North Carolina
Bicycle Crash Facts
2011 - 2015

Prepared for

The North Carolina Department of Transportation
Division of Bicycle and Pedestrian Transportation

Prepared by

THE UNIVERSITY OF NORTH CAROLINA
HIGHWAY SAFETY RESEARCH CENTER

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General NC Bicycle Crash Trends

Over the past ten years, 9,594 bicycle-motor vehicle crashes were reported by North Carolina agencies. This report provides a summary of crash trends and crash-related factors (where, when, who was involved, and conditions present) for bicycle crashes across the State. The information should help road safety practitioners, partners, and the public understand prevalent crash and injury-related factors. In turn, this understanding can help suggest a focus for potential treatments.

The ten-year trend in crashes has been somewhat mixed (up and down) with fewer crashes reported in 2009 and 2014 compared with other years (Figure 1).[1] Approximately 2 percent fewer bicycle-motor vehicle crashes were reported from 2011 – 2015 overall, compared with the 2006 – 2010 period, although a strong uptick in crashes was observed in 2015 compared with 2014. The trend in both rural and urban areas has been mixed, with 2014 seeing the lowest number of rural crashes for the ten-year period, while 2009 had the lowest number reported for urban areas and 2014 the second lowest number[2]. Over the entire time period, 71 percent of bicycle crashes occurred in urban areas, with 29 percent in rural areas of the State.

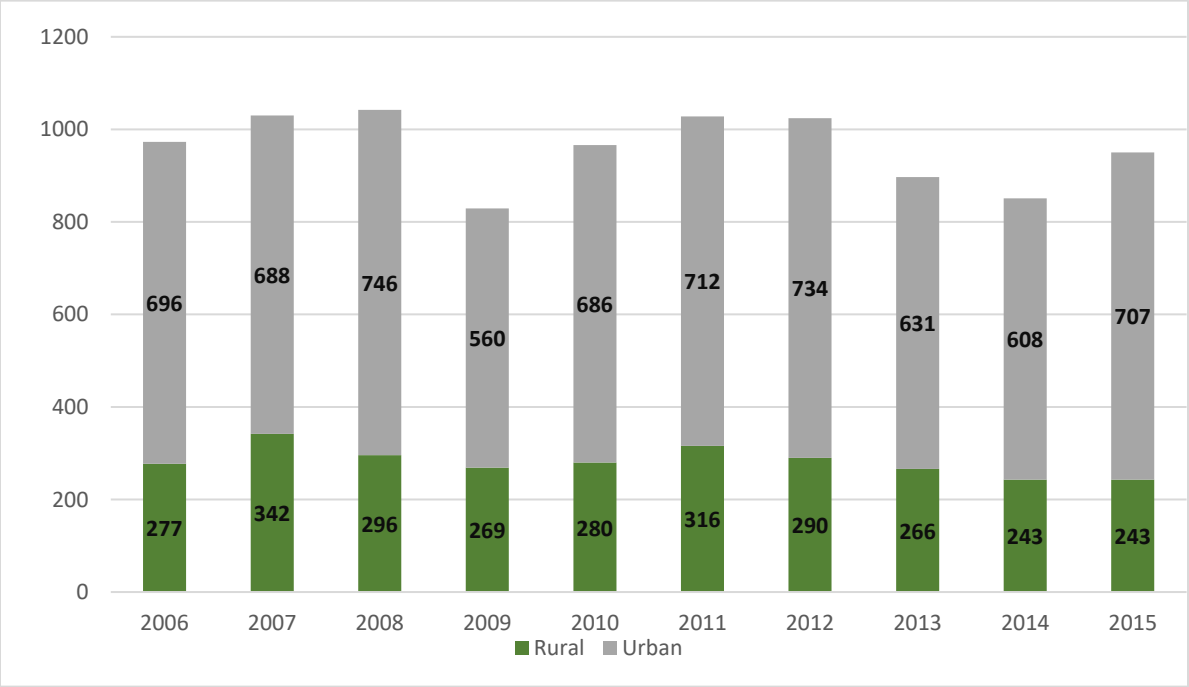

Figure 1 NC bicycle crash trends, 2006 - 2015 (counts of crashes)

[1] Statewide, annual Vehicle Miles Traveled increased by 1.1% from 101.5 billion in 2008, to 102.6 billion in 2009 and by 2.7% from 105.1 billion in 2013 to 108 billion in 2014, so a reduction in exposure to auto traffic would not seem to explain the drop in bicycle crashes in these two years. There is no information on the amount of bicycling but little reason to think that there was a significant decrease. Weather trends could have affected bicycling amounts. There were some concerns by State officials that 2009 crash reporting was not complete for some jurisdictions.

[2] There may have been some anomalies in reporting of 2009 data for at least one urban area.

A total of 4,755 collisions were reported from 2011 to 2015. Of these, 110 crashes involved bicyclist fatalities with another 207 collisions resulting in bicyclists receiving disabling type injuries (Figure 2). No crashes involved motorist fatalities, however five crashes caused disabling injuries for a motorist. An ambulance was requested for more than two-thirds of the collisions (data not shown).

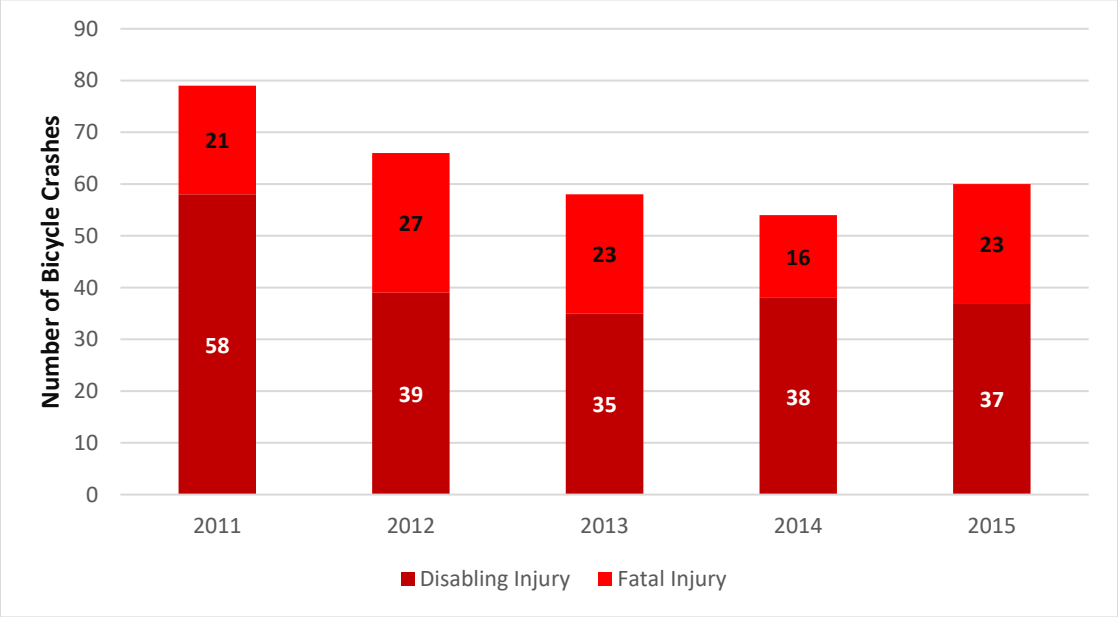

Figure 2 NC fatal and disabling injury severity bicyclist crashes

Number of bicyclists involved and total fatalities and injuries. Beginning in 2014, the project team began compiling the total number of bicyclists involved in crashes, as some collisions involve more than one bicyclist. There were, however, no crashes with multiple bicyclist fatalities or disabling injuries in 2014 or 2015. That year, 864 bicyclists were involved in 851 reported crashes with 16 bicyclists killed. In this case, the number of bicyclists killed and the number of fatal crashes is the same. In 2015, 971 bicyclists were involved in 950 reported crashes, with 23 killed; again, the number of bicyclists reported to be killed matched the number of crashes with reported fatalities.

