



North Carolina Motor Vehicle Crash Injury Surveillance: Bicyclists

Summary Data Based on a Pilot Study Linking 2017 Crash and Hospital Encounter Datasets

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Background

The North Carolina (NC) Governor's Highway Safety Program funded the Carolina Center for Health Informatics to link health outcome data with police crash report data to improve motor vehicle crash injury surveillance. This demonstration project focusing on pedestrians and bicyclists links 2017 NC police crash reports from the UNC Highway Safety Research Center with 2017 NC hospital encounter data from the North Carolina Healthcare Association.

For more information regarding this project, including a detailed overview of the data linkage methodology and study limitations, please see the "[North Carolina Linkage Study for Motor Vehicle Crashes Involving Pedestrians and Bicyclists Report](#)." More reports are available at the following link.

<http://cchi.web.unc.edu/transportation-health-data/>

Note about Statistics: This report displays summary counts and percentages. All percentages have been rounded to the nearest integer value; therefore, percentage totals may not sum to 100%.

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Key definitions

Crash report data are recorded by law enforcement officers for motor vehicle crashes involving a motor vehicle in transport resulting in an un-stabilized situation, which includes at least one harmful event. North Carolina crash records must meet at least one of the following criteria: The crash resulted in a fatality, a non-fatal personal injury, total property damage amounting to \$1,000.00 or more, property damage of any amount to a vehicle seized, or the vehicle has been seized and is subject to forfeiture under G. S. 20-28.3. In addition, a reportable motor vehicle traffic crash must occur on a trafficway (any land way open to the public as a matter of right or custom for moving persons or property from one place to another) or occur after the motor vehicle runs off the roadway but before events are stabilized.

Hospital encounter data at the North Carolina Healthcare Association are aggregated data of all hospital encounters (emergency department and inpatient) to 24/7 civilian acute care hospitals in North Carolina. A hospital encounter can refer to an emergency department visit and/or an inpatient encounter.

Bicyclist crashes represent any collision involving a motor vehicle in transport and a pedalcyclist, including devices known as bicycles, pedal cycles, unicycles and sidecars or trailers attached to these devices (which are moved by human power). This includes any of the following devices in transport: Bicycle, tricycle, unicycle, trailers or sidecars attached to any of the above devices. While the collisions described in the following report can refer to any type of pedal crash, the overwhelming majority are related to bicycle crashes and will be referred to as such.

Bicyclist Injury Incidence and Data Linkage Statistics



Total counts and data linkage for bicyclist records

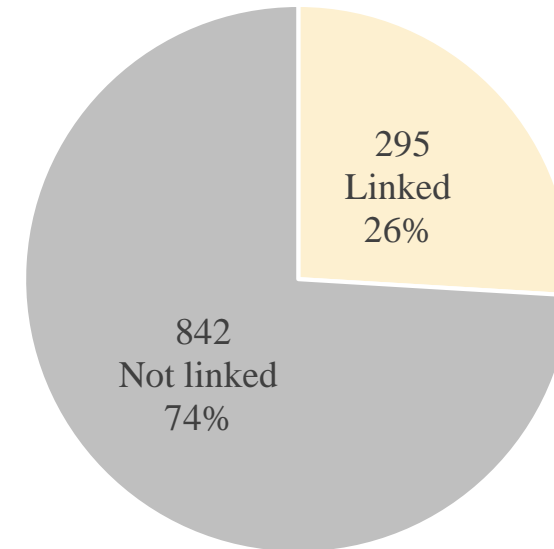
In 2017, a bicyclist was struck by a motor vehicle in North Carolina approximately every *8 hours*.

Linking **crash data** with **hospital encounter data** can increase our understanding of the injuries associated with bicyclist-involved traffic collisions.

Small metro areas* were the least likely to be linked (19%).

*Rurality designation determined by county of crash event.

