



Dane County Bicycle and Pedestrian Crash Study

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Introduction

During the years 2011-2015, there were 798 documented motor vehicle crashes involving bicyclists and 552 involving pedestrians in Dane County, resulting in a total of 29 deaths. The purpose of this study was to identify the common features of these crashes to guide safety improvement efforts, measure the change in bicycle safety since the City of Madison's 1992 bicycle crash study, and set a benchmark for future safety performance measurement in the Madison metropolitan area and Dane County.

Methodology

The data used in this study was developed from a careful review of the crash report filed for each crash, along with data included in the general purpose crash data file produced by the Wisconsin Department of Transportation (WisDOT) Bureau of Traffic Operations (BTO), and distributed by the Wisconsin Traffic Operations and Safety (TOPS) Laboratory at the University of Wisconsin-Madison. All bicycle and pedestrian crashes were categorized according to two different crash categorization systems, the type of facility on which the bicyclist or pedestrian was traveling, whether the bicyclist or pedestrian was traveling with or against motor vehicle travel in the adjacent lane, the location of pedestrian crash victims in or outside of available crosswalks, and other factors.

Unfortunately, comprehensive data regarding bicyclist and pedestrian exposure—such as total annual miles of bicycle or pedestrian travel—is not available. This makes it impossible to quantify overall bicycle and pedestrian safety risk and the comparative bicycle and pedestrian crash risk of different locations. The lack of demographic and other data on bicyclists and pedestrians also limits conclusions that can be drawn from the crash data. For example, is the higher number of crashes involving male bicyclists a result of their bicycling behavior or mostly due to the fact they bicycle at much higher rates?

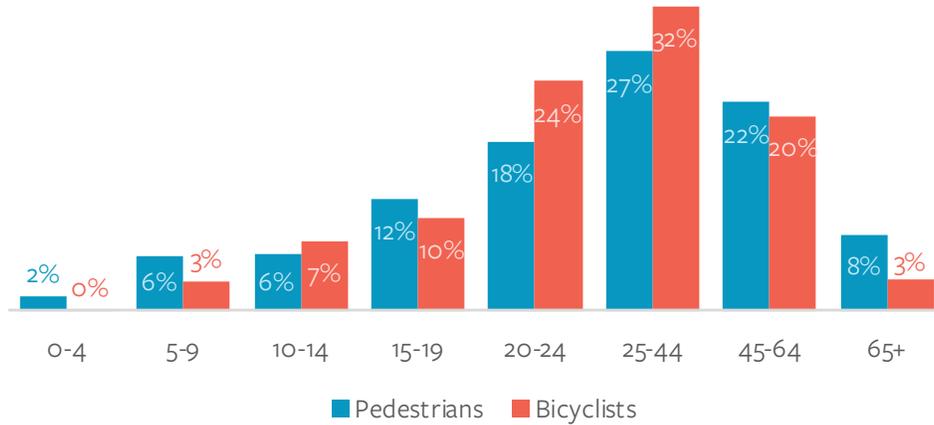


Overview

Demographics

As shown in Figure 1, bicyclists involved in crashes tend to be somewhat more concentrated in the center of the age spectrum than pedestrians. Males are more heavily represented than females among both bicyclists and pedestrians involved in crashes, representing about 70% of bicycle crash victims and 55% of pedestrian crash victims.

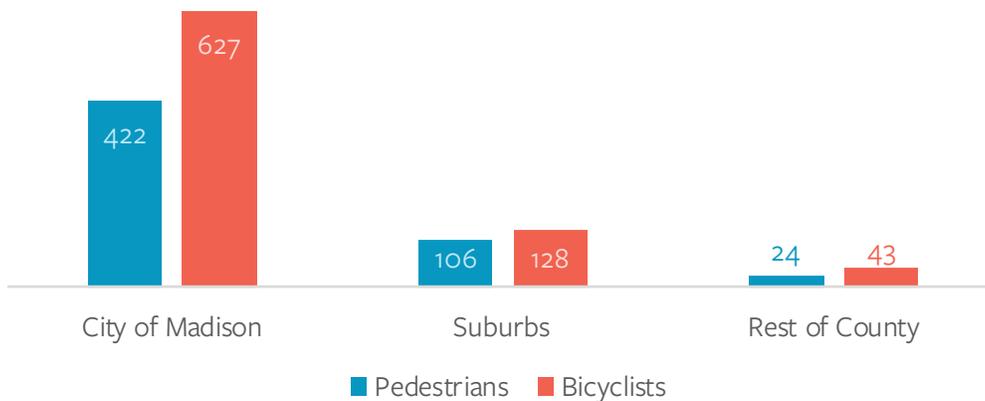
Figure 1: Age of Bicyclists and Pedestrians Involved in Crashes