Exposure risks. Apart from fluctuations in the number of crashes that is due to chance, the amount and numbers of people riding, volumes of traffic, locations of riding and characteristics of those locations tend to affect bicycle-motor vehicle collision frequencies. Behaviors of bicyclists and motorists also affect collision risk. We currently lack estimates on the amounts of riding by bicyclists in NC in different location types, but work is in progress to remedy this situation. Variation in year-to-year collisions may be subject to influences such as weather trends and other factors that may affect the amount of riding. Another primary risk factor is motor vehicle traffic volumes, which have generally been increasing since 2008, so other factors

may be countering that trend. In addition, changes in crash reporting practices and others can sometimes contribute to variations in reported bicycle collisions.

Crash reporting. Crashes are officially reportable to the NC Division of Motor Vehicles (source of these data) if a fatality, injury, or at least $1,000 property damage occurred. Note that the data in these reports, and behind the query tool on the North Carolina Pedestrian and Bicycle Crash Data Tool website may include a small number of non-injury (or non-observed injury) collisions with low property damage that were not officially "reportable" (minimum property damage of $1000 or injury), but, which had been reported to the State Division of Motor Vehicles by local agencies. Non-reportable collisions may not be included in other State crash statistics. Because under-reporting of bicycle crashes is common,[3] any collisions in the database that involved bicyclists were retained in these data. In addition, injuries, even serious injuries that led to visits to emergency departments or other medical facilities, are sometimes noted after the crash report is filed, but crash reports may not be updated with such information.

Finally, as with all crash data, the reported numbers in the crash characteristics that follow undoubtedly reflect some error, including errors or gaps in reporting, as well as errors made during data entry and coding, but every effort has been made to ensure the highest quality and accuracy possible.[4]

The remainder of this report summarizes the location types, person, time, environmental and roadway characteristics for the 4,755 bicycle-motor vehicle crashes reported statewide for 2011-2015. This information, and similar information developed for local communities, can aid in the targeting of resources and countermeasures to address bicycle safety problems. See the companion *North Carolina Bicycle Crash Types* summary report for descriptions of the types of crashes, or events leading up to the crashes. Crash type information can also aid in identifying and developing appropriate treatments.

Where NC Bicycle Crashes Occur

Various factors may be associated with the risk of more severe injuries, as well as with the occurrence of crashes. For example, from 2011 to 2015, a majority of bicycle crashes with motor vehicles occurred within the counties in the Piedmont region (where most people in the State live), with fewer occurring in the Coastal Plain and Mountain regions of the State. (Numerical crash trends by region are shown in Figure 3. To see the counties in each region, refer to Table 12 in the Appendix.)

[3] Injury to Pedestrians and Bicyclists: An analysis based on hospital emergency department data. Report No. FHWA-RD-99-078. US Department of Transportation, Federal Highway Administration.
[4] Note that each crash report was reviewed for the data described in these reports and available on the NCDOT-DBPT website for query. This review offered the opportunity to correct some coding errors.

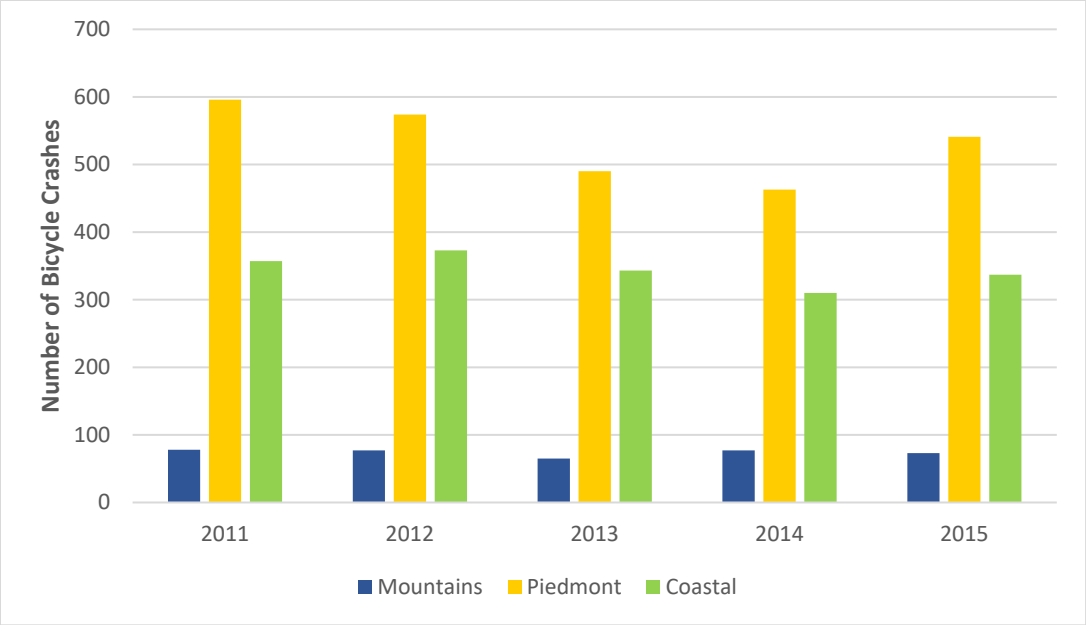

Figure 3 Five-year bicycle crash trends by region of NC

However, compared to the 56 percent of total bicycle crashes, only 41 percent of fatal bicycle crashes occurred in the Piedmont region (Figure 4). A larger share of fatal crashes (53%) compared to total crashes (36%) occurred within the Coastal Plain counties. Part of the explanation is in the extent of urban and rural crashes among the different regions. Rural areas tend to have higher speed roads, few roadways with lighting, and may not have shoulders or other space to ride separately from higher speed motorized traffic. Other factors, as already mentioned, likely also played a role in these trends.

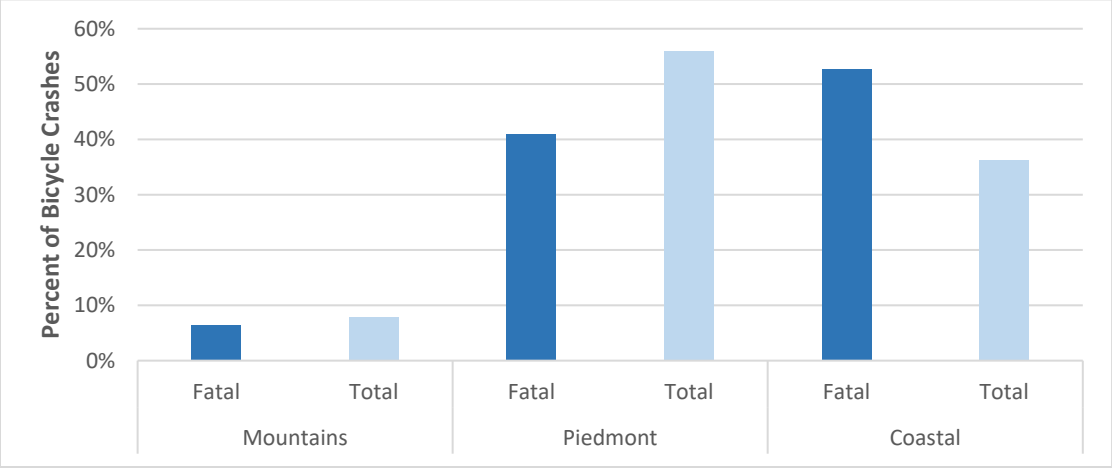

Figure 4 Fatal and total crash proportions by region of the State, 2011-2015

As previously mentioned, 71 percent of NC bicycle collisions between 2011 and 2015 occurred within municipal (urban) limits, with 29 percent in rural (unincorporated) areas of the State. Although designated as rural (outside of municipal limits), some of these locations could also be built up or partly developed.

