took place at posted speeds of 35 mph or less. Typically, bicyclists are more likely to use roadways in the lower speed limit ranges, but, unsurprisingly, when bicycle-involved crashes occur in higher speed limit zones they are much more likely to be severe.

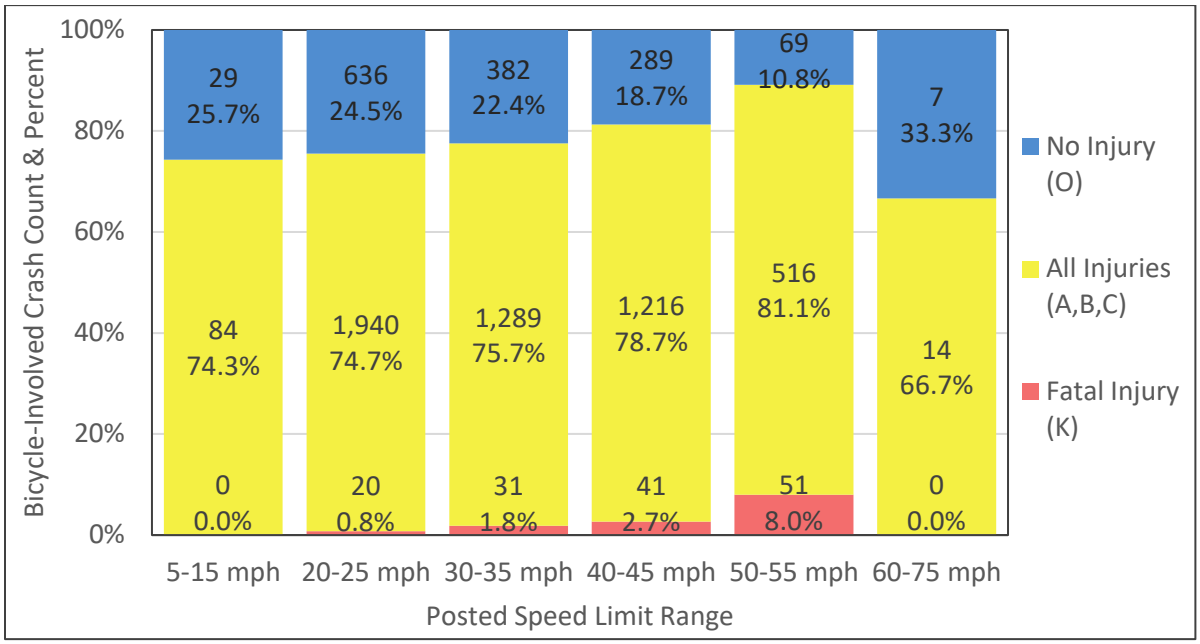

Figure 11 – Bicycle-Involved Crashes by Speed Limit at Crash Site and Severity, 2019-2023

6.3 Rural vs. Urban Areas

Bicycle-involved crashes had a higher proportion of crashes in urban areas (91.9%) than crashes without bicyclists involved (66.8%) as shown in Figure 12. In addition, while only 0.1% of rural area crashes involved bicyclists, about 5.7 times that proportion of urban area crashes involved bicyclists (0.7%).

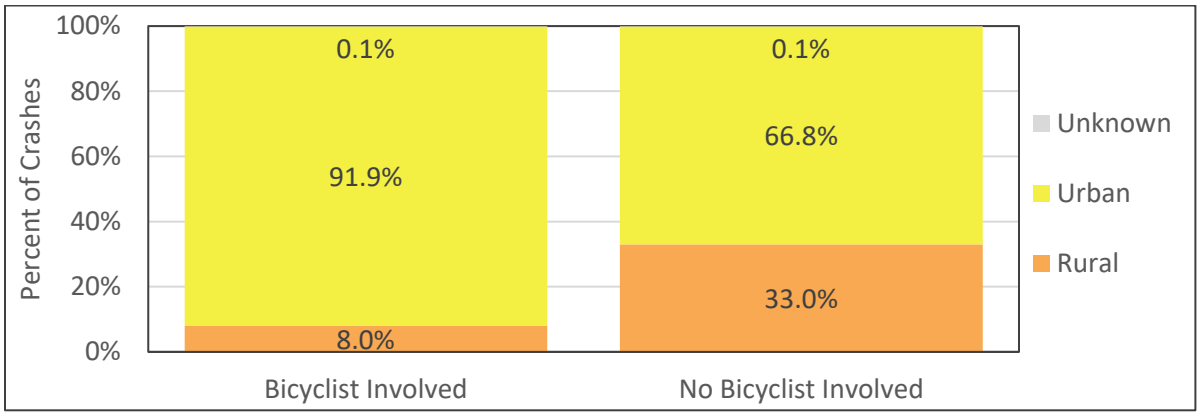

Figure 12 – Distribution of Rural and Urban Areas by Bicycle-Involved Crash Status, 2019-2023

7.0 Impairment-Related Crashes

Table 4 compares impairment distributions for bicycle-involved crashes and crashes involving only motor vehicles. Impairment status is based on what is reported by the police officer at the time of the crash for both bicyclists and drivers. The crashes are split into those not involving alcohol or drugs, those involving alcohol only, those involving drugs only, and crashes involving both alcohol and drugs. The impairment distributions for bicycle-involved crashes and motor-vehicle-only crashes are similar, although a slightly larger share of bicycle-involved crashes (2.9%) involved alcohol only compared with motor vehicle crashes (2.8%).