Crash Summary

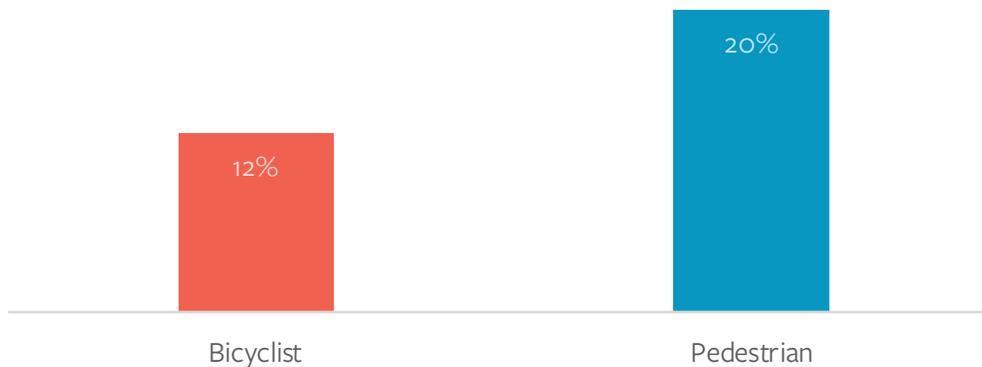
The City of Madison accounts for nearly 80% of the 1,350 bicycle and pedestrian crashes that took place in Dane County during the 2011-2015 study period, with the suburbs in the [MPO planning area](#) accounting for most of the remainder.

Figure 2: Bicycle and Pedestrian Crashes in Dane County



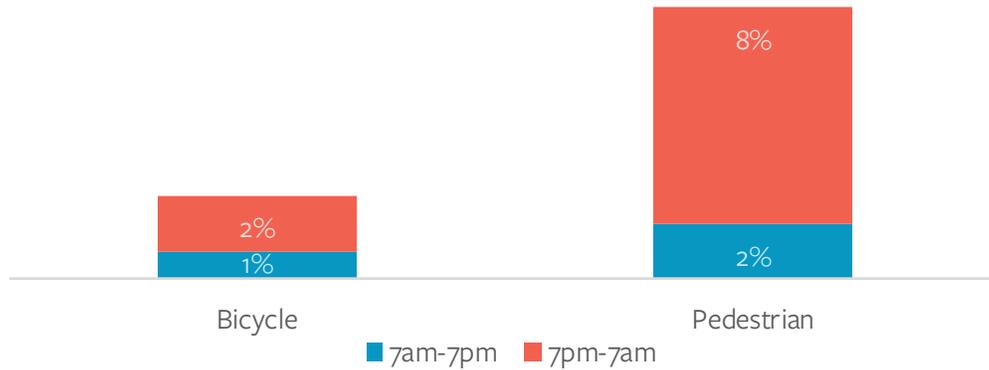
12% of bicycle crashes and 20% of pedestrian crashes were hit-and-runs. Interestingly, most of these crashes occurred during the day. 72% of the hit and run crashes involving bicyclists, and 63% of those involving pedestrians, occurred during the 7:00 am – 7:00 pm period.

Figure 3: Hit-and-Run Crashes as a Percentage of All Pedestrian and Bicycle Crashes



Alcohol use by one or both parties was a factor in nearly 10% of pedestrian crashes and about 3% of bicycle crashes. Most of this disparity is due to crashes taking place in the evening hours, between 7:00 pm and 7:00 am, as shown in Figure 4.