In fact, when looking at development density, as coded by the reporting enforcement agencies, the trend is more heavily weighted toward bicycle crashes occurring in at least somewhat developed areas: 85 percent of all crashes occurred in areas that are at least 30 percent developed, and only 15 percent occurred in areas that are less than 30 percent developed (Table 1).

The areas that are between 30 percent and 70 percent developed may represent areas in transition, where infrastructure is often still more rural in nature and traffic speeds remain high, while demand for cycling, traffic volumes and roadway complexity may be increasing.

Table 1 NC bicycle-motor vehicle crashes by area development extent [5]

Development extent	2011	2012	2013	2014	2015	Total
Rural (<30% Developed)	167	148	148	116	126	705
	16.2[1]	14.5	16.5	13.6	13.2	14.8 [2]
Mixed (30% To 70% Developed)	143	130	114	129	148	664
	13.9	12.7	12.7	15.2	15.6	14.0
Urban (>70% Developed)	721	746	636	605	677	3,385
	69.9	72.9	70.8	71.2	71.2	71.2
Total	1,031	1,024	898	850	951	4,754 [4]
	21.7 [3]	21.5	18.9	17.9	20.0	

Somewhat reflecting the information on development extent, 43 percent of crashes occurred in areas indicated as commercial districts, a similar 42 percent occurred in areas that were residential in character, 12 percent in areas designated as farms, woods, or pasture, and small percentages occurred in institutional (3%) and industrial areas (< 1%) (Table 2).

[5] In this and each of the following tables, the formatting is as follows:
The top row for each variable level is the count of crashes with that characteristic. The numbers (with decimals) in the bottom rows for each category are percentages.
[1] = Row percent of column total
[2] = Row total percent of total
[3] = Column total percent of total
[4] = Total includes total minus any cases with missing or unknown data

Table 2 NC bicycle-motor vehicle crashes by crash area by development type

Development type	2011	2012	2013	2014	2015	Total
Commercial	430	435	387	379	395	2,026
	41.7	42.5	43.0	44.5	41.5	42.6
Farms, Woods, Pastures	138	108	116	102	100	564
	13.4	10.5	12.9	12.1	10.5	11.9
Industrial	4	3	6	3	5	21
	0.4	0.3	0.7	0.4	0.5	0.4
Institutional	25	39	26	30	26	146
	2.4	3.8	2.9	3.5	2.7	3.1
Residential	434	439	363	336	425	1,997
	42.1	42.9	40.5	39.5	44.7	42.0
Total	1,031	1,024	898	850	951	4,754
	21.7	21.5	18.9	17.9	20.0	

County and City Trends

Using 2013 (middle year) population estimates as a rate denominator, the average yearly bicycle crash rate averages for 2011 - 2015 were as follows:

- about 1 per 10,000 residents for the State as a whole,
- 1.2 per 10,000 across all urban areas, and
- 0.6 per 10,000 residents in unincorporated (rural) areas of the State.[6]

Table 3 shows the 12 counties with the highest numbers of bicycle-motor vehicle crashes. (Twelve counties were included in the list this period due to a virtual three-way tie for the tenth position.) The 12 highest crash counties accounted for 61 percent of NC's reported bicycle-motor vehicle crashes.

Most of these counties are highly urbanized. Thus, the high crash counties are, largely, reflections of where people live in the State. However, the average yearly bicycle crash rate per 10,000 residents vary from 0.7 to a high of 3.1 among these top ten. The county-level rates may reflect differences in amounts of cycling in the counties in addition to other exposure and risk factors. For example, New Hanover County is the home of a number of beach communities where a population-based rate does not reflect riding by visitors. Seven of the counties experienced increases or little change in bicycle crash rates compared to the 2008-2012 five-year period; the rest observed decreases.

[6] Population estimates from North Carolina Office of State Budget and Management website, from: https://files.nc.gov/ncosbm/demog/revmuniestbycounty_2013.html

Table 3 Twelve counties with the highest numbers of bicycle-motor vehicle crashes, 2011-2015[7]

County	5-yr. Crash Count	% of NC total (4,755)	Avg. 1-yr. Count	July 2013 Estimate [8]	Avg. yearly crash rate / 10,000 residents	Prior Avg yrly rate (2008-2012)
Wake	673	14.2	134.6	964,022	1.4	1.4
Mecklenburg	497	10.5	99.4	991,508	1.0	1.3
New Hanover	330	6.9	66.0	213,707	3.1	3.2
Guilford	329	6.9	65.8	507,144	1.3	1.4
Durham	230	4.8	46.0	286,239	1.6	1.6
Cumberland	156	3.3	31.2	331,633	0.9	1.1
Pitt	142	3.0	28.4	173,783	1.6	1.1
Buncombe	137	2.9	27.4	248,467	1.1	1.1
Forsyth	118	2.5	23.6	360,086	0.7	0.6
Orange	105	2.2	21.0	139,103	1.5	1.9
Onslow	95	2.0	19.0	193,165	1.0	0.9
Gaston	93	2.0	18.6	209,442	0.9	0.9
Total top 12 Counties	2,905	61.1%	581	4,618,299	1.3	1.3

Reflecting the high crash counties, most of the cities with the highest crash frequencies are the most populous cities in their respective counties (Table 4). These 12 cities accounted for 46.9 percent of the State's reported bicycle crashes. The crash rates based on population averaged 1.6 per 10,000 residents, which is higher than the average of 1.2 per 10,000 for municipalities across the entire State. The numbers may reflect differences in amounts of bicycling as well as other risk factors. Lower rates of auto ownership, factors such as presence of colleges and universities, or a strong cycling culture in some cities may foster more widespread use of bicycles in some communities than in others. However, there are no data available to directly compare crash rates based on miles of bicycling, numbers of cycling trips, or other better measures of exposure.

[7] Population-based rates are shown in the 6th column. Crashes for all counties may be obtained through the crash data query tool.