Percentage of Bicyclists from Crash Data Linked with Hospital Encounter Data (n=1,137)**



**Fatalities at the scene of the crash and persons who were uninjured or did not seek treatment at a hospital would not be present in hospital encounter data. The linkage rate may underrepresent the percentage of linkable records but is not expected to approach 100%. The number of hospital encounter records indicative of bicyclist injuries which did not link with crash records is unknown.

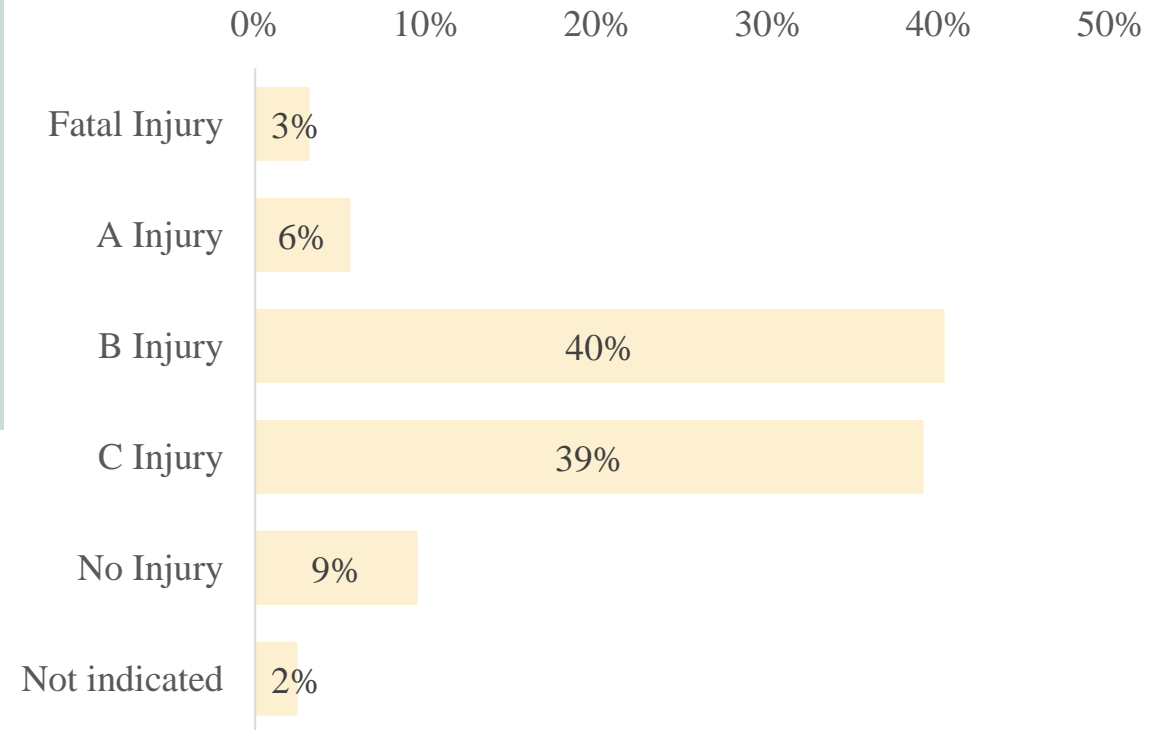
Injury Classification: KABCO

Police officers rate the level of injury for the persons involved using a five scale rating system, abbreviated 'KABCO':

- K: Killed
- A: Suspected serious injury
- B: Suspected minor injury
- C: Possible injury
- O: No injury