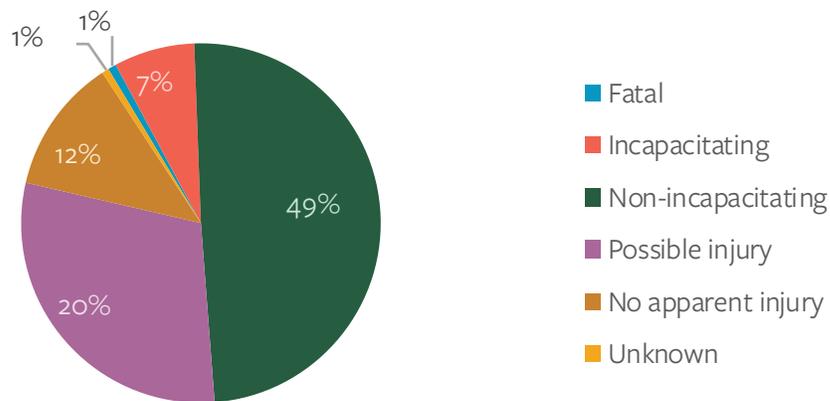
Figure 4: Alcohol-Related Bicycle and Pedestrian Crashes



Bicycle Crashes

Overall, there were 798 reported bicycle crashes in Dane County during the study period. Of these, 0.8% (6) were fatal and another 7.3% (58) resulted in an incapacitating injury. The term “incapacitating,” as used in the MV4000 crash reports that are the basis for the data used in this study, refers to an injury that makes it impossible for the injured person to transport themselves away from the scene of the crash, and encompasses a wide range of injury severities. The vast majority of reported bicycle crashes do not result in serious injuries. Injury severity is closely correlated with posted speed limits. Five of the six fatal bicycle crashes that took place during the study period occurred on roads with speed limits of at least 35 mph, despite these roads accounting for only 20% of total reported bicycle crashes.

Figure 5: Bicyclist Injury Severity



Bicycle Crash Types

Bicycle crashes were categorized according to two separate typologies. The first was developed by the National Highway Transportation Safety Administration (NHTSA). The 39 NHTSA types used to classify crashes can be grouped into larger categories for analysis—e.g. *Motorist Left Turn* includes both *Motorist Left Turn – Facing Bicyclist* and *Motorist Left Turn – In Front Of Bicyclist*. Table 1 details the top NHTSA crash type categories in Dane County.

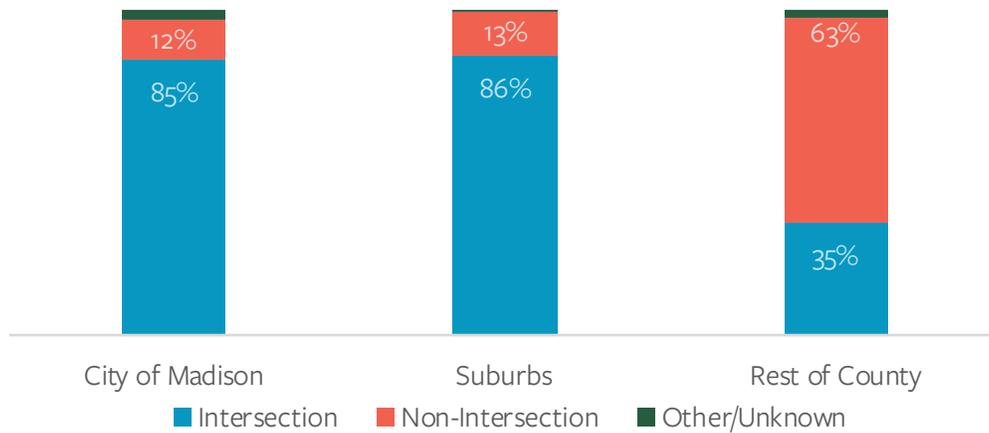
Dooring, crashes that involve a bicyclist striking the open door of a stopped vehicle, accounted for just 1% of crashes in Dane County, a much lower percentage than in many larger cities.

Table 1: Top NHTSA Bicycle Crash Categories in Dane County

Crash Category	#	%
Motorist Left Turn	174	22%
Motorist Drive Out/Through at Intersection	147	18%
Motorist Right Turn	141	18%
Bicycle Ride Out/Through at Intersection	95	12%
Motorist Overtaking	55	7%
Bicycle Right or Left Turn	31	4%
Bicycle Overtaking	32	4%
Bicycle Ride Out at Midblock	24	3%
Motorist Drive Out at Midblock	23	3%
Other	76	9%
Total	798	100%

Unlike the NHTSA crash types, Location Movement Classification Method (LMCM) crash types are based exclusively on where a crash occurs and the relative movements by the parties to the crash, without regard to traffic control devices or other circumstances that may have influenced the crash. This focus on location and direction of movement makes LMCM types useful in identifying differences and commonalities in crash location. As shown in Figure 6, roughly 85% of crashes in the City of Madison and the suburbs in the MPO planning area occurred at intersections. Elsewhere in the County, the majority of crashes occurred at non-intersection locations.