[8] Population estimates from North Carolina Office of State Budget and Management website, from: https://files.nc.gov/ncosbm/demog/countygrowth_2013.html

Table 4 Twelve cities with the highest numbers of bicycle-motor vehicle collisions, 2011-2015

Municipality	5-yr Crash Count	Percent of NC total (4,755)	Average 1-year count	July 2013 population estimate[9]	Avg. yearly crash rate / 10,000 residents	Prior Avg. yearly rate (2008-2012)
Raleigh	459	10.0	91.8	424,817	2.2	2.1
Charlotte	441	9.3	88.2	789,240	1.1	1.4
Wilmington	273	5.7	54.6	111,017	4.9	4.5
Greensboro	218	4.6	43.6	278,249	1.6	1.8
Durham	214	4.5	42.8	239,725	1.8	1.7
Fayetteville	122	2.6	24.4	209,748	1.2	1.3
Greenville	103	2.2	20.6	86,516	2.4	1.1
Asheville	99	2.1	19.8	87,852	2.3	2.3
Cary	83	1.7	16.6	144,110	1.2	1.4
Winston-Salem	83	1.7	16.6	235,223	0.7	0.7
High Point	72	1.5	14.4	107,630	1.3	1.2
Rocky Mount	62	1.3	12.4	56,162	2.2	3.3
Total top 12 Cities	2,229	46.9%	445.8	2,770,289	1.6	1.7

The crash characteristics described in the remainder of this summary are also undoubtedly related to exposure, or when and where people ride, who is riding (age, attitudes, skill and physical condition) as well as how often and how far, and how much traffic is encountered. In addition, as already mentioned, crash numbers can also change over time due to chance, to changes in crash reporting procedures, and because of safety countermeasures including engineering, educational, and enforcement initiatives.

Bicyclist Characteristics

Bicyclist Age

With year-to-year variability in the number and proportions of crashes by different ages, clear trends are difficult to decipher (Table 5). (Note that age group intervals vary to show more detail for the younger age groups.) Over the entire five-year time period, the largest proportion of crashes involved the 50 to 59 year group (16%), followed by the 40 to 49 year group (14%), and the 20 to 24 year age group (13%). Crashes among children have fluctuated. (Analyses by population could normalize trends according to age groups, but do not provide information about the amounts of riding among the different ages.)

[9] Population estimates from North Carolina Office of State Budget and Management website, from: https://files.nc.gov/ncosbm/demog/revmuniestbycounty_2013.html

Table 5 Age group of bicyclists involved in NC crashes

Bicyclist age	2011	2012	2013	2014	2015	Total
0-5	15	8	13	13	7	56
	1.5	0.8	1.5	1.5	0.7	1.2
6-10	62	64	57	52	59	294
	6.1	6.4	6.4	6.2	6.3	6.3
11-15	125	114	93	86	105	523
	12.4	11.4	10.5	10.2	11.2	11.2
16-19	114	95	98	92	101	500
	11.3	9.5	11.0	10.9	10.7/	10.7
20-24	121	157	121	109	108	616
	12.0	15.7	13.6	12.9	11.5	13.2
25-29	72	87	70	78	105	412
	7.1	8.7	7.9	9.2	11.2	8.8
30-39	105	106	106	117	100	534
	10.4	10.6	11.9	13.9	10.6	11.4
40-49	163	148	121	100	108	640
	16.2	14.8	13.6	11.8	11.5	13.7
50-59	154	145	144	129	159	731
	15.3	14.5	16.2	15.3	16.9	15.6
60-69	55	62	53	55	63	288
	5.5	6.2	6.0	6.5	6.7	6.2
70+	23	12	13	13	25	86
	2.3	1.2	1.5	1.5	2.7	1.8
Total	1,009	998	889	844	940	4,680
	21.6	21.3	19.0	18.0	20.1	

Combining age categories into larger ranges gives a picture of the overall crash involvement by children, young adults, middle-aged adults, and older adults (Figure 5). Children up to age 16, on average, accounted for 18.7 percent of bicycle-motor vehicle crash-involvement over this time period (when age was known). Teens and young adults between the ages of 16 to 29 accounted for 33 percent; adults from 30 to 59 years accounted for 41 percent, and older adults 61 and up for 8 percent.

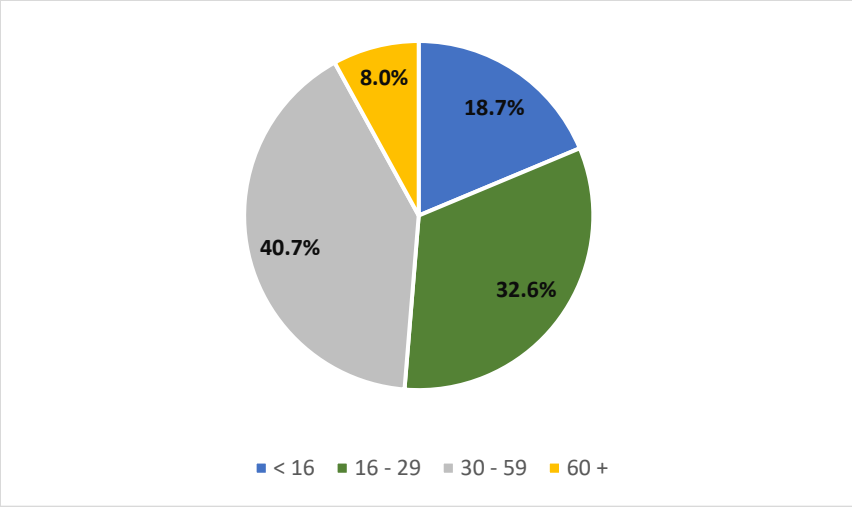

Figure 5 Percentage of NC bicycle crashes by bicyclist age range, 2011-2015

Bicyclist Injury

Table 6 shows the data for all five years for crashes where the injury severity was reported. As shown, slightly more than 2 percent of crashes resulted in fatal injuries. This proportion compares with about 0.5 percent of all reportable crashes resulting in fatalities for the same time period. An additional 5 percent of cyclists suffered serious (A-type) injuries over the five years. The percentage of A-type injuries decreased somewhat compared with the period 2008-2012.

Table 6 Five-year bicycle crash injury levels [10]

Bicyclist Injury	2011	2012	2013	2014	2015	Total
K: Killed	21	27	23	16	23	110
	2.1	2.7	2.6	1.9	2.5	2.4
A: Disabling Injury	58	39	35	38	37	207
	5.9	3.9	4.0	4.6	4.0	4.5
B: Evident Injury	407	414	344	356	406	1,927
	41.1	41.9	39.2	42.8	43.7	41.7
C: Possible Injury	407	424	372	343	365	1,911
	41.1	42.9	42.4	41.2	39.2	41.4
O: No Injury	97	84	104	79	100	464
	9.8	8.5	11.8	9.5	10.7	10.0
Total	990	988	878	832	931	4,619
	21.4	21.4	19.0	18.0	20.2	

[10] Counts are of crashes with the most severe injury reported. Crashes with unknown injury severity are omitted.

Figure 6 shows the number of bicyclists by age group who received fatal or disabling type injuries, those with less severe injuries, and those reported to receive no injuries or the injury was unknown. (Note that around 10 percent were reported to receive no injuries.)