Table 4. Impairment Distributions for Bicycle-Involved and Motor Vehicle Crashes, 2019-2023

Impairment	Bicycle-Involved Crashes	Motor-Vehicle-Only Crashes
Alcohol Only	2.9%	2.8%
Drugs Only	0.6%	0.5%
Alcohol & Drugs	0.3%	0.4%
None	96.2%	96.3%
Total	**100.0%**	**100.0%**

In the five years of data, there were 213 bicycle-involved crashes involving alcohol. Figure 13 shows the drinking status for the bicyclists and motor vehicle drivers in those crashes (two drivers with unknown alcohol use was excluded). Of the 214 bicyclists in these crashes, 150 (70.1%) were drinking. In contrast, of the 214 drivers in these crashes, only 75 (35.0%) were drinking. In bicycle-involved fatal crashes, 60.0% of bicyclists and 48.0% of drivers were drinking.

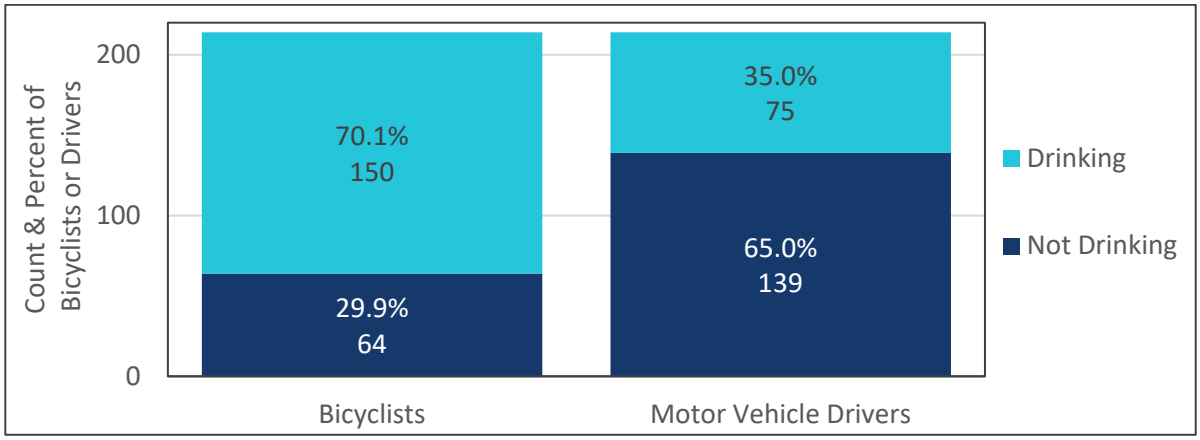

Figure 13 – Bicyclists and Drivers in Alcohol-Involved Bicycle-Involved Crashes, 2019-2023

8.0 Helmet Use by Bicyclist Age and Gender

Of the 6,834 bicyclists involved in crashes over the five-year period, age was unknown for 246 and coded as “0” for five. In theory, zero values should mean less than one year old, but in reality, some of these were likely also unknown age. Excluding both of those age categories leaves 6,583 bicyclists and their age group results are charted in Figure 14. For these bicyclists of known age one and older, 25.1% were under age 18, 61.9% were under age 40, and 15.3% were age 60 and older.

