Wisconsin Pedestrian and Bicycle Crash Analysis: 2011-2013

HIGHLIGHTS & EXECUTIVE SUMMARY

Prepared by
Robert Schneider, Ph.D., AICP, University of Wisconsin-Milwaukee
Joseph Stefanich, University of Wisconsin-Milwaukee

Prepared for
Larry Corsi, Wisconsin Department of Transportation (WisDOT), Bureau of Transportation Safety (BOTS)

FINAL DRAFT—October 1, 2015

Highlights

Overall Trends in Wisconsin Pedestrian and Bicycle Safety

- Higher levels of walking and bicycling were associated with greater pedestrian and bicyclist safety: between 2006 and 2013, the number of people walking and bicycling to work increased and the risk of pedestrian and bicyclist fatalities and injuries (per commuter) decreased.
- Of fatal traffic crashes reported between 2011 and 2013, approximately 10% involved pedestrians and 2% involved bicyclists. Approximately 9% of total trips were made by pedestrians and 1% were made by bicyclists, so these travel modes were overrepresented in fatal crashes.
- The highest concentrations ("hot spots") of fatal and severe-injury pedestrian and bicycle crashes tend to be along signalized, multilane, arterial roadway corridors in urban and suburban areas with moderate to high levels of pedestrian or bicycle activity. Without controlling for pedestrian and bicycle volumes (or other measures of exposure), it is not possible to determine if these locations experienced more crashes simply because they had more activity or because their conditions were inherently more dangerous. Regardless, these types of locations warrant attention due to high numbers of crashes.

Fatal Pedestrian and Bicycle Crashes

The following points highlight common characteristics of fatal pedestrian and bicycle crashes reported in Wisconsin between 2011 and 2013. Note that these results do not control for exposure: some characteristics may have high percentages of crashes because they are associated with higher levels of pedestrian or bicycle activity.

Fatal Pedestrian Crashes: Location

- 83% were at locations with no traffic signal or stop sign facing the driver (some of these locations had crosswalks, which require motorists to yield the right-of-way to pedestrians).
- 74% were on arterial or collector roadways.
- 55% occurred on roadways between intersections (i.e., >50 feet from the nearest intersection).
- 46% were on roadways with speed limits of 35 mph or higher.
- 36% were on rural roadways.
- 20% were at night on roadways with no lights.

Fatal Pedestrian Crashes: Behavior

- 77% involved a motor vehicle traveling straight.
- 31% involved alcohol (either the driver or the pedestrian had been drinking alcohol).
- 28% involved a driver not yielding to a pedestrian in a crosswalk.
- 65% of fatalities at intersections involved driver error (59% failed to yield to a pedestrian in a crosswalk and 6% violated a traffic signal) while 12% involved pedestrian error (violated a traffic signal).

Fatal Pedestrian Crashes: Other

- 52% occurred between 3 p.m. and midnight. The peak 3-hour period was 3 to 6 p.m. (24%).
- 31% involved pedestrians aged 65 or older.

Fatal Bicycle Crashes: Location

- 76% were on arterial or collector roadways.
- 70% were on roadways with speed limits of 35 mph or higher.

- 67% were at locations with no traffic control for the driver (i.e., no traffic signal or stop sign).
- 64% were on roadways between intersections.
- 33% were on rural roadways.

Fatal Bicycle Crashes: Behavior

- 79% involved a motor vehicle traveling straight.
- 39% involved a motor vehicle striking a bicyclist from behind on a roadway. Of these rear-end fatalities, 62% were on rural highways and 31% occurred during darkness.
- 27% involved alcohol (either the driver or the bicyclist had been drinking alcohol).

Fatal Bicycle Crashes: Other

- Crashes involving bicyclists younger than age 20 decreased from 62% of all bicycle crashes in 2003 to 33% of all bicycle crashes between 2011 and 2013 (includes all injury severity levels).

Strategies to Improve Pedestrian and Bicycle Safety

This report recommends a multi-faceted approach to reduce pedestrian and bicycle crash risk, including engineering, education, enforcement, and evaluation strategies.

Engineering

- Reduce roadway design speeds (e.g., reduce the number of lanes, narrow roadway lanes).
- Reduce roadway crossing distances.
- Provide pedestrian and bicycle facilities (e.g., sidewalks, paved shoulders, and bicycle lanes).
- Improve roadway lighting.

Education

- Increase driver awareness of laws requiring them to yield to pedestrians in crosswalks and provide at least three feet of space when passing bicyclists (even when a bike lane exists).
- Increase driver awareness of the danger they pose to their neighbors who are walking and bicycling when they speed, are intoxicated, or are distracted (e.g., texting while driving, eating).
- Increase driver awareness of their responsibility to travel at a prudent speed (potentially lower than the speed limit) in order to be able to react safely to pedestrians and bicyclists at night.
- Increase bicyclist awareness of the risk of riding in the opposite direction of adjacent traffic, disobeying traffic control, and bicycling at night without lights and bright clothing.
- Increase pedestrian awareness of the risk of walking while intoxicated and disobeying traffic control. Emphasize the importance of pedestrian nighttime visibility to aid driver detection.

Enforcement

- Enforce laws to reduce drunk driving, speeding, failure to yield to pedestrians, and passing too close to bicyclists
- Enforce laws to reduce bicycling at night without lights and pedestrian and bicyclist traffic signal violations.

Evaluation

- Improve police pedestrian and bicycle crash reporting practices to record details such as alcohol involvement by person/individual, crash type, helmet use, use of lights, and relevant maintenance problems.
- Collect pedestrian and bicycle counts and surveys to account for exposure.
- Quantify the impacts of specific intersection and roadway characteristics, education, and enforcement efforts on pedestrian and bicycle crash risk to inform future recommendations.

Executive Summary

Between 2011 and 2013, Wisconsin averaged more than 1,600 reported pedestrian crashes and more than 1,100 reported bicycle crashes per year[1]. Pedestrians and bicyclists are particularly vulnerable to serious injuries when they are involved in a crash with a motor vehicle: 19% of these pedestrian crashes and 10% of these bicycle crashes resulted in fatal ("K"-level) or severe ("A"-level) injuries[2]. Of all 1,568 fatal crashes reported in Wisconsin between 2011 and 2013, 152 (9.7%) involved pedestrians and 33 (2.1%) involved bicyclists. Of all 8,737 severe-injury crashes during this period, 774 (8.9%) involved pedestrians and 307 (3.5%) involved bicyclists. See the grey box below for information about crash data used in this report.

Crash Data Used in this Report

The crash numbers cited throughout this report are based on all police-reported crashes in the WisTransPortal Database (Wisconsin TOPS Laboratory 2014a) except deer-related crashes. Crashes on private property (parking lots and driveways) are included. Private-property crashes account for approximately 22% of pedestrian crashes (12% of fatal, 19% of severe, and 24% of non-severe pedestrian crashes) and 6.4% of bicycle crashes (0.0% of fatal, 5.2% of severe, and 6.5% of non-severe bicycle crashes). Note that the official crash statistics provided by the Wisconsin Department of Motor Vehicles (DMV) exclude private-property crashes. Since crashes on private property are less likely to involve turning vehicles, less likely to occur at high speeds, and less likely to result in fatal and severe injuries than crashes on public roadways, the percentages of crashes with these characteristics presented in this report are slightly different than percentages calculated from DMV records.

DMV statistics (for public roadways only) show: Wisconsin averaged more than 1,250 reported pedestrian crashes and more than 1,050 reported bicycle crashes per year between 2011 and 2013. 21% of pedestrian crashes and 10% of bicycle crashes resulted in fatal or severe injuries. Of all 1,541 fatal crashes reported in Wisconsin between 2011 and 2013, 136 (8.8%) involved pedestrians and 33 (2.1%) involved bicyclists. Of all 8,449 severe-injury crashes during this period, 647 (7.7%) involved pedestrians and 291 (3.4%) involved bicyclists.