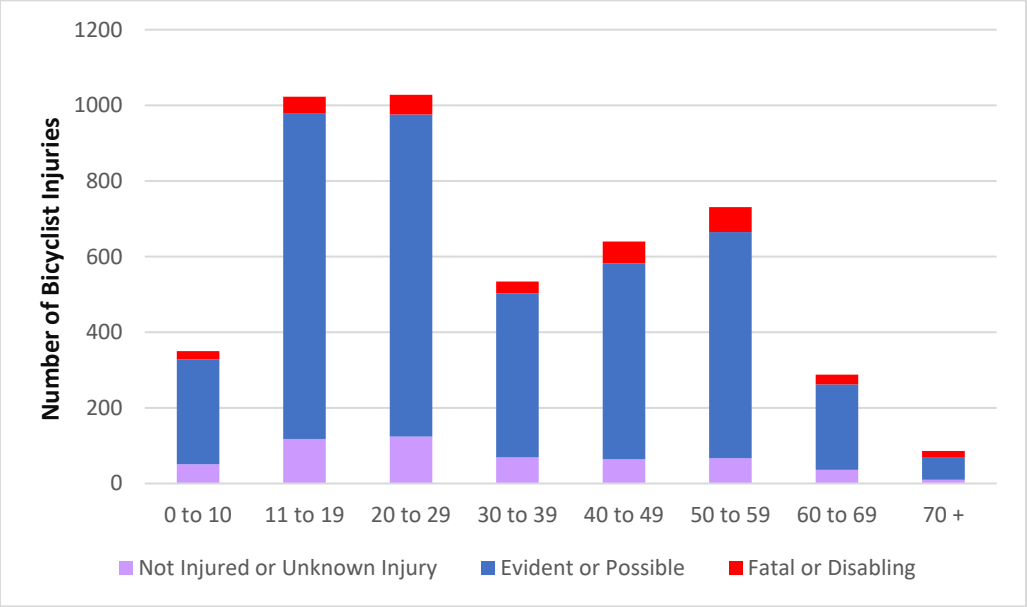

Figure 6 Injury severity by age group of bicyclist, 2011-2015

Although the total numbers are smaller due to overall smaller involvement in crashes, older adults (especially ages 70 and older) have the highest rate of fatal or disabling injury for those in crashes (19% for bicyclists over 70). The fatal or severe injury rate for adults ages 41 to 60 was about 9 percent, while that for younger ages was in the range of 4 – 6 percent killed or disabling injuries.

Bicyclist Gender

There is relatively little change year-to-year, with male bicyclists accounting for an average of 85 percent of the crash-involved bicyclists in NC (Table 7) where gender was known.

Table 7 Gender of bicyclists involved in crashes

Gender	2011	2012	2013	2014	2015	Total
Female	155	163	137	108	159	722
	15.4	16.3	15.4	12.8	16.9	15.4
Male	851	835	755	736	784	3,961
	84.6	83.7	84.6	87.2	83.1	84.6
Total	1,006	998	892	844	943	4,683
	21.5	21.3	19.0	18.0	20.1	

Bicyclist Alcohol Use

According to the information available on police crash reports, alcohol use by bicyclists was detected or suspected for 6 percent of all bicyclists involved in crashes. The numbers and proportion using alcohol appears to have declined since 2011, but it is also possible that there have been changes in reporting (Table 8). Suspected alcohol use does not confirm that alcohol was a factor in the crash. Beginning in 2014, drug use as well as alcohol use was reported (data not shown). However, only six crashes occurred where drug and/or alcohol use was detected or suspected. There are difficulties in detecting drug use and tests may not be available to measure all potentially impairing drugs or assess their possible influence on crashes.

Table 8 Bicyclist use of alcohol

Bicyclist Alcohol Use suspected/detected	2011	2012	2013	2014	2015	Total
No	951	938	839	803	896	4,427
	93.6	93.9	94.6	94.7	95.0	94.3
Yes	65	61	48	45	47	266
	6.4	6.1	5.4	5.3	5.0	5.7
Total	1,016	999	887	848	943	4,693
	21.7	21.3	18.9	18.1	20.1	

Driver Characteristics

On average, 14 percent of the collisions were reported to involve hit and run drivers (data not shown), in itself of interest to enforcement and safety officials. Driver characteristics data are usually lacking for hit and run drivers unless they were subsequently identified; occasionally data are missing for other drivers as well. The numbers and percentages in the driver tables below reflect the first driver involved in the crash, and exclude cases with missing data for the drivers.

Driver Age

On average, drivers younger than age 25 accounted for 18.9 percent of all collisions with bicyclists (Table 9). (Note that again age intervals vary). Drivers ages 25 to 29 accounted for another 10.9 percent. Among 10-year+ age groups, the largest proportion of crashes involved the 40 to 49 year age group of drivers (17.9%), closely followed by the 30 to 39 year old group (17.5%), with proportions decreasing for groups aged 50 and older. Again, these percentages reflect population numbers by age group as well as other types of exposure (amounts of driving and other risk factors).

Table 9 Ages of drivers involved in crashes with bicyclists

Driver Age	2011	2012	2013	2014	2015	Total
< 19	60	78	39	45	47	269
	6.8	8.8	5.0	6.2	5.7	6.5
20-24	111	122	103	77	95	508
	12.5	13.8	13.2	10.5	11.5	12.4
25-29	98	97	82	80	93	450
	11.1	10.9	10.5	10.9	11.3	10.9
30-39	140	152	138	133	155	718
	15.8	17.1	17.6	18.2	18.8	17.5
40-49	172	149	155	132	128	736
	19.4	16.8	19.8	18.1	15.5	17.9
50-59	140	114	104	108	118	584
	15.8	12.9	13.3	14.8	14.3	14.2
60-69	94	97	105	79	112	487
	10.6	10.9	13.4	10.8	13.6	11.8
70+	70	78	57	77	78	360
	7.9	8.8	7.3	10.5	9.4	8.8
Total	885	887	783	731	826	4,112
	21.5	21.6	19.0	17.8	20.1	

Driver Gender

Male drivers accounted for an average of 54percent of the bicycle-motor vehicle crashes and female drivers an average of 46 percent over this period (Table 10). Although there are slight year-to-year fluctuations, no obvious trend is apparent.

Table 10 Gender of drivers involved in collisions with bicyclists

Driver Sex	2011	2012	2013	2014	2015	Total
Female	401	403	365	340	383	1,892
	45.3	45.3	46.6	46.3	46.4	45.9
Male	484	486	419	395	442	2,226
	54.7	54.7	53.4	53.7	53.6	54.1
Total	885	889	784	735	825	4,118
	21.5	21.6	19.0	17.8	20.0	

Driver Injury Severity

As would be expected, drivers are rarely seriously injured in crashes with bicyclists. 98 percent were reported to receive no injuries from 2011-2015, with 2percent reported to receive possible or evident injuries (data not shown). There were no driver fatalities and five drivers received disabling injuries as a result of crashes involving bicyclists. (Note that other motor vehicles could also have been involved in some collisions.)

Driver Alcohol Use

Alcohol use by drivers in crashes with bicyclists was detected or suspected in 1.8 percent of crashes (Table 11). This indication does not confirm impairment or that alcohol was a factor in the crash. Beginning in 2014, drug use as well as alcohol use was reported (data not shown). Four crashes were reported where the driver was suspected to be impaired by drugs.

Table 11 Suspected alcohol use among drivers involved in collisions with bicyclists

Driver Alcohol	2011	2012	2013	2014	2015	Total
No	902	899	785	736	835	4,157
	98.2	98.6	97.5	98.0	98.6	98.2
Yes	17	13	20	15	12	77
	1.8	1.4	2.5	2.0	1.4	1.8
Total	919	912	805	751	847	4,234
	21.7	21.5	19.0	17.7	20.0	

Temporal and Environmental Factors

Month of Year

There is substantial difference in the proportions of bicycle-motor vehicle crashes related to month of year. In contrast to pedestrian collisions, more bicycle collisions occur during the warmer months (Figure 7), especially April through October (72% of all crashes). January and February typically observe the fewest bicycle-motor vehicle collisions.