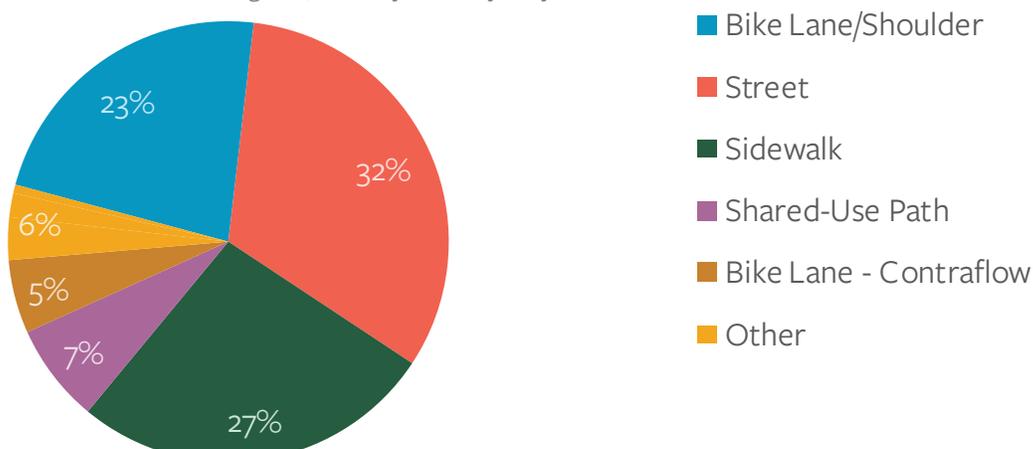
Figure 6: LMCM Crash Types By Community



Facilities

Bicyclists are almost always in the roadway when they are struck by motor vehicles, but many are merely crossing the roadway in order to continue along the shared-use path or sidewalk on which they are riding. As shown in Figure 7, streets were the most common type of facility being used by bicyclists involved in crashes, with sidewalks being the second most common. While we lack reliable information about the relative share of miles ridden by bicyclists on sidewalks compared to other types of facilities, bicyclists riding on sidewalks almost certainly face a higher overall crash risk than those using other types of facilities. This may be in part due to the types of bicyclists (e.g., younger, less experienced) that ride on the sidewalk as well as the false sense of security it provides, given that street intersections are where most crashes occur.

Figure 7: Facility Used by Bicyclists Involved in Crashes



Traveling With/Against Traffic

Bicyclist travel direction relative to adjacent motor vehicle traffic appears to play a significant role in crash risk. Traveling against traffic does not necessarily indicate that a bicyclist was riding in the wrong direction. For example, contraflow bicycle lanes, like the one on the south side of University Avenue in the UW campus area, are designed so that bicycle traffic flows against motor vehicle traffic. Generally, bicycle traffic should flow with motor vehicle traffic on bike lanes, shoulders, and streets.

Sidewalks and shared-use paths are unique in that riders may travel in either direction. Crashes involving bicyclists using these facilities dramatically illustrate the increased risk faced by bicyclists traveling against traffic. In both cases, the number of crashes involving bicyclists traveling against traffic is more than 3.5 times those involving bicyclists traveling with traffic. This disparity does not appear in pedestrian crashes and suggests that bicyclists' higher speeds may put them at particular risk when traveling against traffic.

Half of all crashes involving children under the age of 14 involve a bicyclist riding on the sidewalk, and in 60% of these cases the bicyclist was riding against traffic.

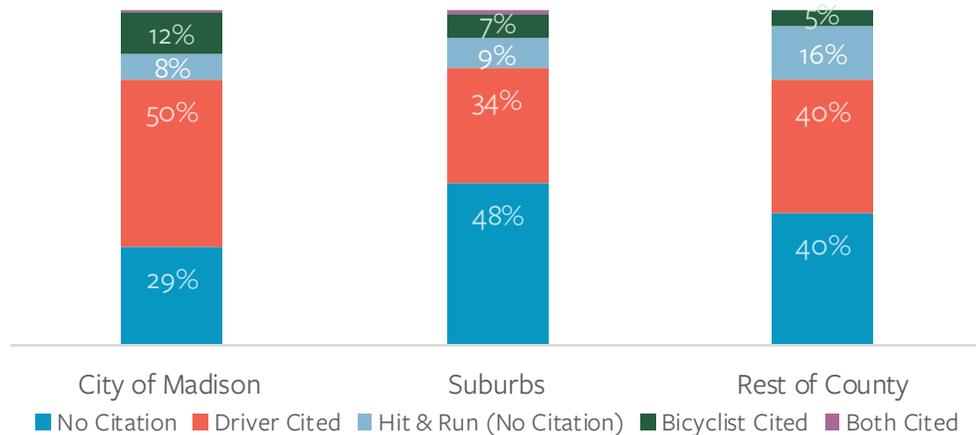
Table 2: Facility Used by Bicyclist and Direction Relative to Motor Vehicles in Adjacent Roadway Travel Lane