Recognizing the importance of pedestrian and bicycle safety, the Wisconsin Department of Transportation (WisDOT) Strategic Highway Safety Plan (SHSP) for 2014-2016 includes "Provide Safe Pedestrian and Bicycle Travel" as one of the state's "Highest Priority Issue Areas" (WisDOT 2014a). Further, the WisDOT SHSP sets goals to reduce the number of pedestrian and bicycle fatal and serious-injury crashes by 5% by 2016, reduce the number of pedestrian and bicycle injury crashes by 5% by 2015, and reduce the total number of pedestrian and bicycle crashes by 5% by 2016 (WisDOT 2014a).

This study explores the characteristics of pedestrian and bicycle crashes reported between 2011 and 2013, focusing especially on serious crashes (crashes resulting in fatal and severe injuries). The results help Wisconsin DOT identify education, enforcement, and engineering treatments to help achieve its goals to improve pedestrian and bicycle safety.

[1] Following convention, this report often uses the term "bicycle crash" to refer to the vehicle in crashes involving people on bicycles (i.e., bicyclists). The term "bicyclist" is used where the sentence refers to a person.

[2] This report classifies crash injury severity according to the KABCO scale. The definitions of each code are K = "Killed"; A = "Incapacitating"; B = "Non-incapacitating"; C = "Possible"; and Blank = Unreported. These codes are simplified in the text to K = "Fatal"; A = "Severe"; and B, C, or O = "Non-severe".

Summary of Previous Research

According to previous studies, pedestrian crashes are associated with roadway design characteristics such as higher automobile speeds, more lanes, and more automobile traffic. Pedestrian crashes are also more likely on roads without sidewalks and crossings without median islands. Behaviors associated with pedestrian crashes include driver and pedestrian intoxication, drivers failing to yield to pedestrians in crosswalks, and pedestrians stepping into the road between cars. Children and male adults tend to be overrepresented in pedestrian crashes compared to their proportion of the population.

Bicycle crashes also tend to be associated with higher-speed roadways, more lanes, and more automobile traffic. In addition, bicycle crashes are more common on roadways without designated bicycle facilities. Many bicycle crashes involve children and male adults, but fewer involve females and seniors. Common causes of bicycle crashes include driver and bicyclist failure to yield and bicyclists riding in the opposite direction of adjacent traffic (contra-flow riding in a location without designated contra-flow facilities).

Some of the common crash characteristics listed above are found simply because pedestrian and bicycle crashes tend to be more common in locations and during time periods with more pedestrian and bicycle activity. After controlling for exposure, the risk of being involved in a crash tends to be lower for each individual when there are more people walking and bicycling. Both pedestrians and bicyclists experience more fatal and severe injuries in crashes on higher-speed roads.

Summary of Analysis Approach

The analysis approach used in this study advances our understanding of pedestrian and bicycle safety in Wisconsin in six important ways. This study:

1) Provides a detailed understanding of pedestrian, bicyclist, and driver movements that preceded a crash. This is done by reviewing the narrative descriptions in police crash reports and applying a location-movement classification method (LMCM) to expand on the National Highway Traffic Safety Administration (NHTSA) crash typology used in the Pedestrian and Bicycle Crash Analysis Tool (PBCAT) (Harkey et al. 2006).[3]
2) Summarizes detailed roadway characteristics at pedestrian and bicycle crash sites. This is done by reviewing aerial and street-level imagery and recording characteristics such as local street versus collector or arterial roadway; number of lanes; and presence of bicycle lanes, sidewalks, marked crosswalks, curb extensions, and median islands.
3) Analyzes the characteristics of pedestrian and bicycle crashes that result in different levels of injury severity (fatal, severe, and non-severe).
4) Creates a list of the top 20 pedestrian and top 20 bicycle crash "hot spots". These lists include locations in all five Wisconsin DOT districts that have high concentrations of fatal and severe pedestrian and bicycle crashes. This is done by analyzing the density of crash locations in GIS. Common characteristics of these locations are noted.
5) Explores the characteristics of crashes involving young pedestrians and young bicyclists. Pedestrians and bicyclists were considered to be young if they were below age 20. Age 20 was chosen for consistency with the analysis of Wisconsin bicycle crashes in 2003 (Amsden and Huber 2006). Future studies should use age 16 to divide age categories so that it is possible to examine the differences between crashes involving pedestrians and bicyclists at ages younger and older than the legal driving age.
6) Identifies whether the motorist, pedestrian, or bicyclist (or more than one party) was primarly responsible for the crash. Since "fault" is not assigned for crashes in Wisconsin, primary responsibility was determined by reviewing citations and the police description of the crash.

Pedestrian and bicycle crashes were analyzed separately, since they tended to involve different groups of people, different behaviors, and different roadway characteristics. The unit of analysis was crashes (rather than number of individual pedestrians or bicyclists injured). It is important to recognize several important limitations of the available data. These included unreported crashes, injury severity levels assessed by police, and lack of data on pedestrian and bicyclist exposure.

Available data from crashes reported to police between January 1, 2011 and December 31, 2013 were used for many analyses. This dataset included 4,857 pedestrian and 3,365 bicycle crashes on public roadways and on private property (only deer crashes were excluded). However, the existing crash data do not include information about some important behaviors and and roadway characteristics, so additional data were collected for a sample of 296 pedestrian and 229 bicycle crashes. This made it possible to conduct several other detailed analyses.

[3] The pedestrian and bicycle crash typologies were originally developed by the National Highway Traffic Safety Administration (NHTSA) (Snyder and Knoblauch 1971; Cross and Fisher 1977) and refined for the Federal Highway Administration (FHWA) PBCAT in the 1990s (Harkey et al. 1999).

Summary of Findings

Overall, pedestrian and bicycle crashes have declined in Wisconsin over the last 15 years (Amsden and Huber 2006; WisDOT 2011; Wisconsin TOPS Laboratory 2014a). The tables below show the total number of reported pedestrian and bicycle crashes by severity level over the last decade (Table 1 and Table 2).[4] Note that these tables include all police-reported crashes on public roadways and private property (parking lots and driveways) except deer crashes.

Table 1. Wisconsin Pedestrian Crashes by Severity Level, 2004 to 2013

Severity Level	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Fatality (K)	55	43	58	57	59	40	56	62	48	42	**520**
Incapacitating Injury (A)	327	348	330	297	304	275	268	258	262	254	**2,923**
Other/No Injury (B, C, or O)	1,382	1,421	1,475	1,434	1,300	1,236	1,287	1,259	1,324	1,348	**13,466**
Total	**1,764**	**1,812**	**1,863**	**1,788**	**1,663**	**1,551**	**1,611**	**1,579**	**1,634**	**1,644**	**16,909**

Source: WisTransPortal Database (Wisconsin TOPS Laboratory 2014a)

Table 2. Wisconsin Bicycle Crashes by Severity Level, 2004 to 2013

Severity Level	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Fatality (K)	14	14	8	10	9	7	9	12	11	10	**104**
Incapacitating Injury (A)	145	144	132	136	119	118	109	105	115	87	**1,210**
Other/No Injury (B, C, or O)	1,091	1,064	1,034	1,093	1,005	990	1,055	1,003	1,098	924	**10,357**
Total	**1,250**	**1,222**	**1,174**	**1,239**	**1,133**	**1,115**	**1,173**	**1,120**	**1,224**	**1,021**	**11,671**

Source: WisTransPortal Database (Wisconsin TOPS Laboratory 2014a)

Crashes may decrease over time for several reasons. One possibility is that roadway designs and pedestrian, bicyclist, and driver behaviors are safer. Another possibility is that overall levels of walking, bicycling, or driving have varied. To control changes in population and activity levels, Table 3 and Figure 1 provide several different measures of exposure and calculations of pedestrian crash rates over the last decade. Table 4 and Figure 2 provide similar calculations for bicycle crash rates.

[4] Similar statistics are also available from DMV records for public roadways only. See http://wisconsindot.gov/Pages/about-wisdot/newsroom/statistics/final.aspx.