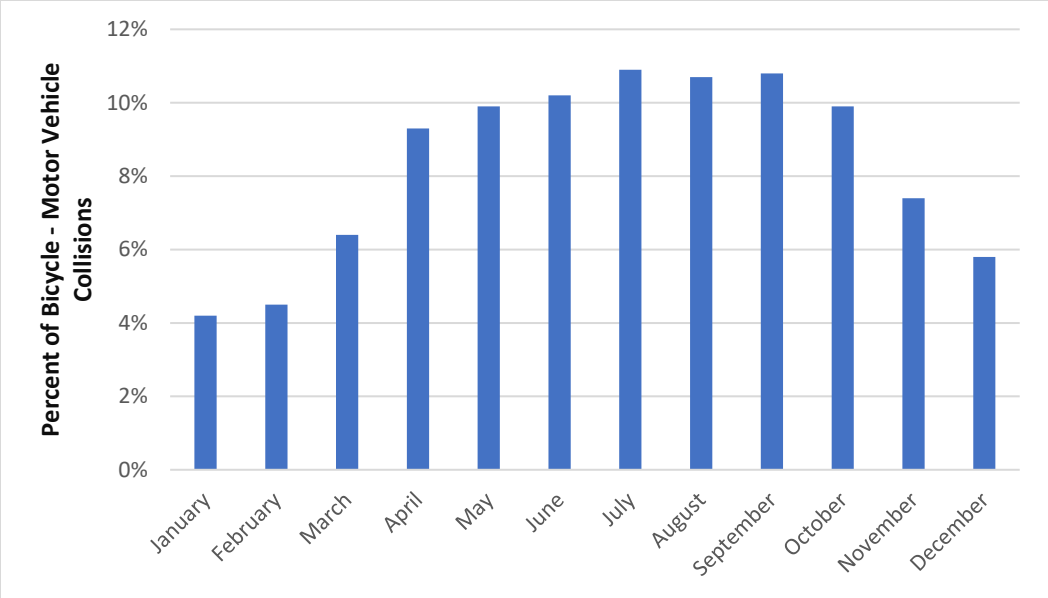

Figure 7 NC bicycle collisions by crash month, 2011-2015

Day of Week and Time of Day

Thursday is the highest crash day over this period with 16 percent. About one-third (34%) of collisions occurred between the hours from 2 pm to 6 pm across all the days, followed by 25 percent between 6 pm and 10 pm (Figure 8). Note that these patterns may vary across the State and for urban and rural areas.

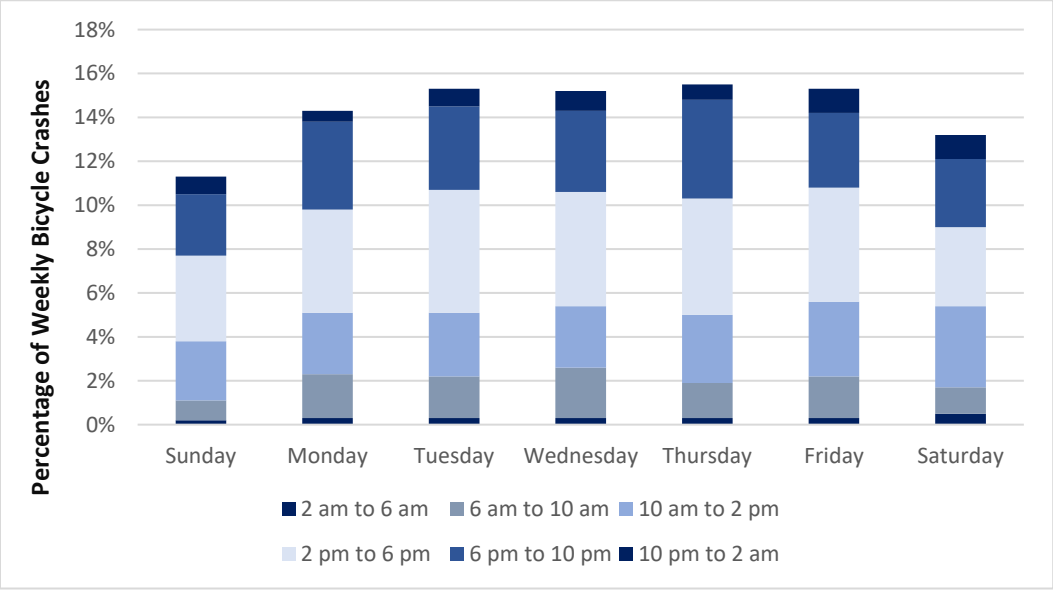

Figure 8 NC bicycle crashes by day of week and time of day, 2011-2015

Light Conditions

About three-fourths (74%) of crashes happened during daylight hours when most bicycle riding takes place (Figure 9). Twelve percent occurred in darkness on lighted roadways (most likely in urban areas), with another 9 percent at night on unlighted road sections. Dawn and dusk conditions combined account for 5 percent of crashes, with all other or unknown lighting conditions accounting for less than 1 percent. There is some variability across years in these percentages, but no distinct trends. The proportions of crashes occurring under lower light conditions may be over-represented based on the amount of riding that occurs under such conditions, but again, there are no data to support this conjecture.

NC State law requires bicyclists operating at night to have an active, white front light visible from at least 300 feet and a rear, red reflector that is visible from a distance of 200 feet. In addition, active rear, red lights are also available to supplement passive reflectors. Reflective clothing, leg and arm bands, helmets or other reflective gear may further help to increase the conspicuity of cyclists riding at night. Locations where bicyclists frequently ride at night, such as trail crossings or commuting routes, may also be considered for enhanced street lighting.

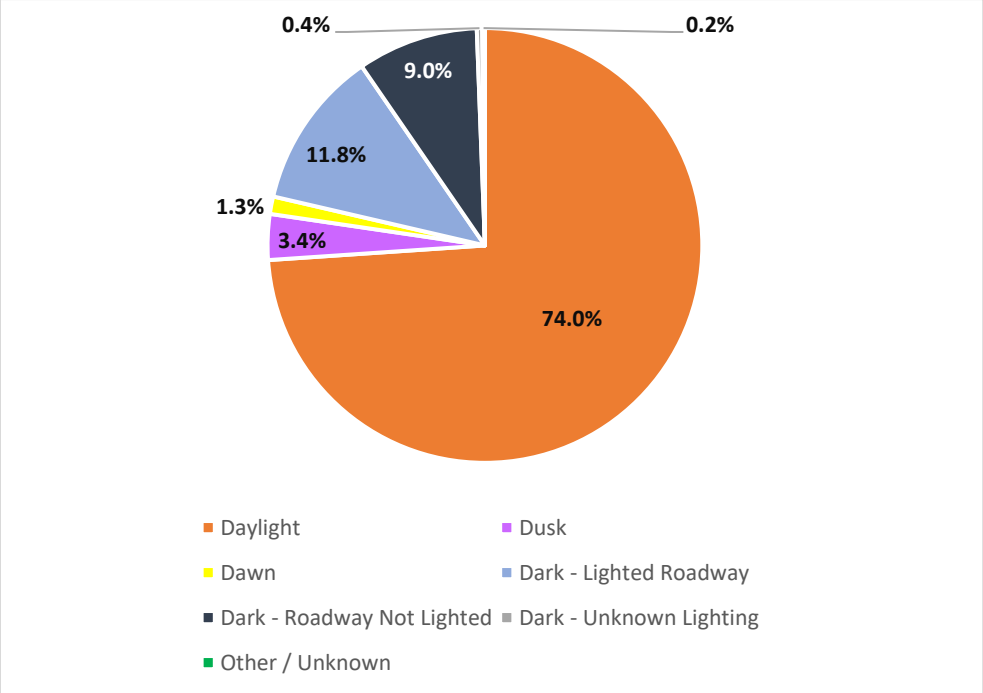

Figure 9 Bicycle collisions (percentage) by light condition, 2011 - 2015

Weather

Most – 95 percent over the five years – of crashes occurred under clear (82%) or cloudy (13%) weather conditions (Figure 10). Approximately 5 percent of bicycle-motor vehicle crashes took place under rainy conditions, with all other (icy, snowy, foggy, and other) conditions accounting