Facility Type	With	Against	Intersection	Stopped	Unknown	Total	
	%	%	%	%	%	#	%
Bike Lane/Shoulder	97%	3%	0%	0%	0%	181	100%
Bike Lane - Contraflow	2%	98%	0%	0%	0%	43	100%
Street	89%	3%	5%	0%	2%	259	100%
Bike Boulevard	100%	0%	0%	0%	0%	14	100%
Shared-Use Path	14%	53%	31%	0%	2%	58	100%
Sidewalk	20%	69%	5%	0%	6%	213	100%
Unknown	68%	16%	4%	4%	8%	25	100%
Driveway	0%	0%	100%	0%	0%	5	100%
Grand Total	61%	30%	6%	0%	3%	798	100%

Citations

As shown in Figure 8, following crashes both bicyclists and drivers were cited at a higher rate in the City of Madison than elsewhere in the county. Potential reasons for this disparity include differences in law enforcement experience and training dealing with bicycle crashes, or a greater number of potential witnesses to crashes within the City.

Figure 8: Citations Issued in Bicycle Crashes by Municipality



Common Crash Scenarios

Certain common crash scenarios are not directly identified by the NHTSA and LMCM crash types used to classify bicycle crashes in this study. The following common crash scenarios were identified based on data aggregated by using a combination of NHTSA and LMCM crash types.

Motorist Right Turn from Stop – Bicyclist Approaching from the Right

Crashes between motorists making a right turn from a stop at a stop sign or red light and bicyclists traveling against traffic on a sidewalk or shared-use path approaching from the motorist’s right are among the most common in the Madison area. These made up 12% of all crashes during the study period, with just over half of these occurring at traffic lights.

Right/Left Hook Crashes

Right hook crashes are those that occur when a car makes a right turn into or right in front of a bicyclist traveling in the same direction on the right side of a motorist, often in a bicycle lane. Left hook crashes, as defined in this report, are the mirror image of right hook crashes, involving a bicyclist traveling on the left side of a motorist traveling in the same direction who is hit or cut off when the motorist makes a left turn. These crashes made up 12% of all bicycle crashes during the study period, the vast majority of which occurred in the City of Madison.

Overtaking Crashes

Crashes involving bicyclists traveling straight being struck from behind by straight traveling motorists were dominant in rural parts of Dane County. These provoke particular anxiety among cyclists due to the fact that the motor vehicle is approaching from behind, making it nearly impossible for the bicyclist to anticipate and avoid the crash. Overtaking crashes accounted for 6% of all bicycle crashes that occurred during the study period. Nearly half of these crashes were hit-and-runs.

Comparison to the 1992 City of Madison Bicycle Crash Study

This study comes 25 years after a similar study, which focused on bicycle crashes in the City of Madison during the four-year 1987-1990 period. Despite population growth of more than 25% and a 50% increase in the rate of bicycle commuting, the annual crash rate between bicycles and motor vehicles has declined substantially. It is likely that this reduction in bicycle crashes has been driven by both large-scale investments in bicycle infrastructure and smaller safety improvement projects during the intervening years, along with safety education efforts. It also provides some validation for the “safety in numbers” theory: as the number of bicyclists increases, motorists are more inclined to look for, notice, and yield to them when appropriate. Table 3 provides an overview of these two studies.