Table 3. Wisconsin Pedestrian Crash Rates, 2004 to 2013

Statewide Metric	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Population (in 100,000s)	55.14	55.46	55.78	56.11	56.41	56.69	56.89	57.09	57.25	57.43
Pedestrian Crashes per 100,000 People	**32**	**33**	**33**	**32**	**29**	**27**	**28**	**28**	**29**	**29**
Ped. K & A Crashes per 100,000 People	**6.9**	**7.0**	**7.0**	**6.3**	**6.4**	**5.6**	**5.7**	**5.6**	**5.4**	**5.2**
Vehicle Miles Traveled (VMT) (in Millions)	60,398	60,018	59,401	59,493	57,462	58,157	59,420	58,554	59,087	59,484
Pedestrian Crashes per Million VMT	**0.029**	**0.030**	**0.031**	**0.030**	**0.029**	**0.027**	**0.027**	**0.027**	**0.028**	**0.028**
Walk Commuters (in 1,000s)			99.41	93.82	97.39	94.87	86.73	94.27	91.65	99.93
Ped. Crashes per 1,000 Walk Commuters			**19**	**19**	**17**	**16**	**19**	**17**	**18**	**16**
Ped. K & A Crashes per 1,000 Walk Commuters			**3.9**	**3.8**	**3.7**	**3.3**	**3.7**	**3.4**	**3.4**	**3.0**

Sources: US Census Bureau State Intercensal Estimates (US Department of Commerce 2014a); US Census Bureau Annual Estimates of the Resident Population (US Department of Commerce 2014b); Road Mileage and Annual VMT in Wisconsin (WisDOT 2014b); US Census Bureau American Community Survey (US Department of Commerce 2014c); WisTransPortal Database (Wisconsin TOPS Laboratory 2014a).

Table 4. Wisconsin Bicycle Crash Rates, 2004 to 2013

Statewide Metric	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Population (in 100,000s)	55.14	55.46	55.78	56.11	56.41	56.69	56.89	57.09	57.25	57.43
Bicycle Crashes per 100,000 People	**23**	**22**	**21**	**22**	**20**	**20**	**21**	**20**	**21**	**18**
Bicycle K & A Crashes per 100,000 People	**2.9**	**2.8**	**2.5**	**2.6**	**2.3**	**2.2**	**2.1**	**2.0**	**2.2**	**1.7**
Vehicle Miles Traveled (VMT) (in Millions)	60,398	60,018	59,401	59,493	57,462	58,157	59,420	58,554	59,087	59,484
Bicycle Crashes per Million VMT	**0.021**	**0.020**	**0.020**	**0.021**	**0.020**	**0.019**	**0.020**	**0.019**	**0.021**	**0.017**
Bike Commuters (in 1,000s)			20.07	19.06	21.47	20.01	20.75	19.08	24.46	23.48
Bicycle Crashes per 1,000 Bike Commuters			**59**	**65**	**53**	**56**	**57**	**59**	**50**	**43**
Bicycle K & A Crashes per 1,000 Bike Commuters			**7.0**	**7.7**	**6.0**	**6.2**	**5.7**	**6.1**	**5.2**	**4.1**

Sources: US Census Bureau State Intercensal Estimates (US Department of Commerce 2014a); US Census Bureau Annual Estimates of the Resident Population (US Department of Commerce 2014b); Road Mileage and Annual VMT in Wisconsin (WisDOT 2014b); US Census Bureau American Community Survey (US Department of Commerce 2014c); WisTransPortal Database (Wisconsin TOPS Laboratory 2014a).

Figure 1. Wisconsin Fatal & Severe Pedestrian Crash Rates, 2004 to 2013

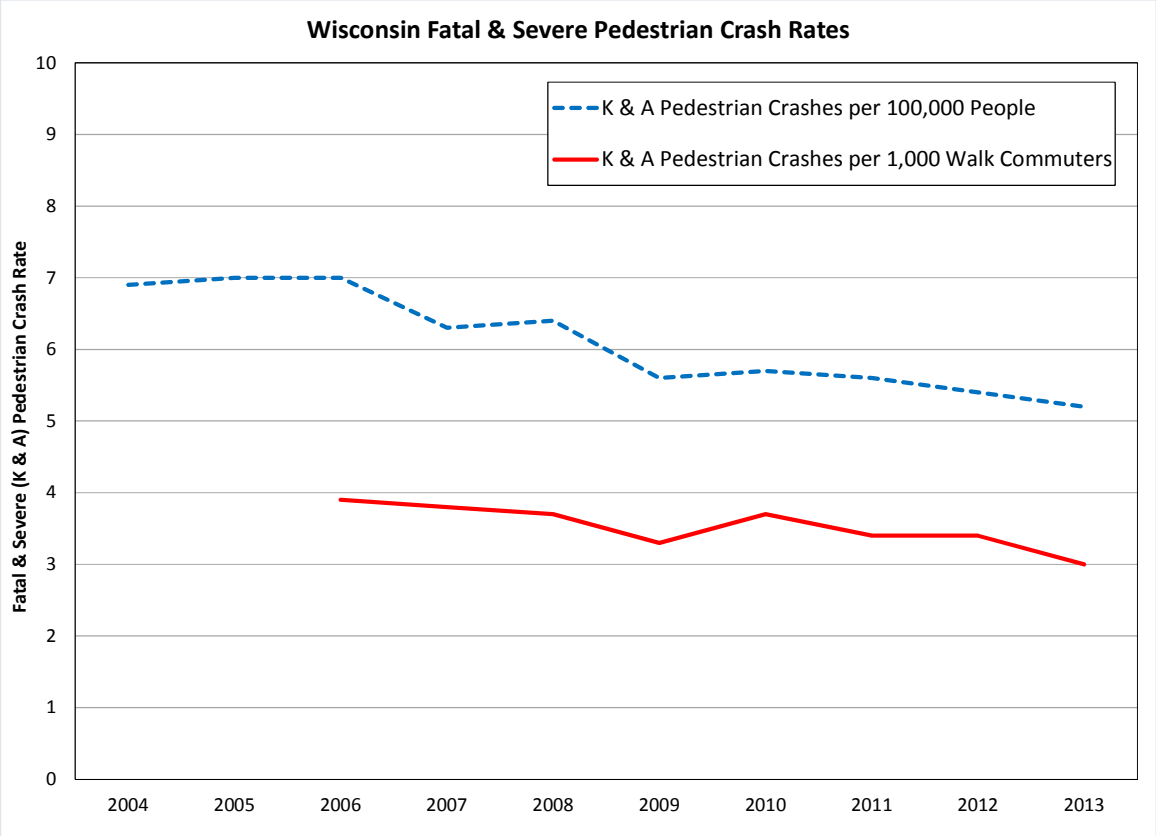
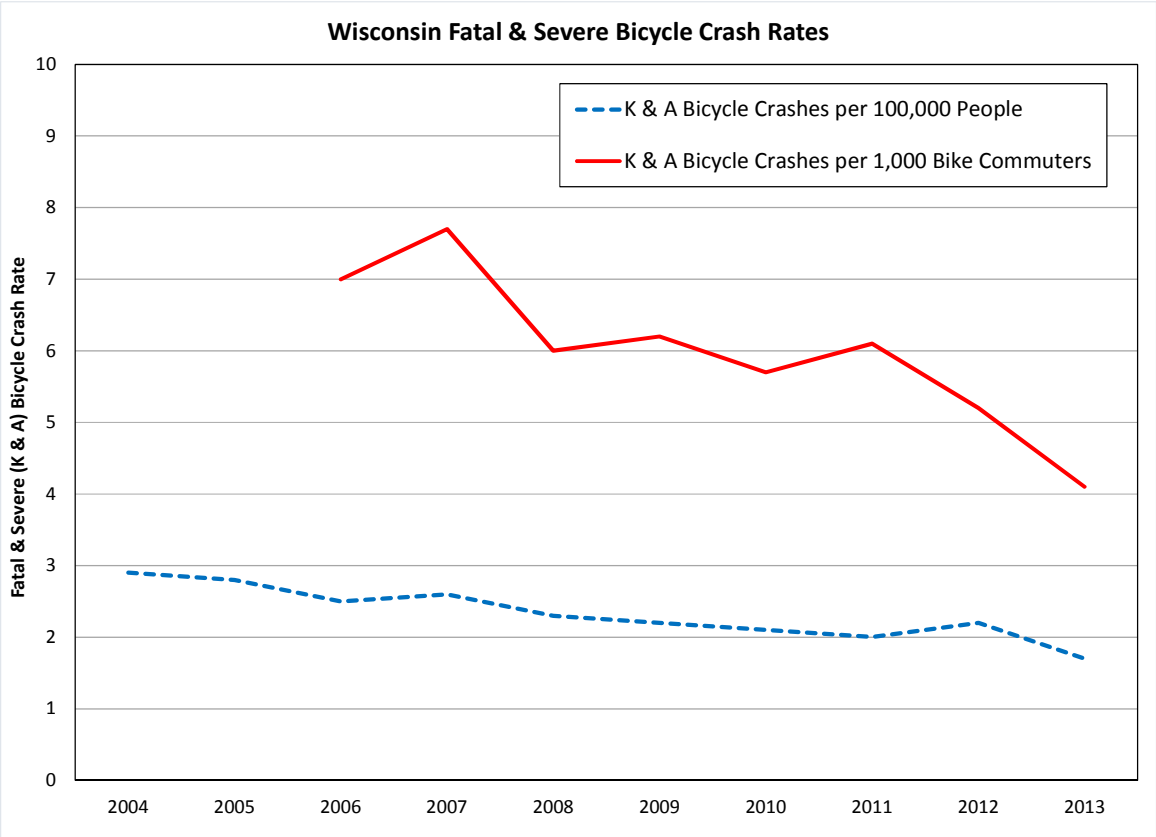