for less than 1 percent of the total. Nevertheless, wet or slippery conditions affect bicyclists' ability to ride safely and efforts should be made to provide surfaces (which include pavement markings, utility covers, etc.) suitable for riding in wet weather. Nine percent of crashes occurred when surfaces were wet or had standing water, which includes after a rainfall (surface conditions data not shown).

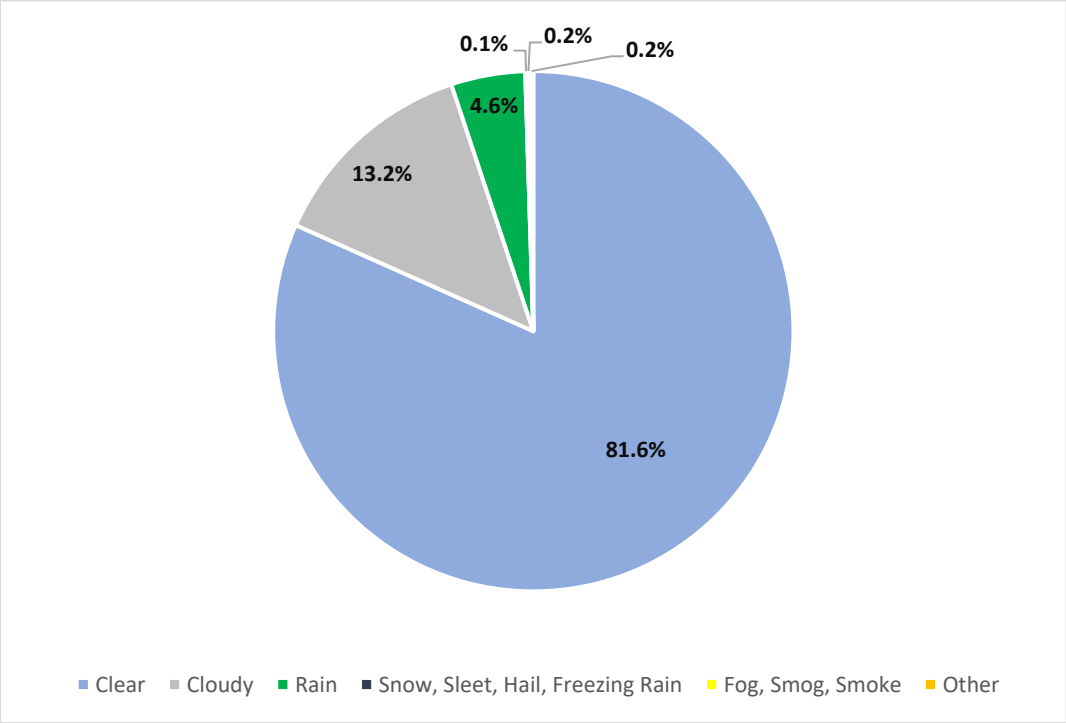

Figure 10 Bicycle crashes (percentage) by weather conditions, 2011-2015

Roadway Characteristics

Roadway Type

On average, more than three-fourths of bicycle collisions that occurred on a roadway or road right-of-way occurred on two-way, undivided roads. Nearly 16 percent occurred on two-way roads divided by an unprotected median, with much smaller percentages on two-way roads divided with a positive median barrier (often freeways), or on one-way roads (Figure 11). Note that these designations are based on crash reporting; more accurate estimations of roadway characteristics may be obtained by joining spatial data with accurate roadway inventory data.

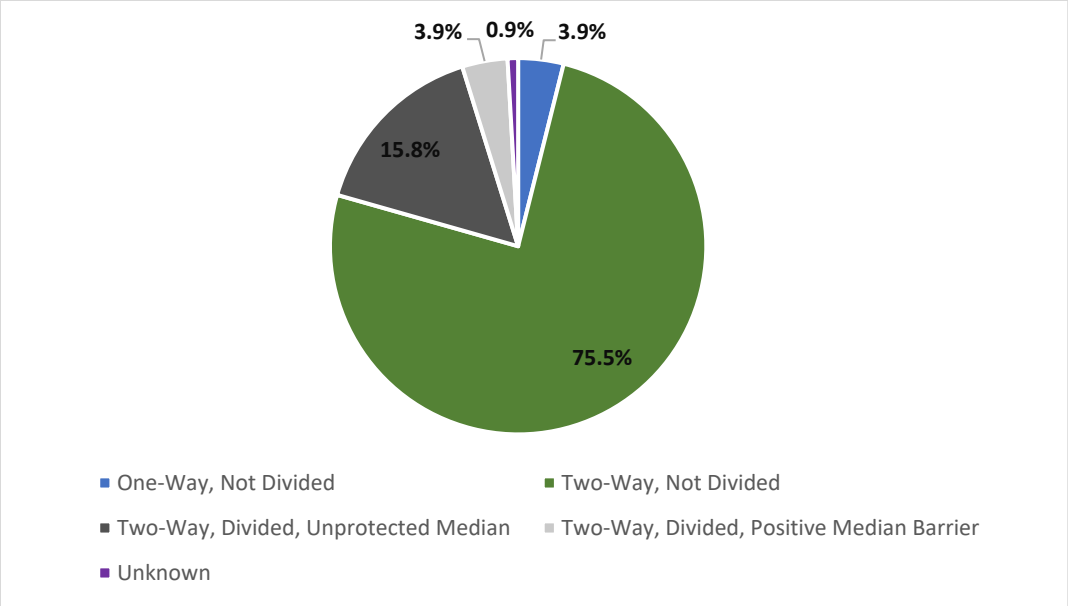

Figure 11 Percentage of on-road NC bicycle crashes by road configuration, 2011-2015

Speed Limit

A majority (62%) of NC's bicycle-motor vehicle crashes that occurred on roadways with posted speed limits, occurred on roads with speed limits of 35 mph or less. However, crashes on higher speed roads may be especially severe. Less than 4 percent of bicyclists struck (3.5%) on NC roads with speed limits of 35 mph and lower received fatal or disabling type injuries, but the proportions killed rose to 21 percent of those struck on 55 mph roads (Figure 12). In all, 77 percent of bicyclists who were killed in their crashes, were struck on roadways of 40 mph limits and higher. Many of North Carolina's higher speed roadways lack separated space or facilities for bicyclists to ride. (Note that there is a lack of reliable information on actual travel speeds of the striking vehicles, but the speed limit of the roadway provides some information about the general travel speed environment.)