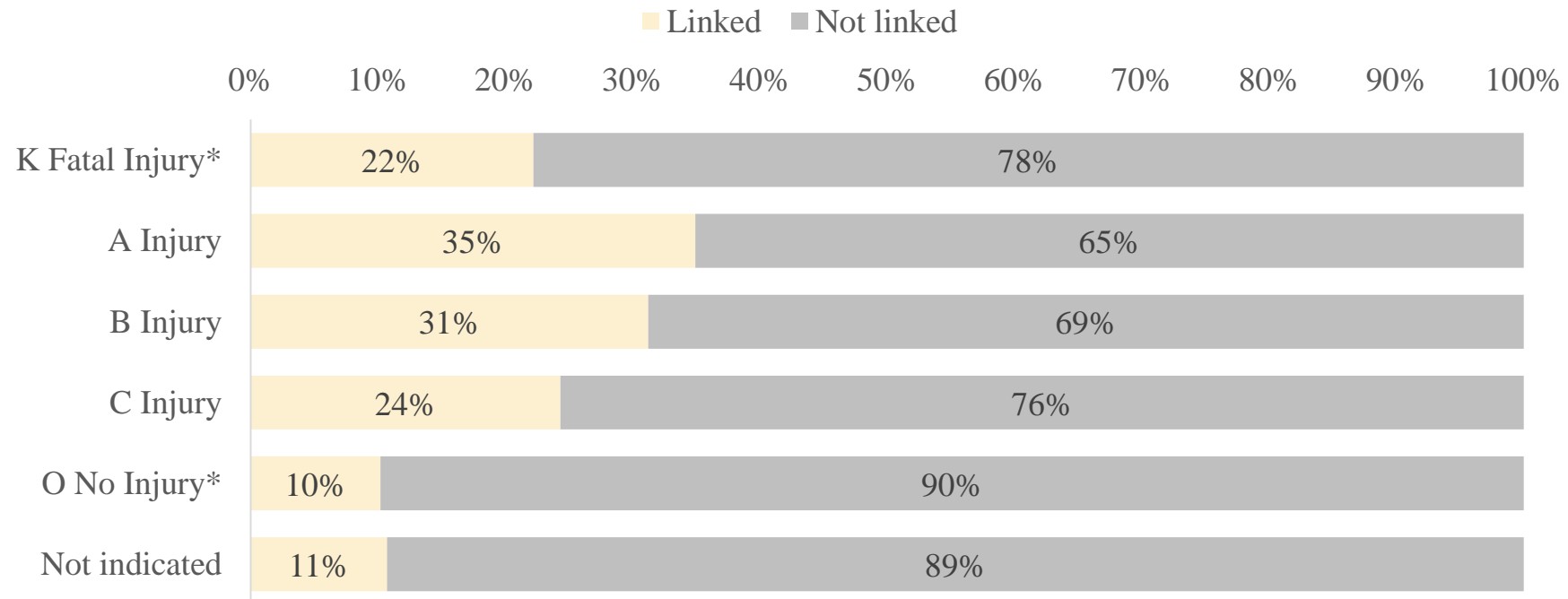
[See page 4 of the full report for more information.](#)

Proportions of Bicyclist Records by KABCO
(n=1,137)



Data linkage and KABCO

Proportions of Bicyclist Records by KABCO and Linkage Status
(n=1,137)



* Fatalities at the scene of the crash and persons who were uninjured or did not seek treatment at a hospital would not be present in hospital encounter data. The linkage rate may underrepresent the percentage of linkable records but is not expected to approach 100%.