Table 3: Comparison of 2018 and 1992 Crash Studies

	2018 Study	1992 Study
Time Period	2011-2015	1987-1990
Number of Years	5	4
Study Area	Dane County	City of Madison
Total Crashes*	798	774
Bicycle Crashes - City of Madison		
Total Crashes	627	774
Population	243,122 (2011-2015 est.)	190,766 (1990)
Annual Crashes	125	194
Bicycle Commuting Pct.	5.2% (2011-2015 est.)	3.3% (1990)
Crash Rate per 100,000 pop.	51.4	101.7

* Includes only motor vehicle – bicycle crashes

Pedestrian Crashes

Overall, there were 552 reported pedestrian crashes in Dane County during the study period. Of these, 4.2% (23) were fatal and another 14.3% (79) resulted in an incapacitating injury. While the majority of reported pedestrian crashes do not result in serious injuries, the rate of fatal and incapacitating injury in crashes with motor vehicles is much higher for pedestrians than for bicyclists.

While the overall fatality rate for pedestrians involved in reportable crashes was 4.2%, the fatality rate was much higher for streets with higher speed limits. 22% of the crashes that occurred on roads with speed limits of at least 40 mph were fatal, compared to just 1% of the crashes that occurred on roads where the speed limit is 25 mph or below.

Pedestrian Crash Types

Like bicycle crashes, pedestrian crashes were categorized according to both NHTSA and LMCM typologies. Table 4 details the top NHTSA pedestrian crash type categories in Dane County. Most common are crashes involving turning or merging vehicles at intersections in which the driver fails to yield to the pedestrian. These

Table 4: Top NHTSA Pedestrian Crash Categories in Dane County

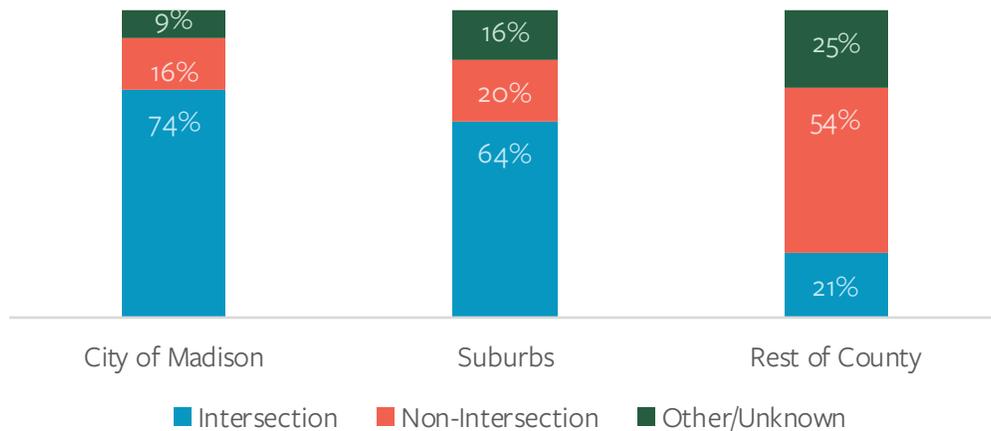
Crash Category	#	%
Intersection - Vehicle Turn Or Merge	187	34%
Intersection Dash/Walkout	80	14%
Driver Violation (Intersection or Midblock)	66	12%
Midblock Dart Out/Dash/Walkout	38	7%
Working/Playing in Roadway	27	5%
Multiple Threat/Trapped	26	5%
Walked Into Vehicle	18	3%
Special Circumstances	17	3%
Not in Road	14	3%
Backing Vehicle	13	2%
Walking Along Road	12	2%
Other and Unknown	54	10%
Total	552	100%

crashes account for more than 1/3 of all pedestrian crashes. Intersection dashes, where a pedestrian fails to yield and runs into an intersection or is obstructed from the driver’s view as they enter the intersection, and walkouts, where the pedestrian fails to yield to traffic as they walk out into the intersection, represent the next most common pedestrian crash type. Thirty of the 52 crashes identified as walkouts, 30 involved pedestrians violating a traffic signal as they walked out into the intersection. Driver violations involve straight-traveling motorists that committed some type of violation, which could include anything from failure to yield to driving while intoxicated.

It is important to note that each crash is unique and that these crash types do not necessarily imply fault on the part of any one party to the crash.

Figure 9 details the number of intersection, non-intersection, and other crashes, based on pedestrian LMCM crash types. Intersection crashes are most numerous in the City of Madison and the suburbs, but non-intersection crashes dominate in the rest of Dane County.