Figure 2. Wisconsin Fatal & Severe Bicycle Crash Rates, 2004 to 2013



Pedestrian crash rates decreased between 2004 and 2013 by nearly all measures in Table 3. One exception was pedestrian crashes per million vehicles traveled, which remained relatively stable. Bicycle crash rates decreased over the 10-year period by all measures in Table 4. This suggests that there were real improvements in safety for pedestrians and bicyclists in Wisconsin between 2004 and 2013. These data also show that higher levels of walking and bicycling were associated with greater pedestrian and bicyclist safety: between 2006 and 2013, the number of people walking and bicycling to work increased and the risk of pedestrian and bicyclist fatalities and injuries (per commuter) decreased.

Several other measures can be used to assess Wisconsin pedestrian and bicycle crash trends. The National Household Travel Survey (NHTS) is the best available source of total pedestrian and bicycle activity in Wisconsin (including all types of walking and bicycling trips, not just commuting to work), but was only conducted in 2001 and 2009. This source shows that pedestrian crashes per million Wisconsin pedestrian trips decreased from 3.6 to 2.4 between 2001 and 2009. Bicycle crashes per million Wisconsin bicycle trips increased from 14.1 to 15.1 between 2001 and 2009 (Federal Highway Administration 2001 and 2009).

In 2004, 7.7% of all fatal crashes in Wisconsin involved pedestrians. This number increased to 8.5% in 2013 (and reached a high of 12.0% in 2011). The proportion of fatal crashes that involved bicyclists was 2.0% in 2004 and 2013 (Wisconsin TOPS Laboratory 2014a). From 2011 to 2013, 9.7% of fatal crashes involved pedestrians and 2.1% involved bicyclists. Based on 2009 NHTS data, approximately 9% of total trips in Wisconsin were made by pedestrians and 1% were made by bicyclists, so these travel modes were overrepresented in fatal crashes during the 2011 to 2013 period.

Pedestrian and bicycle fatalities are prominent in urban areas, as these communities tend to have more walking and bicycling activity. In the City of Milwaukee, 30% of all fatal traffic crashes reported between 2011 and 2013 involved pedestrians and 2.9% involved bicyclists. In the City of Madison, 28% of fatal crashes involved pedestrians and 10% involved bicyclists.

Pedestrian Crash Characteristics by Severity Level

There were 152 fatal ("K"-level) injury crashes, 774 severe ("A"-level) injury crashes, and 3,931 non-severe ("B"-, "C"-, or "O"-level) crashes involving pedestrians between 2011 and 2013. Detailed analysis of these pedestrian crashes showed:

- 83% of fatal crashes were at locations where there was no traffic signal or stop sign facing the driver. These locations included roadways between intersections, parking lots/driveways, and intersections of major roadways with minor streets. Most intersections of major roadways with minor streets had stop signs for the minor street but no stop sign or signal for the major roadway. However, most of these intersections had crosswalks across the major roadway, meaning that the driver was legally required to yield the right-of-way to the pedestrian. Only 66% of non-severe crashes had no traffic signal or stop sign facing the driver.
- 74% of fatal crashes were on arterial and/or collector roadways.[5] These thoroughfares were associated with more serious pedestrian injuries, as only 45% of non-severe crashes occurred on arterial or collector roadways. Arterial and collector roadways tend to have higher automobile speeds and volumes and more travel lanes.
- 55% of fatal crashes occurred on a roadway between intersections.

[5] These variables are not included in the WisTransPortal database. Therefore, the results for these characteristics were based on a detailed analysis of a sample of 80 fatal pedestrian crashes.

- 46% of fatal crashes were on roadways with speed limits of 35 miles per hour or higher. Higher-speed roadways were associated with more serious pedestrian injuries, as only 16% of non-severe crashes occurred on roadways with speed limits of 35 miles per hour or higher. These roadways also tend to have higher volumes and more travel lanes.
- 47% of fatal crashes were on roadways with 4 or more lanes.[5,6] Interestingly, 46% of the non-severe crashes took place on roadways with 4 or more lanes. Fatal crashes were initially expected to be much higher on multilane roadways because multilane roadways are often arterial and collector roadways in urban areas. These main roadways often have higher speeds than two-lane neighborhood streets. However, the narrow difference that exists between fatal and non-severe crashes on multilane roadways may be due to the strong connection between fatal crashes and rural locations. Rural roads often have two lanes and allow for higher speeds, which are associated with more severe injuries.
- 36% of fatal crashes were on rural roadways. Rural roadways were associated with more serious pedestrian injuries, as only 15% of non-severe crashes occurred on rural roadways.
- 20% of fatal crashes were at night on roads with no lights. Dark, unlit roads were associated with more serious pedestrian injuries as only 4.8% of all non-severe crashes were at night on roads without lighting. Of the fatalities that occurred on dark, unlit roads, 67% were in rural areas.
- Only 17% of fatal crashes had some form of traffic control present (other than a crosswalk). In contrast, 34% of all non-severe crashes had traffic control present.
- 48% of fatal crashes had some form of pedestrian crossing facility present (e.g., marked crosswalk, median refuge, or curb extensions; sidewalks are not a crossing facility; unmarked crosswalks are not considered to be a facility in this analysis), which was slightly higher than non-severe, which only had pedestrian facilities present in 42% of crashes.[5] Of the fatal crashes that had pedestrian facilities present, 68% had a marked crosswalk and 50% had a median present. Without controlling for exposure (people are likely to walk more in locations with pedestrian facilities), it is not possible to determine a relationship between pedestrian facilities and pedestrian crash risk.
- 77% of fatal crashes involved a vehicle going straight. Vehicles were going straight in only 49% of non-severe crashes.
- 31% of fatal crashes involved alcohol (either the driver or pedestrian was intoxicated). Alcohol involvement was less prominent in severe (12%) and non-severe (6.9%) crashes.
- 28% of fatal crashes involved drivers not yielding to pedestrians in crosswalks.[5] Of these failure-to-yield fatalities, 68% were at intersections where the driver was going straight and no signal or stop sign was present, 18% were at intersections where the driver struck the pedestrian while turning left (none involved right turns), and 14% involved the driver disobeying a signal or stop sign. Most of these failure-to-yield crashes were at marked crosswalks (with painted lines), but some were at unmarked crosswalks.
- Most pedestrian fatalities at intersections involved driver error.[5] Considering the sample of 34 intersection pedestrian fatalities examined in detail, 65% were due to driver error (59% involved a driver not yielding to a pedestrian in a crosswalk and 6% involved a driver disobeying a traffic signal). Only 12% involved a driver with a green light striking a pedestrian who violated a red signal.