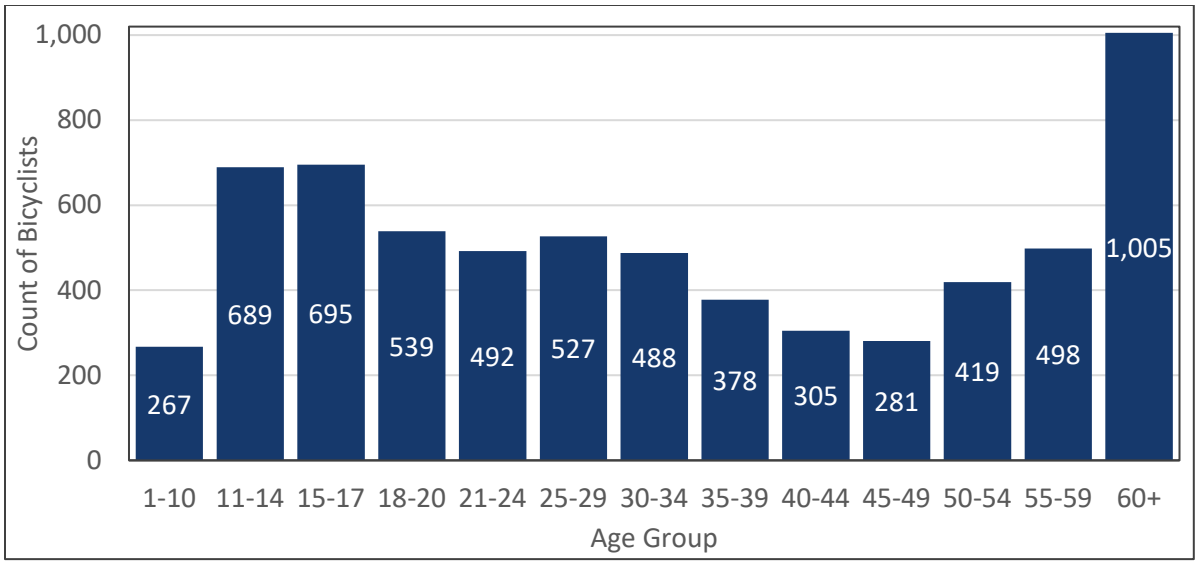

Figure 14 – Bicyclists in Crashes by Age Group, 2019-2023

Of the 6,583 bicyclists of known age one and older, helmet use was not reported for 2,780 (42.2%) bicyclists. These cases were coded as helmet use unknown, no belts available, or uncoded and errors. When helmet use was reported, 1,045 (27.5%) bicyclists were reported as having worn a helmet at the time of the crash and 2,758 (72.5%) were unhelmeted. Since helmet use was not recorded in a large share of cases, it is unknown how well the known helmet use distribution represents the entire population of crash-involved bicyclists. That said, where helmet use was known, a comparison of helmet use rates of crash-involved bicyclists by age group is shown in Figure 15. In general, the percentage helmeted was higher for older riders than younger riders. The lowest percentages of helmet use were among ages 18-20 (12.1%) and age 11-14 (12.7%). Conversely, the age group with the highest percentage of helmet use was the oldest age group of ages 60+ (44.3%).

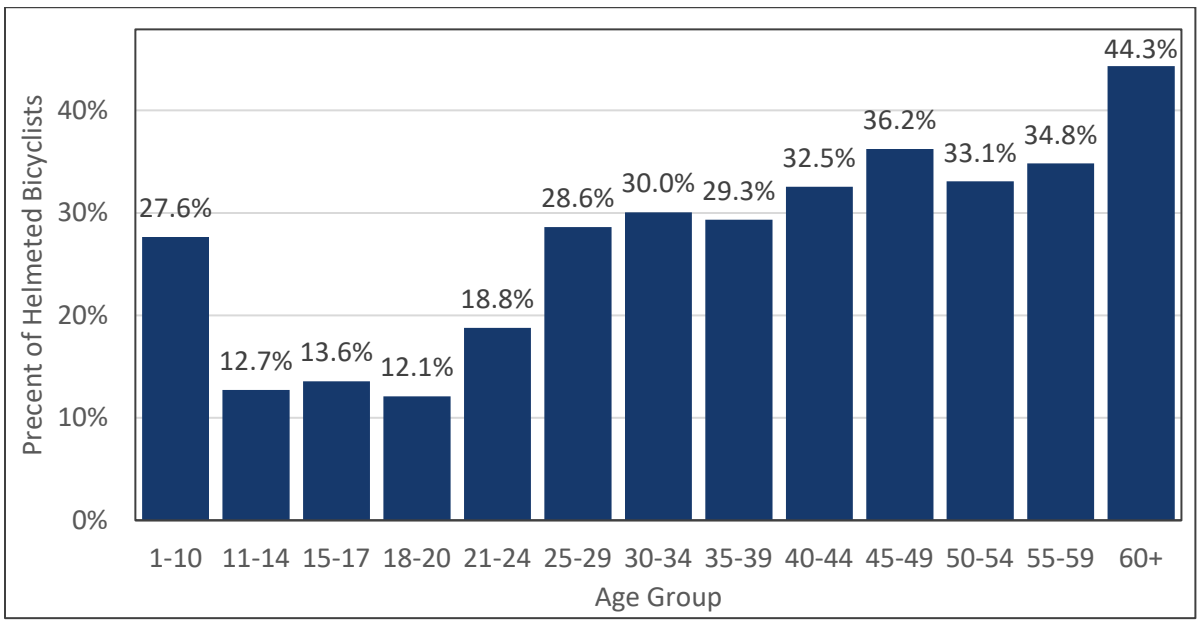

Figure 15 – Percent of Helmeted Bicyclists in Crashes by Age Group, 2019-2023

A comparison of helmet use of crash-involved bicyclists by both age group and gender is shown in Figure 16. About 79.2% of bicyclists involved in crashes were male. Female bicyclists averaged 31.0% helmet use while males averaged 26.5%. Females had higher proportion of helmet use than males among all age groups except the youngest group of ages 1-10 (25.0% vs. 29.0%). Bicyclists age 60+ had the largest gender difference in helmet use proportions with males 28.3% lower than females (41.4% vs. 57.8%).