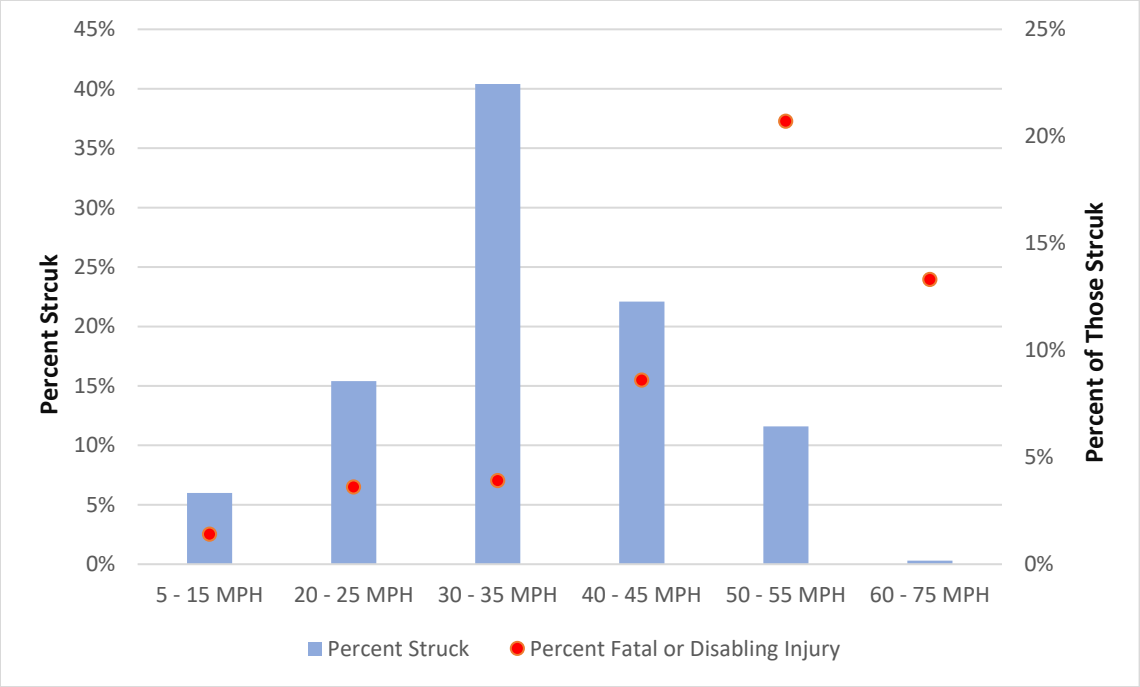

Figure 12 Roadway speed limits and NC bicycle crashes and severity, 2011-2015

The red markers indicate the percentage of crashes on the different speed limit roads with fatal or disabling injuries.

Intersections and Traffic Control

According to data entered during crash typing, about half (51%) of all crashes occurred at or related to an intersection (including signalized commercial driveways). For crashes at intersection locations, the type of traffic control most often present was a stop sign (37%), followed by a traffic signal (34%) (Figure 13). More than one-fifth (22%) of crashes at intersections were indicated to have no traffic control present. These locations could include main road junctions that have no control, with intersecting side streets that do, most often, have stop control.

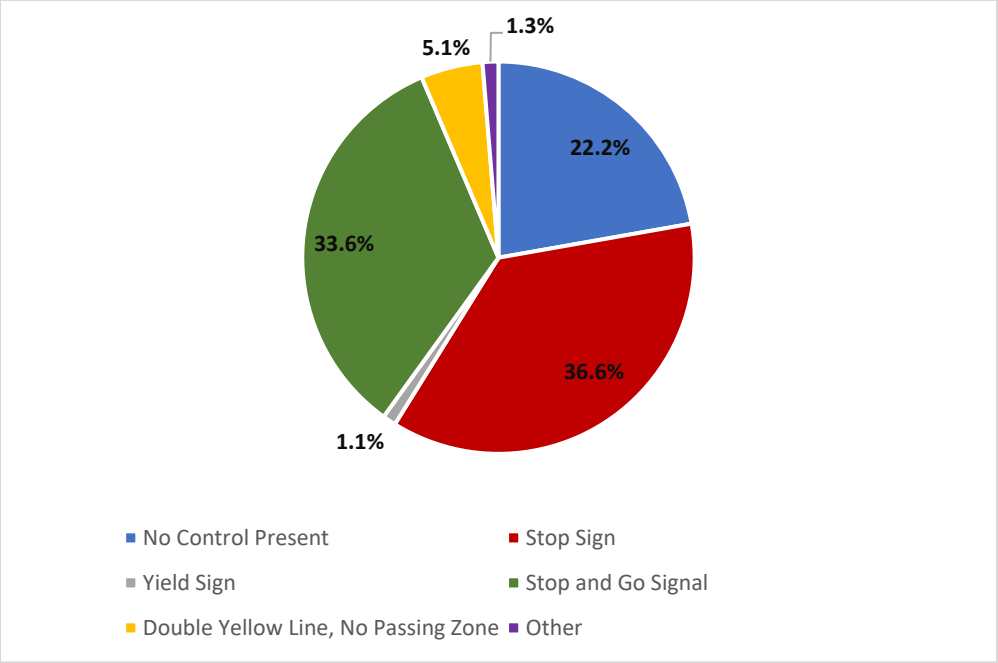

Figure 13 Type of traffic control present and percent of intersection and intersection-related crashes only (n = 2,412) 2011-2015

The crash factors discussed in this summary provide information useful for assessing problems and providing safe and accessible bicycle facilities for local and State roads. Resources such as *Bicycle Road Safety Audit Guidelines and Prompt Lists*, BIKESAFE: Bicycle Safety Guide and Countermeasure Selection System, and others can provide additional assistance with diagnosing and identifying appropriate treatments for bicycle safety issues.

For additional information on the crash types and other characteristics of bicycle-motor vehicle crashes occurring in the State over the same time period, and additional information on potential treatments, please see the *North Carolina Bicycle Crash Types* summary report.

Appendix – NC Counties by Geographic Region

Table 12 NC counties by region of the state

Coastal	Piedmont	Mountains
Beaufort	Alamance	Alleghany
Bertie	Alexander	Ashe
Bladen	Anson	Avery
Brunswick	Cabarrus	Buncombe
Camden	Caswell	Burke
Carteret	Catawba	Caldwell
Chowan	Chatham	Cherokee
Columbus	Davidson	Clay
Craven	Davie	Cleveland
Cumberland	Durham	Graham
Currituck	Forsyth	Haywood
Dare	Franklin	Henderson
Duplin	Gaston	Jackson
Edgecombe	Granville	Macon
Gates	Guilford	Madison
Greene	Iredell	McDowell
Halifax	Lee	Mitchell
Harnett	Lincoln	Polk
Hertford	Mecklenburg	Rutherford
Hoke	Montgomery	Surry
Hyde	Moore	Swain
Johnston	Orange	Transylvania
Jones	Person	Watauga
Lenoir	Randolph	Wilkes
Martin	Richmond	Yadkin
Nash	Rockingham	Yancey
New Hanover	Rowan	
Northampton	Scotland	
Onslow	Stanly	
Pasquotank	Stokes	
Pender	Union	
Perquimans	Vance	
Pitt	Wake	
Robeson	Warren	
Sampson		
Tyrrell		
Washington		
Wayne		
Wilson		