[6] Crashes were counted as being on a roadway with 4 or more lanes if they occurred at an intersection that had at least one approach with 4 or more lanes. Percentages are taken out of all intersection and non-intersection crashes (crashes that have an identified number of lanes), not parking lot or private property crashes.

- Fatalities at intersections were most common when pedestrians were in the far crosswalk (crosswalk negotiated by the driver when exiting the intersection) rather than the near crosswalk (crosswalk negotiated by the driver when entering the intersection).[5]
- Fatalities were more likely when pedestrians were approaching from the driver's left side.[5] Non-severe crashes were more likely when pedestrians were approaching from the driver's right side.
- 13% of fatal crashes involved a motorist striking a pedestrian who entered the roadway from the driver's left on the far side of an intersection.[5] Six of these crashes (60%) had no traffic control present on the motorist's roadway and 3 crashes (30%) had operating traffic signals.
- The common categories of movements preceding a crash were different for non-severe-injury crashes.[5] These less severe crashes were more likely to be at intersections and involve motorists turning left and right. In contrast, more severe crashes involved motorists traveling straight.
- 19% of all pedestrian crashes involved hit-and-run drivers. This rate was similar for all injury severity levels. However, police were much more likely to conduct follow-up investigations and find the hit-and-run drivers when the pedestrian was killed.
- Four pedestrian fatalities involved a pedestrian near a disabled vehicle. Three of these were at the side of freeways.
- One fatal crash was reported to involve a driver being distracted by a cell phone.[5] Other fatalities may have involved distraction, but it was not noted in the crash narrative.
- 52% of fatal crashes occurred between 3 p.m. and midnight. 24% of fatal crashes occurred between 3 p.m. and 6 p.m.
- 31% of fatal crashes involved a pedestrian age 65 or older.

Bicycle Crash Characteristics by Severity Level

There were 33 fatal ("K" injury) crashes, 307 severe injury ("A" injury) crashes, and 3,025 non-severe ("B", "C", or "O" injury) crashes involving bicyclists between 2011 and 2013. Detailed analysis of these bicycle crashes showed:

- 76% of fatal crashes were on arterial and/or collector roadways.[7] These thoroughfares were associated with more severe bicycle injuries, as only 61% of all non-severe crashes occurred on arterial or collector roadways. These roadways tend to have higher automobile speeds and volumes and more travel lanes. Of these fatal crashes on major roadways, 80% were at a location without a bicycle lane or paved shoulder.
- 70% of fatal crashes were on roadways with speed limits of 35 miles per hour or higher. Higher-speed roadways were associated with more severe bicycle injuries, as only 19% of all non-severe crashes occurred on roadways with speed limits of 35 miles per hour or higher. These roadways also tend to have higher volumes and more travel lanes.
- 67% of fatal crashes were at locations where there was no traffic control for the driver (e.g., traffic signal, stop sign).
- 64% of fatal crashes occurred on a roadway between intersections.[7]
- 36% of fatal crashes were on roadways with 4 or more lanes. 41% of non-severe crashes were on roadways with 4 or more lanes.[7] The proportion of fatalities on multi-lane roads may be smaller because a relatively high proportion of fatalities are on high-speed, two-lane, rural roads.

[7] These variables are not included in the WisTransPortal database. Therefore, the results for these characteristics were based on a detailed analysis of all 33 fatal bicycle crashes.

- 33% of fatal crashes were on rural roadways. Rural roadways were associated with more severe bicyclist injuries, as only 14% of non-severe crashes occurred on rural roadways.
- 9.1% of fatal crashes were at night on roads with no lights. Dark, unlit roads were associated with more severe bicyclist injuries, as only 1.7% of all non-severe crashes occurred at night on roads with no lights.
- 33% of fatal crashes had a bicycle facility present (e.g., bicycle lane, paved shouler, or sidepath; signed bike routes were not considered to be bicycle facilities). 15% of all non-severe crashes have a bicycle facility present. Without controlling for exposure (people are likely to bicycle more in locations with bicycle facilities), it is not possible to determine a relationship between bicycle facilities and bicycle crash risk. However, the higher percentage of fatal crashes with bike facilities present may reflect that many of the fatalities were on rural roadways with paved shoulders.
- 79% of fatal crashes involved a vehicle going straight.
- 39% of fatal crashes involved a motorist striking a bicyclist from behind on the roadway.[7] All of these crashes were identified in the WisTransPortal database as occurring at non-intersection locations.[8] 62% of these crashes occurred on rural roadways. 31% of these crashes occurred during darkness, meaning that 69% occurred in daylight. 31% of these crashes occurred with bicycle facilities present.
- 9.1% of fatal crashes were head-on, in which the vehicle crossed the center line and struck a bicyclist in the opposite lane of traffic.[7] These circumstance was much less common for less severe crashes, as none of the non-severe injury crashes studied involved this situation.
- 27% of fatal crashes involved alcohol (either the driver or bicyclist was intoxicated). Alcohol involvement was less prominent in severe crashes (3.6%) and non-severe crashes (2.5%).
- When classified by contributing circumstances, 12% of fatal crashes involved a motorist striking a bicyclist who was approaching from the left on the near side of the intersection.[7] 6.1% of fatal crashes involved a motorist striking a bicyclist approaching from the right (in the opposite direction of adjacent traffic) on the near side of the intersection. This contributing circumstance was much more common in less severe bicycle crashes, as 23% of non-severe-injury crashes involved a bicyclist riding contra-flow without a contra-flow bicycle facility.
- One bicycle fatality involved a driver being distracted by a cell phone. Other fatalities may have involved distraction by cell phone or other means, but it was not noted in the crash narrative.
- Many of the bicycle fatalities were middle-aged men. 16 (48%) of the bicyclists killed were between 46 and 65 years old. 88% of bicycle fatalities were men. Only one of the bicyclists killed was younger than 18 (age 15), and only three were younger than 22.
- Overall, bicycle crashes among young bicyclists (younger than age 20) decreased dramatically over the last decade. These young bicyclists accounted for nearly 62% (657 of 1,065) of bicycle crashes in 2003, but they accounted for only 33% (1,103 of 3,323) between 2011 and 2013. This change may reflect improvements in young bicyclist education and behavior, reductions in bicycling by this age group, or increases in bicycling by other age groups.

[8] Two of the 13 crashes were within 50 feet of an intersection, so our definition classified these as intersection crashes.

Location-Movement Classification Method (LMCM) Crash Types

To analyze and better understand the events leading up to each pedestrian and bicycle crash, we developed a location-movement classification method (LMCM). The LMCM classifies each crash according to 1) the location of the crash relative to an intersection or roadway segment and 2) the direction of movement of the pedestrian or bicyclist relative to the movement of the motor vehicle. The LMCM includes 57 distinct pedestrian crash types and 57 distinct bicycle crash types within four main categories: 1) roadway non-intersection (segment between intersections), 2) roadway intersection, 3) parking lot/private property, and 4) other. The LMCM complements existing NHTSA pedestrian and bicycle crash types used in the PBCAT and is intended to classify pedestrian and bicycle crashes in a useful way to identify problems and suggest safety measures.