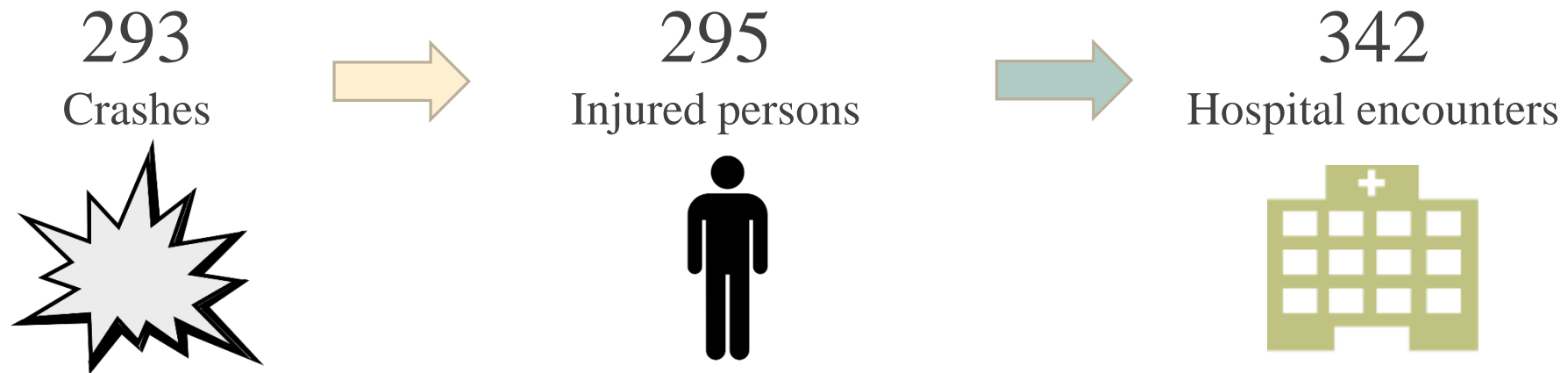
Bicyclist Crash Injury Linked Data Summaries



Bicyclist linked data: a breakdown

Crash report data represents each person involved in a motor vehicle crash. Crashes may injure multiple people.

Hospital encounter data represents each encounter a person has with a hospital. Patients may have multiple hospital encounters after a motor vehicle crash.



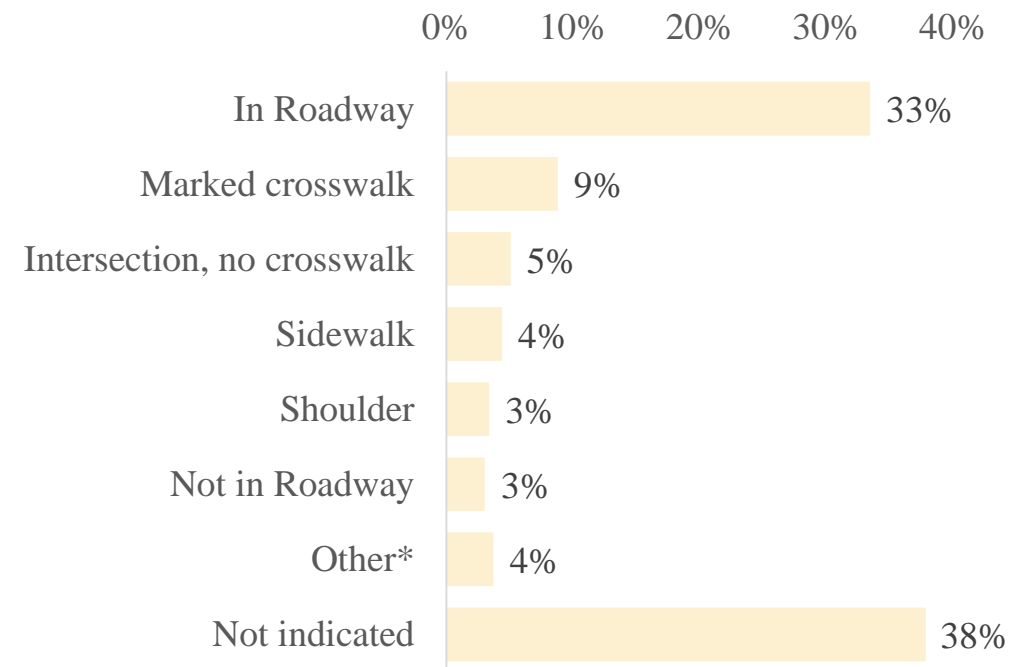
Common circumstances of bicyclist crashes

The most common vehicle maneuvers prior to the crash (n=293):

1. Going straight ahead (45%)
2. Making a left turn (16%)
3. Making a right turn (15%)
4. Backing up (5%)
5. Stopped in lane (3%)

10% were other maneuvers and 8% were not indicated. Maneuvers not listed (2% or less of the total) include passing, starting in road, making a U-turn, and being parked out of lane.