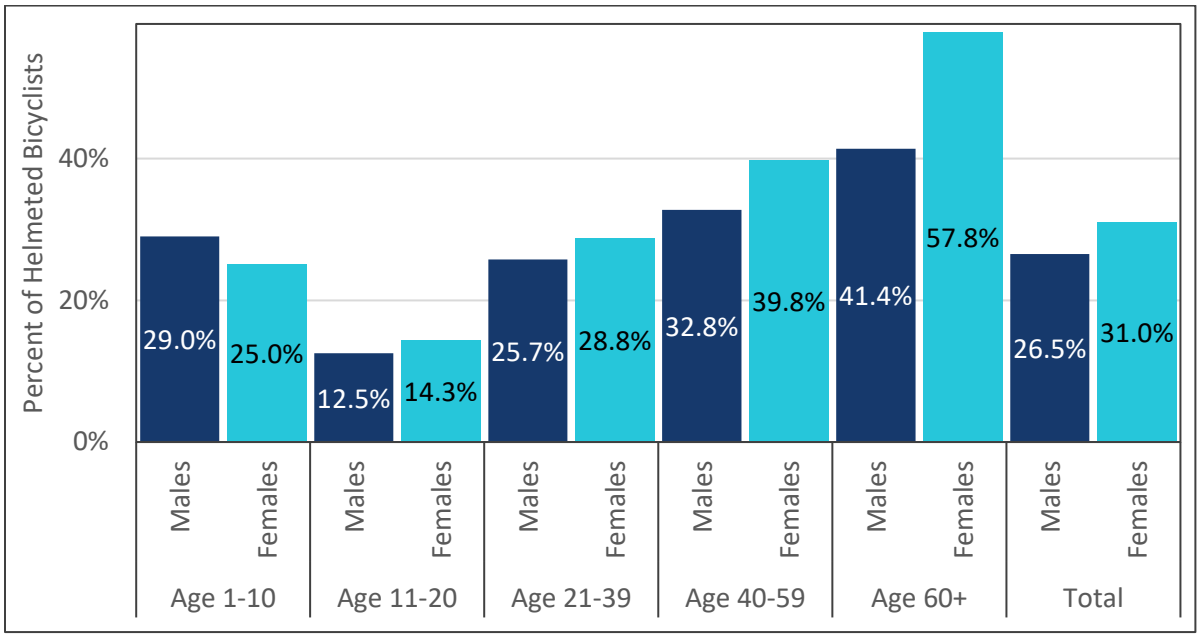

Figure 16 – Percent of Helmeted Bicyclists in Crashes by Age Group and Gender, 2019-2023

9.0 Summary

From 2019 through 2023 in Michigan, an average of 1,357 motor vehicle crashes per year involved a bicyclist (0.5% of all crashes, and 2.9% of fatal crashes) and an average of 29 bicycle-involved crashes involved at least one fatality. Bicyclists are vulnerable roadway users compared with motor vehicle occupants, as they lack the protection a vehicle's frame, airbags, and seat belts provide. While only 17.3% of crashes involving only motor vehicles resulted in death or injury, 78.5% of bicycle-involved crashes resulted in death or injury to at least one person.

Bicycle-involved crashes were concentrated during the warmer months, in clear weather, on the weekdays, and during daylight. About 63.1% of bicycle-involved crashes took place at intersections, but only 47.3% of fatal bicycle-involved crashes took place at intersections. While 0.7% of urban area crashes involved bicyclists, only 0.1% of rural area crashes involved bicyclists, and 91.9% of all bicycle-involved crashes are in urban areas. For bicycle-involved crashes that involved alcohol, alcohol use was reported for the bicyclists about two times as often as for the motor vehicle drivers (70.1% vs. 35.0%).

Among bicyclists with known age 1 and older, helmet use was not reported for about 42.2% of bicyclists, excluding these unknowns, about 27.5% of bicyclists involved in crashes wore a helmet. Among bicyclists with known helmet use, bicyclists age 18 to 20 had the lowest proportion of helmet use (12.1%) and bicyclists age 60 and older had the highest proportion of helmet use (44.3%). About 79.2% of bicyclists involved in crashes were male, and male bicyclists had lower helmet usage than females (26.5% vs. 31.0%).