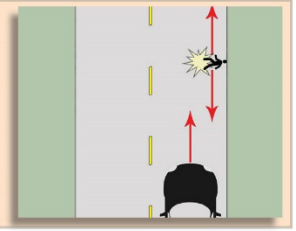
It was necessary to review the narrative crash report description to determine the LMCM crash type for each crash. Therefore, the LMCM was applied to the sample of 296 pedestrian and 229 bicycle crashes. This sample included 80 pedestrian fatalities (53% of total pedestrian fatalities) and 33 bicycle fatalities (100% of total bicycle fatalities). The LMCM crash types were supplemented with additional information about roadway (e.g., traffic control, number of lanes, speed limit), behavior (e.g., distraction, intoxication, contra-flow riding), and other characteristics (e.g., age, gender, lighting, time of day). Many crashes within the top four fatal pedestrian crash types involved darkness and alcohol; many occurred at multi-lane roadway intersections or between intersections along high-speed, two-lane roadways (Figure 3). Many crashes within the top four fatal bicycle occurred during darkness, on two-lane roadways, and on roadways with high speed limits (Figure 4).

Figure 3. Top Four Fatal LMCM Pedestrian Crash Types

#1 Fatal Pedestrian Crash Type

N_RRD_X : Non-intersection: Straight-traveling motorist strikes pedestrian in roadway; pedestrian not approaching from left or right **(13 crashes)**

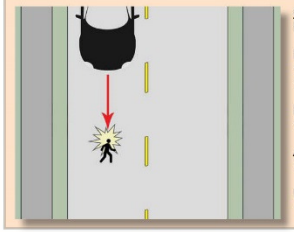
Crash Scenario 1: 5 Crashes
Pedestrian walking in roadway, with or against traffic, struck by vehicle in roadway lane.



Night Crashes
- 3 crashes (60%) occurred between Midnight and 6 am
- 4 crashes (80%) involved dark, unlit conditions

Alcohol Involvement
- 3 crashes (60%) were flagged for alcohol involvement

Speed
- 4 crashes (80%) were on roads with speed limits of 45 mph or higher



Crash Scenario 2: 4 Crashes
Pedestrian struck by vehicle while lying/sitting in roadway.

Night Crashes
- 4 crashes (100%) occurred between 6 pm and 6 am
- 3 crashes (75%) involved dark, but lit conditions

Driver Awareness
- 3 crashes (75%) noted that the driver did not see the pedestrian

Alcohol Involvement
- 3 crashes (75%) were flagged for alcohol involvement

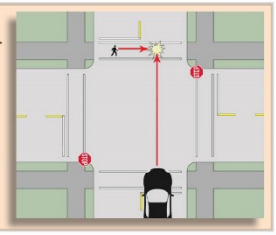
Urban Roadways
- 3 crashes (75%) occured on an urban roadway

Other Crashes: 4 Crashes
- 2 crashes involved a pedestrian who was dealing with a disabled vehicle at the time of crash
- 2 crashes involved a pedestrian whose action in the roadway could not be determined

#2 Fatal Pedestrian Crash Type

I_FS_ST_L : Intersection: Straight-traveling motorist strikes pedestrian approaching from left on far side of intersection **(10 crashes)**

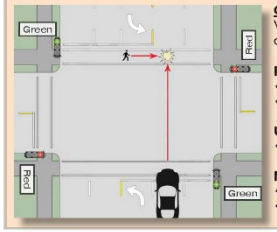
Crash Scenario 1: 6 Crashes
No traffic control on vehicle driver's roadway, but a crosswalk was present.



Peak Period and Night Crashes
- 3 crashes (50%) occurred between 3 pm and 6 pm
- 2 crashes (33%) occurred between 9 pm and midnight

Urban Roadways
- 5 crashes (83%) occurred on an urban roadway
- 6 crashes (100%) occurred on roadways with speed limits of 25-30 mph

Lighting Condition
- 5 crashes (83%) occurred during darkness, but there were street lights



Crash Scenario 2: 3 Crashes
Vehicle driver had a green traffic signal and the pedestrian was noted as disobeying traffic control.

Peak Period Crashes
- 2 crashes (67%) occurred between 6 am and 9 am
- 1 crashes (33%) occurred between 3 pm and 6 pm

Urban Roadways
- 3 crashes (100%) were deemed to occur on an urban roadway

Multi-lane, Moderate Speed Roadways
- 3 crashes (100%) occurred on roadways with speed limits of 30-35 mph
- 2 crashes (67%) involved a 5 lane roadway

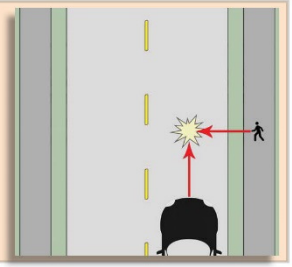
Other Crashes: 1 Crash
- 1 crash involved a pedestrian crossing at a non-crosswalk location with no traffic control on the driver's roadway

Other Characteristics:
- 8 crashes (80%) involved pedestrians who were 60+ years old

#3 Fatal Pedestrian Crash Type

N_RRD_R : Non-intersection: Straight-traveling motorist strikes pedestrian in roadway; pedestrian approaching from the right **(9 crashes)**

Crash Scenario 1: 8 Crashes
Straight-traveling motorist strikes pedestrian approaching from right with no noted obstructions.



Daytime Crashes
- 6 crashes (75%) occurred between 9 am and 6 pm

Higher-Speed Urban Roadways
- 7 crashes (88%) occurred on urban roadways
- 5 crashes (63%) occurred on roadways that were 30 mph or higher

Two-Lane Roadways
- 5 crashes (63%) occurred on 2-lane roadways

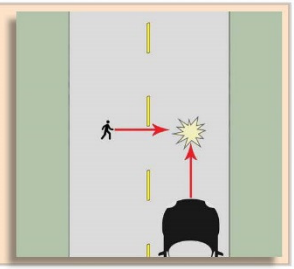
Other Crashes: 1 Crash
- 1 crash involved a pedestrian who had entered the roadway from between two parked vehicles

Other Characteristics:
- None of the crashes in this crash type involved a marked or unmarked crosswalk

#4 Fatal Pedestrian Crash Type

N_RRD_L : Non-intersection: Straight-traveling motorist strikes pedestrian in roadway; pedestrian approaching from the left **(9 crashes)**

Crash Scenario 1: 9 Crashes
Straight-traveling motorist strikes pedestrian approaching from the left with no noted obstructions.



Evening Crashes
- 6 crashes (67%) occurred between 6 pm and midnight

Higher Speed, Rural Roadways
- 6 crashes (67%) occurred on rural roadways
- 8 crashes (89%) occurred on roadways that were 35 mph or higher
- 5 crashes (56%) occurred on 2 lane roadways
- No crosswalks present

Alcohol Involvement
- 4 crashes (44%) were flagged for alcohol involvement

Other Characteristics:
- All crashes involved pedestrians who were 40+ years old

Figure 4. Top Four Fatal LMCM Bicycle Crash Types

#1 Fatal Bicyclist Crash Type

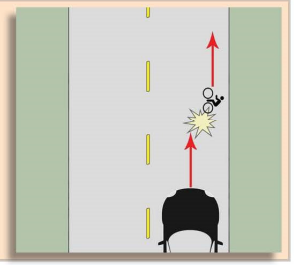
N_RRD_S : Non-Intersection: Straight-traveling motorist strikes bicyclist on right side of roadway (in a travel lane), bicyclist traveling in same direction (includes door-related) **(10 crashes)**

Crash Scenario 1: 9 Crashes
Vehicle driver rode straight into the bicyclist, with no suggestion of the bicyclist swerving into the vehicle's path of travel

Night Crashes
- 2 crashes (22%) occurred between 6 pm and 9 pm
- 3 crashes (33%) occurred between midnight and 3 am

High Speed, 2 Lane Roadways
- 8 crashes (89%) occurred on roadways that were 35+ mph
- 7 crashes (78%) occurred on 2 lane roadways

Limited Visibility
- 4 crashes (44%) noted that the driver did not see the bicyclist



Other Crashes: 1 Crash
- 1 crash involved a bicyclist who swerved into the passing vehicle

Additional Crash Characteristics:
- Bike lanes were not present in any of the crashes
- 3 crash reports (33%) noted alcohol as a potential contributing factor to the crash

#2 Fatal Bicyclist Crash Type

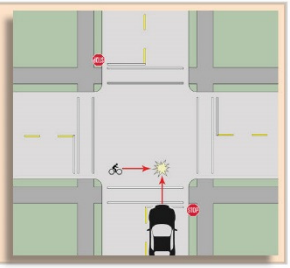
I_NS_ST_L : Intersection: Straight-traveling motorist strikes bicyclist approaching from left on near side of intersection **(5 crashes)**

Crash Scenario 1: 3 Crashes
Vehicle driver had a stop sign.