Figure 9: Top LMCM Crash Categories by Community

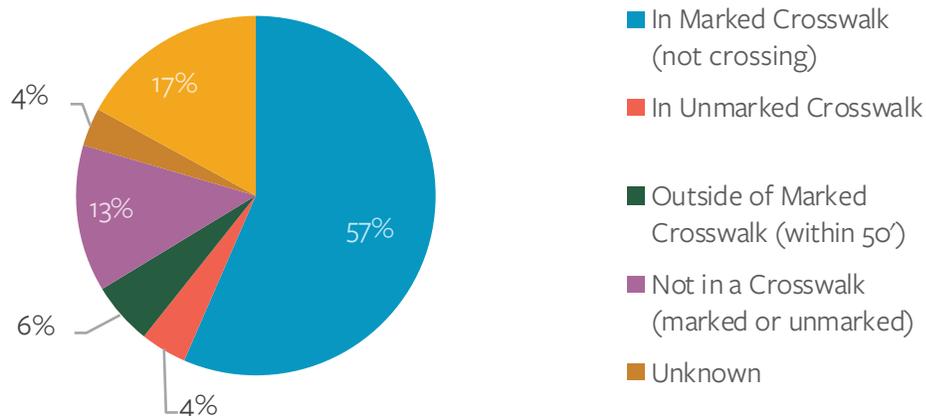


Use of Crosswalk

Overall, 57% of pedestrians involved in crashes were struck while using a marked crosswalk. An additional 4% were struck while using a legal unmarked crosswalk. 6% were struck while crossing outside of the marked crosswalk within 50 feet of an available marked crosswalk. 13% of pedestrians were struck crossing a roadway without a crosswalk; of these 73 crashes, 72 occurred at midblock locations (some of these were within 50 feet of an unmarked crosswalk) and one occurred at an intersection where no unmarked crosswalk was available¹.

Of the 17% of pedestrians that were not crossing when they were struck, just over half were walking in the street or in a bike lane or shoulder. Only 7% were on the sidewalk.

Figure 10: Pedestrian Crashes by Crosswalk Usage



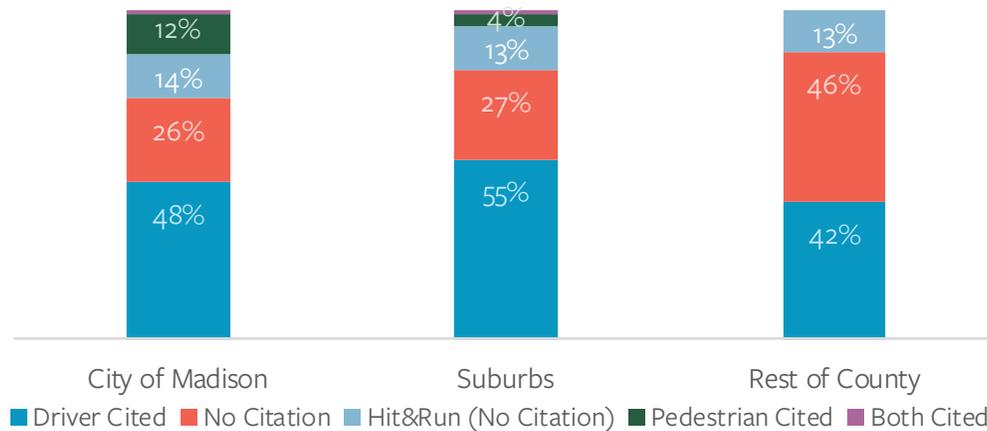
¹ Under State of Wisconsin Statutes, unmarked crosswalks exist only at locations where there is a sidewalk on at least one side of an intersection. 340.01 (10) [https://docs.legis.wisconsin.gov/document/statutes/340.01\(10\)](https://docs.legis.wisconsin.gov/document/statutes/340.01(10))

Citations

Overall, drivers in Dane County received a citation in about half of all pedestrian crashes while pedestrians were cited in nearly 10%. In about 40% of crashes, including hit-and-runs, neither party received a citation. However, the rate of citations among drivers and pedestrians varied between communities.

Pedestrians were much more likely to receive citations following crashes in the City of Madison than in other parts of Dane County. Crashes in which no citation was issued to either party were much more common outside of the metro area. While there was no citation issued in about 40% of the crashes occurring in Madison and its surrounding suburbs, this figure climbs to 60% outside of the metro area. Possible reasons for these disparities include differences in the availability of witnesses, pedestrian behavior, law enforcement practices, or other variables.