Location of Bicyclist (n=295)

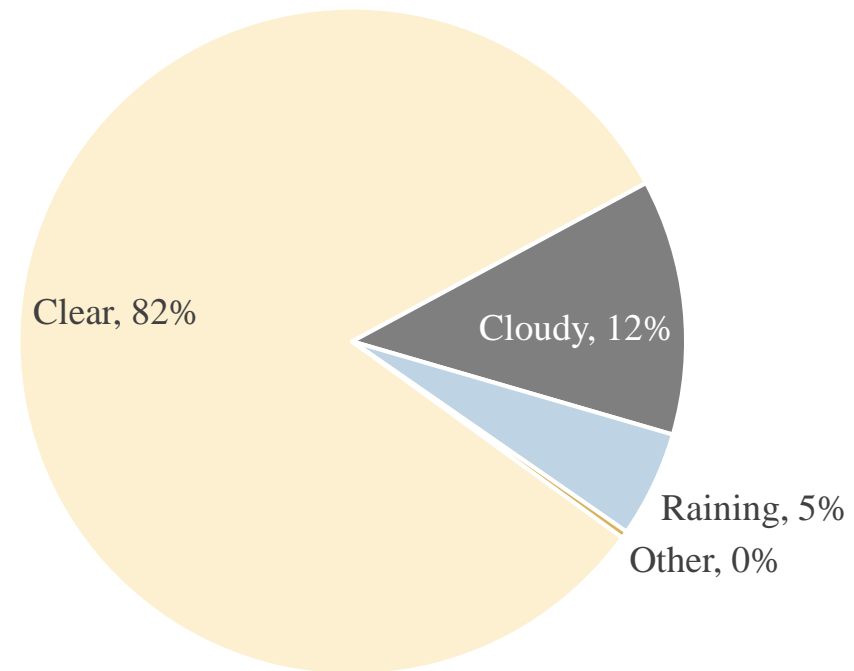


*The following 'other' locations were 1% or less of the total: shared use path/trail, non-intersection crosswalk, within 10 ft - no shoulder, outside traffic-way, island, driveway access crosswalk, and beyond 10 ft.