Limited Bike Facilities
- 2 crashes (67%) had no bike facility.

Urban Roadways
- 3 crashes (100%) occurred on urban roadways

Limited Visibility
- 2 crashes (67%) noted that the driver did not see the bicyclist



Other Crashes: 2 Crashes
- 1 crash occurred at an intersection controlled by a traffic light and involved a bicyclist who disobeyed traffic control
- 1 crash occurred at an intersection with a commercial parking lot driveway

#3 Fatal Bicyclist Crash Type

I_FS_ST_R : Intersection: Straight-traveling motorist strikes bicyclist approaching from right on far side of intersection **(3 crashes)**

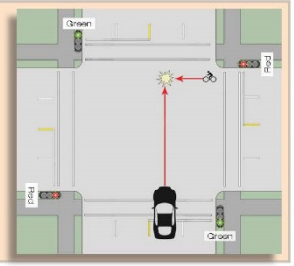
Crash Scenario 1: 3 Crashes
Bicyclist disregarded traffic control in each crash.

No bike lanes present

Multi-lane, Urban Roadways
- 2 crashes (67%) occurred on urban roadways
- 3 crashes (100%) occurred on multi-lane roadways

Limited Visibility
- 2 crashes (67%) noted that the driver did not see the bicyclist

Alcohol Involvement
- 2 crashes (67%) noted that alcohol potentially played a role in the crash



#4 Fatal Bicyclist Crash Type

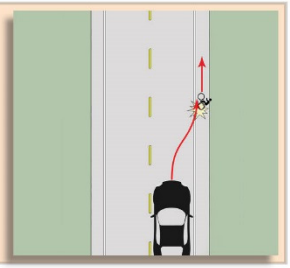
N_RSH_S : Non-Intersection: Straight-traveling motorist strikes bicyclist on right roadway shoulder or bicycle lane, bicyclist traveling in same direction **(3 crashes)**

Crash Scenario 1: 3 Crashes
Vehicle driver noted at fault. Bicyclist was in the bike lane or on the shoulder in each crash.

Rural, High Speed Roadways
- 3 crashes (100%) occurred on rural roadways
- 3 crashes (100%) occurred on 2 lane roadways
- 3 crashes (100%) had a posted speed limit of 55 mph

No Visibility Obstructions
- 3 crashes (100%) involved daylit conditions
- 3 crashes (100%) noted no obstructions
- 1 crash (33%) had a bicycle lane present

No Citations Given
- Driver deemed at fault in each crash, but no citations given



Comparison of LMCM and NHTSA Crash Typologies

The LMCM and NHTSA typologies were applied to identify characteristics of the most serious pedestrian and bicycle crashes reported in Wisconsin between 2011 and 2013. Both LMCM and NHTSA crash types were assigned to the sample of 296 pedestrian and 229 bicycle crashes used for detailed analysis. First, the top crash types for each severity level were identified separately using each method (e.g., Figure 3 and Figure 4). Next, the LMCM and NHTSA crash types were compared directly for all 231 pedestrian and 155 bicycle crashes in the sample with fatal and severe injuries. The examples below show how the LMCM can be used to supplement the information provided by the top NHTSA pedestrian crash type and top NHTSA bicycle crash type.

- *Top NHTSA Pedestrian Crash Type: Pedestrian entered the roadway at a location where the motorist's view was not obstructed (741)*. The LMCM shows that the majority (63%) of fatal and severe pedestrian crashes of this type occurred at non-intersection locations. Further, nearly three-quarters of these non-intersection crashes involved pedestrians approaching from the right (N_RRD_R) rather than the left (N_RRD_L). Therefore, countermeasures should emphasize protecting pedestrians approaching from the right along roadway segments. In addition, 48% of these crashes and 44% of those that involved a pedestrian entering the roadway from the right (N_RRD_R) occurred with non-daylit conditions. This may suggest that roadway lighting should be improved and that automated vehicle pedestrian detection systems should be designed to work in darkness and low-light conditions. Further, 56% of N_RRD_R crashes occurred with multilane roadways, so roadway designers should look for opportunites to reduce roadway lanes and to install pedestrian crossing facilities appropriate for multilane roads (e.g., median islands, pedestrian hybrid beacons).
- *Top NHTSA Bicycle Crash Type: Motorist failed to detect the bicyclist and struck the bicyclist from behind (231)*. While the NHTSA crash type indicates the direction of the motorist and bicyclist, it does not provide detailed information about the location of the crash on the roadway. The LMCM shows that 72% of these fatal and severe bicycle crashes occurred in the travel lane and 28% occurred on paved shoulders or bicycle lanes. Further, 61% of crashes occurred in non-daylight conditions and 56% occurred on a rural roadway. Improving roadway lighting and adding roadway space for bicyclists (e.g., paved shoulders, bicycle lanes, separated bicycle lanes) may help prevent bicyclists from being struck from behind in travel lanes.

Fatal and Severe Crash Hot Spot Characteristics

The top 20 pedestrian crash hot spots had several common characteristics. One of the most prominent characteristics was being located along multilane arterial roadway corridors. Many of these corridors had speed limits of 30 miles per hour or higher and additional turn lanes that allow greater traffic capacity and allow drivers to maintain faster speeds. Many were signalized corridors, and many of the crashes occurred at intersections between signals. These corridors often had a large number of driveway crossings, bus stops, and mixed land uses. These characteristics are associated with higher levels of pedestrian activity as well as a more complex environment for drivers to negotiate. However, a review of the crash narratives at each hot spot also showed that driver and pedestrian behavior as well as randomness also contributed to the occurrence of crashes.

The top 20 bicycle crash hot spots had several common characteristics. One of the most prominent characteristics was being located along multilane arterial roadway corridors. Many of these corridors had speed limits of 30 miles per hour or higher and additional turn lanes that allow greater traffic capacity and allow drivers to maintain faster speeds. Many were signalized corridors, and many of the crashes occurred at intersections between signals. These corridors often had a large number of driveway crossings and mixed land uses. These characteristics are associated with higher levels of

bicycle activity as well as a more complex environment for drivers to negotiate. Notably, most of the hot spots did not have bicycle facilities. Like crashes at pedestrian crash hot spots, the crash narratives showed that driver and bicyclist behavior as well as randomness contributed to the occurrence of crashes.

Young Pedestrian Crashes

Pedestrians younger than age 20 accounted for approximately 28% (1,343 of 4,751) of all pedestrian crashes (with pedestrian age information) reported between 2011 and 2013. Approximately 20% (59 of 289) of the 2011 to 2013 pedestrian crashes analyzed in detail (with pedestrian age information) involved pedestrians younger than age 20.

The three most common young pedestrian crash types involved motorists driving straight.

- Non-intersection: Straight-traveling motorist strikes pedestrian approaching from right (N_RRD_R) (16 crashes).
- Intersection: Straight-traveling motorist strikes pedestrian approaching from left on near side of intersection (I_NS_ST_L) (8 crashes).
- Intersection: Straight-traveling motorist strikes pedestrian approaching from left on far side of intersection (I_FS_ST_L) (6 crashes).