Figure 11: Citations Issued in Pedestrian Crashes by Municipality



Highlights

- The bicycle-motor vehicle crash rate per 100,000 people in the City of Madison during the 2011-15 period was roughly half of the 1987-90 rate, despite substantial population growth and an increase in bicycle commuting. (historical data not available for Dane County)
- During the years 2011-15 in Dane County, there were 798 documented motor vehicle crashes involving bicyclists and 552 crashes involving pedestrians.
- While there were fewer pedestrian crashes than bicycle crashes, pedestrian crashes were more likely to be fatal. About 4.2% of reported pedestrian crashes were fatal, compared to 0.8% of bicycle crashes.
- Hit-and-run crashes accounted for 12% of all bicycle crashes and 20% of pedestrian crashes.
- Most bicycle and pedestrian crashes involved turning motorists at intersections.
- Bicyclists riding on sidewalks against adjacent motor vehicle traffic face a crash risk roughly 3.5 times greater than those riding with traffic.
- Over 60% of pedestrians involved in crashes were in a marked or unmarked crosswalk at the time of the collision.

Next Steps

Dangerous behaviors—speeding, impairment, inattention, or simply failing to obey traffic controls—are a contributing factor in the vast majority of crashes. These behaviors must be addressed through education and enforcement. Engineering solutions should continue to be used to mitigate the risk of crashes at certain locations, particularly at high volume intersections with many roadway users and conflict points. Finally, in order to better evaluate safety needs and target these solutions, better information about crashes and travel trends is required. Maximizing safety for bicyclists and pedestrians will require a comprehensive approach that involves strategies in all of these areas.

Evaluation

The two most significant limitations to the present study were both related to data availability. Usage cannot be determined without comprehensive bicycle and pedestrian count data, and a lack of information about crashes for which no report was filed means some crashes are missing from the analysis. The Madison Area Transportation Planning Board (MATPB) will work to address both of these limitations to improve bicycle and pedestrian safety information in the coming years.

MATPB staff will work with City of Madison Traffic Engineering and other local community staff to supplement Madison's extensive permanent bicycle count program with a short-duration count program using portable counters. This will allow more comprehensive tracking of bicycling activity over time and allow an estimate of annual average bike volumes by applying factors derived from the permanent count locations to the short-duration count locations. In addition to enabling location-based risk or exposure analysis, this data could be used to evaluate the likely impacts of new infrastructure on bicycle use, which would be helpful in project prioritization. While collecting pedestrian exposure data is more challenging, MATPB will continue to investigate ways to gather this information as well.

Over the coming year, MATPB also plans to analyze National Household Travel Survey (NHTS) data and the findings of a separate local household survey using the same questions and travel logs to better understand bicyclist and pedestrian travel and demographics of those using these modes.

In order to gather information about unreported crashes, MATPB will look into integrating emergency room admission data and other information sources, such as bikemaps.org, into future updates of this study.

Engineering

MATPB's [Regional Transportation Plan \(RTP\) 2050](#) highlights high priority gaps and barriers in the bicycle and pedestrian networks. MATPB is building upon this analysis by identifying and mapping the "low-stress" bikeway network and its gaps using a new "bicycle level of traffic stress" methodology. MATPB's RTP 2050 also makes recommendations related to other policies that set the stage for future development that supports pedestrian and bicyclist safety.

MATPB will supplement future updates to this bicycle and pedestrian crash analysis with an evaluation of different types of recently installed pedestrian and bicycle safety treatments by monitoring crash data at locations where these treatments have been installed.

MATPB will continue efforts to inform local officials and staff about available resources related to designing streets and other facilities for safe pedestrian and bicycle travel. Cities and villages in Dane County should ensure that their local transportation policies (e.g., Vision Zero), plans, and engineering design guidelines adequately address appropriate countermeasures.

Education

MATPB staff will support the efforts of the Dane County Traffic Safety Commission, [Safe Communities of Madison and Dane County](#), and other groups to educate drivers, bicyclists, and pedestrians about common crash scenarios and promote traffic safety.

Enforcement

MATPB is working with the Dane County Traffic Safety Commission and Safe Communities of Madison and Dane County to communicate county-specific information to law enforcement in Dane County and to encourage targeted enforcement efforts performed in conjunction with education campaigns to improve bicyclist and pedestrian safety.

For more information contact:



p: 608-266-4336

e: mpo@cityofmadison.com

w: MadisonAreaMPO.org

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The contents of this report do not necessarily reflect the official views or policy of the U.S. Department of Transportation or WisDOT.