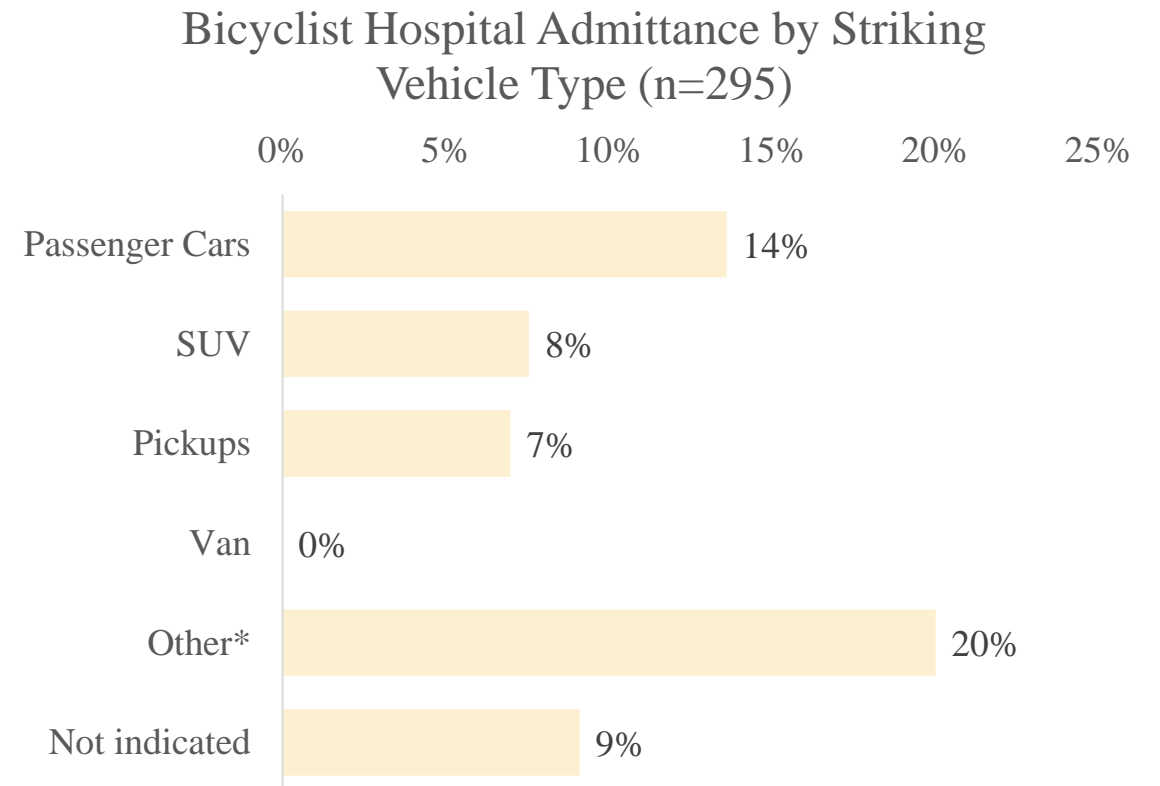
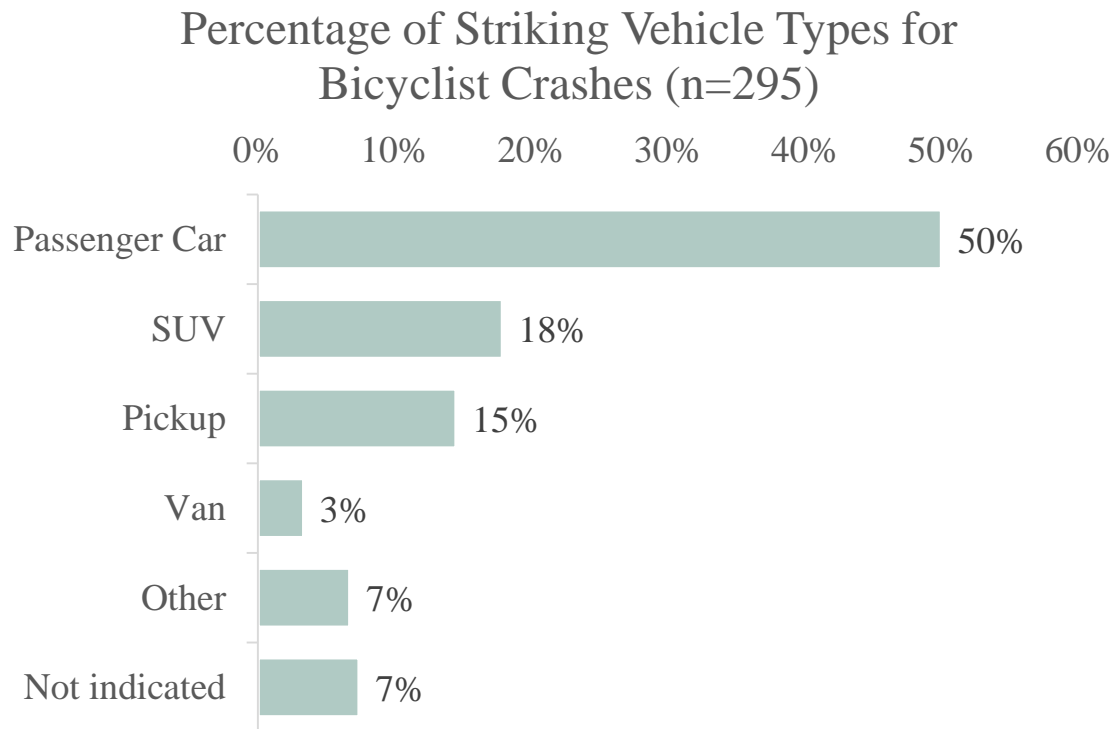
Weather conditions

Only **2%** of linked bicycle crashes indicated weather was a contributing factor in the crash (1% clear and 1% raining).