Young Bicyclist Crashes

The study of Wisconsin bicycle crashes reported in 2003 (Amsden and Huber 2006) looked closely at crashes involving young bicyclists, so this report includes a similar analysis. Overall, crashes involving bicyclists under age 20 decreased dramatically over the last decade. These young bicyclists accounted for 62% (657 of 1,065) of bicycle crashes in 2003, but they accounted for only 33% (1,103 of 3,323) between 2011 and 2013. This change may reflect improvements in young bicyclist education and behavior, reductions in bicycling by this age group, or increases in bicycling by other age groups.

The three most common types of crashes for young bicyclists involved motorists striking bicyclists on the near side of an intersection.

- Straight-traveling motorist strikes bicyclist approaching from left on near side of intersection (I_NS_ST_L) (9 crashes).
- Straight-traveling motorist strikes bicyclist approaching from right on near side of intersection (contra-flow bicyclist) (I_NS_ST_R) (8 crashes).
- Right-turning motorist strikes bicyclist approaching from right on near side of intersection (contra-flow bicyclist) (I_NS_RT_R) (8 crashes).

Summary of Recommendations

The following engineering, education, and enforcement strategies are recommended to prevent the most common types of fatal and severe pedestrian and bicycle crashes identified by this study. These recommendations complement the pedestrian and bicycle recommendations already included in the WisDOT Strategic Highway Safety Plan (SHSP). The study recommendations are listed below. More detailed discussions of pedestrian and bicycle safety treatments, as well as key considerations about appropriate situations to apply each treatment, are provided in other references such as the WisDOT *Wisconsin Guide to Pedestrian Best Practices* (2010) and *Wisconsin Bicycle Facility Design Handbook* (2009) and the FHWA *PEDSAFE* (2013) and *BIKESAFE* (2014) countermeasure selection systems.

Engineering: Treatments to Improve Pedestrian Safety

- Construct sidewalks on both sides of roadways in urban and suburban areas and construct paved shoulders along major roadways in rural areas.
- Reduce the design speed and posted speed limit on arterial and collector roadways.
- Reduce the number of travel lanes on arterial and collector roadways.
- Provide marked crosswalks at key pedestrian crossing locations. These marked crosswalks should be installed according to FHWA crosswalk guidelines (i.e., marked crosswalks across multi-lane, high-speed, high-volume roadways should be supplemented by median islands, pedestrian crossing beacons, or other treatments) (FHWA 2005).
- Provide a dedicated left-turn phase at signalized intersections.
- Construct curb extensions to reduce crossing distances and increase pedestrian visibility at mid-block and intersection locations.
- Construct medians and median refuge islands along arterial and collector roadways.
- Install pedestrian crossing beacons at uncontrolled crosswalks, where warranted (rectangular rapid flashing beacons or pedestrian hybrid beacons).
- Prohibit right-turn-on-red at signalized intersections.
- Reduce turning radii at the corners of intersections.
- Eliminate dedicated right-turn lanes at intersections.
- Improve roadway lighting, especially at the sides of the roadway near crosswalks.
- Remove roadside visibility obstructions, including parked cars near crosswalks.

Engineering: Treatments to Improve Bicyclist Safety

- Add bicycle facilities along arterial and collector roadways in urban and suburban areas. These facilities include standard, striped bicycle lanes as well as other facilities that are more comfortable for bicyclists, including buffered bicycle lanes and separated bike lanes.
- Construct paved shoulders (at least four feet wide; wider if rumble strips are used) along major roadways in rural areas.
- Improve roadway lighting, especially in urban and suburban areas where bicyclists are common.
- Prohibit right-turn-on-red at signalized intersections.
- Reduce the number of roadway lanes on arterial and collector roadways.
- Provide a dedicated left-turn phase at signalized intersections.

Education: Safety Messages for Motorists

- You must yield the right-of-way to a pedestrian in a crosswalk. In other words, you must allow a pedestrian who has stepped off the curb into the crosswalk to cross in front of you before you proceed.
- You must yield the right-of-way to a pedestrian in a crosswalk when turning left or right at an intersection.
- You must yield the right-of-way to a pedestrian in a crosswalk when you are traveling straight, even if you are on a main roadway with no stop sign or traffic light and there is a stop sign for automobiles on the side street.
- Always be ready to yield to pedestrians when traveling straight, including people crossing from either the right *or the left*. This means that you need to be traveling slow enough to come to a stop before you reach any crosswalk, in case a pedestrian enters it.
- Always look in both directions for vehicles, bicyclists, and pedestrians at a stop sign. In particular, look for pedestrians and bicyclists approaching from the sidewalk on your right

before turning right at an intersection. This includes looking to the right before turning right on red and before turning right onto a major street.
- Look for pedestrians in the crosswalk on the left side of the intersection before turning left.
- Reduce speed and watch closely for pedestrians near disabled vehicles in the roadway or at the side of the roadway.
- Look for bicyclists traveling through the intersection on the roadway or in the crosswalk on the left side of the intersection before turning before turning left.
- Travel at a prudent speed at night (potentially lower than the speed limit) in order to have the ability react safely to pedestrians and bicyclists.

Education: Safety Messages for Pedestrians

- Cross the street within crosswalks. Motorists are required to yield the right-of-way to you (stop so that you can cross) if you set foot into a crosswalk.
- Since motorists may not always be aware that you are trying to cross the street in a crosswalk, point your arm in the direction that you intend to cross before setting foot into the crosswalk.
- Do not cross from between parked cars. This is especially important for children.
- Watch for left-turning cars, especially when crossing driveways and minor streets along busy streets.
- Be aware that motorists may not see you if they are turning right and you are approaching on their right side (especially if they are turning onto a busy street).
- Be aware that motorists may have a difficult time seeing you at night, especially if you are not wearing bright/retroreflective clothing.
- If you stop your vehicle on the side of a high-speed roadway, do not get out before the police arrive.

Education: Safety Messages for Bicyclists

- Obey all traffic control, including stop signs and traffic signals.
- Ride in the street in the same direction as traffic. This is particularly important for keeping safe when you cross driveways and intersections.
- Assume that motorists will not see you if you approach from the right side of their vehicle at an intersection (especially from the sidewalk).
- Watch for left-turning cars at intersections on busy streets, even when you have the right-of-way.
- If you ride when it is dark, have a white light on the front of your bike and a red reflector or light on the back of your bike. Go beyond these minimum legal requirements and wear bright/retroreflective clothing.
- Be aware that motorists may have a difficult time seeing you at night, especially if you do not have lights and are not wearing bright/retroreflective clothing.

Enforcement: Motorist, Pedestrian, and Bicyclist Behaviors to Target

- Motorists speeding, especially on streets in locations with high levels of pedestrian and bicycle activity.
- Motorists not yielding to pedestrians in crosswalks when traveling straight through uncontrolled intersections.
- Motorists not yielding to pedestrians in crosswalks when turning at intersections.
- Motorists driving while intoxicated.
- Motorists passing within less than three feet of a bicyclist.

- Pedestrians disobeying traffic signals.
- Bicyclists disobeying traffic signals.
- Bicyclists riding without lights at night.

Evaluation

- Improve police pedestrian and bicycle crash reporting practices.
  - Identify alcohol involvement by person/individual.
  - Record the bicyclist person/individual in a consistent location on the crash report.
  - Record the LMCM crash type code on the crash report.
  - Record bicyclist helmet use consistently in the safety equipment field on the crash report. While helmet use is not required by law, more data can be useful for exploring the relationship between safety equipment and injuries.
  - Record bicyclist use of lights in a standard field on the crash report.
  - Record environmental context characteristics that may contribute to the crash (e.g., record if landscaping or parked vehicles were blocking the motorist's view of a pedestrian before he or she stepped into the crosswalk; record if a bicycle lane had a pothole or debris that made a bicyclist swerve into traffic).
- Collect pedestrian and bicycle counts and surveys to account for exposure.
- Quantify the pedestrian and bicycle crash risk associated with specific intersection and roadway characteristics.
- Analyze crashes using WisTransPortal and emergency room data.
- Supplement standard police reports with detailed reconstruction data for fatal crashes.
- Analyze all pedestrian and bicycle crashes in detail.