Weather Conditions of Bicycle Crashes (n=293)



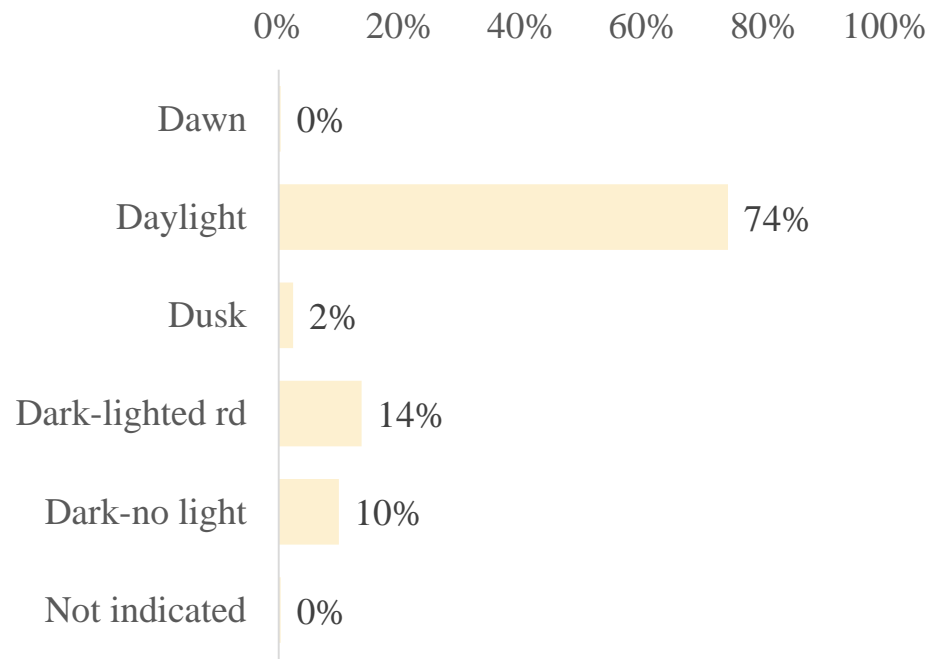
Striking vehicle type in bicyclist crashes



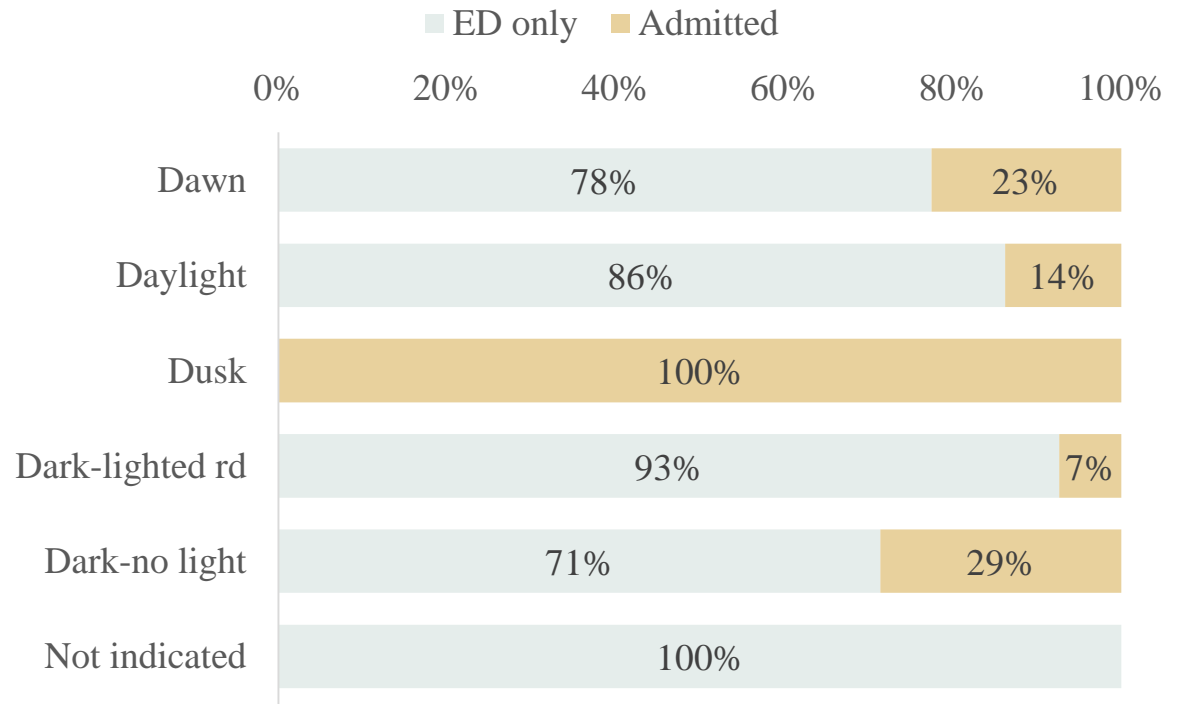
* Although rare (less than 5 hospital encounters), the following striking vehicle types had hospital admittance rates greater than 30%: 2 axle, 6 tire trucks, motorcycles and tractor/semi-trailers.

Light conditions

Light Conditions for Linked Bicyclist Crashes (n=295)



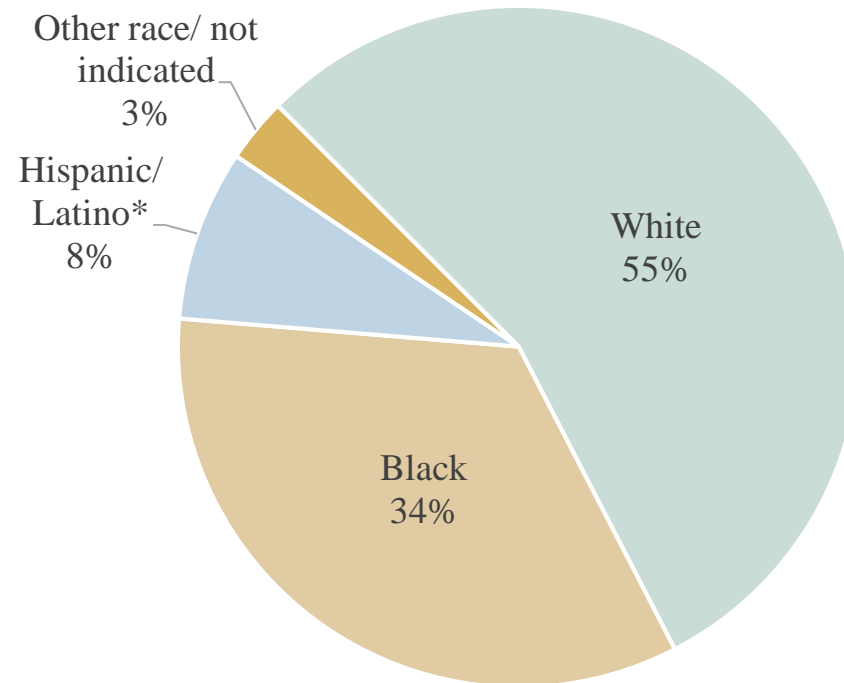
Percentage of Bicyclists Admitted to the Hospital by Light Condition (n=295)



Race/ethnicity of bicyclist crash victims

Black North Carolinians make up only 22% of the NC population, but 34% of the bicyclist crash victims with a linked hospital encounter record.

Proportion of Injured Bicyclists by Race/Ethnicity (n=295)



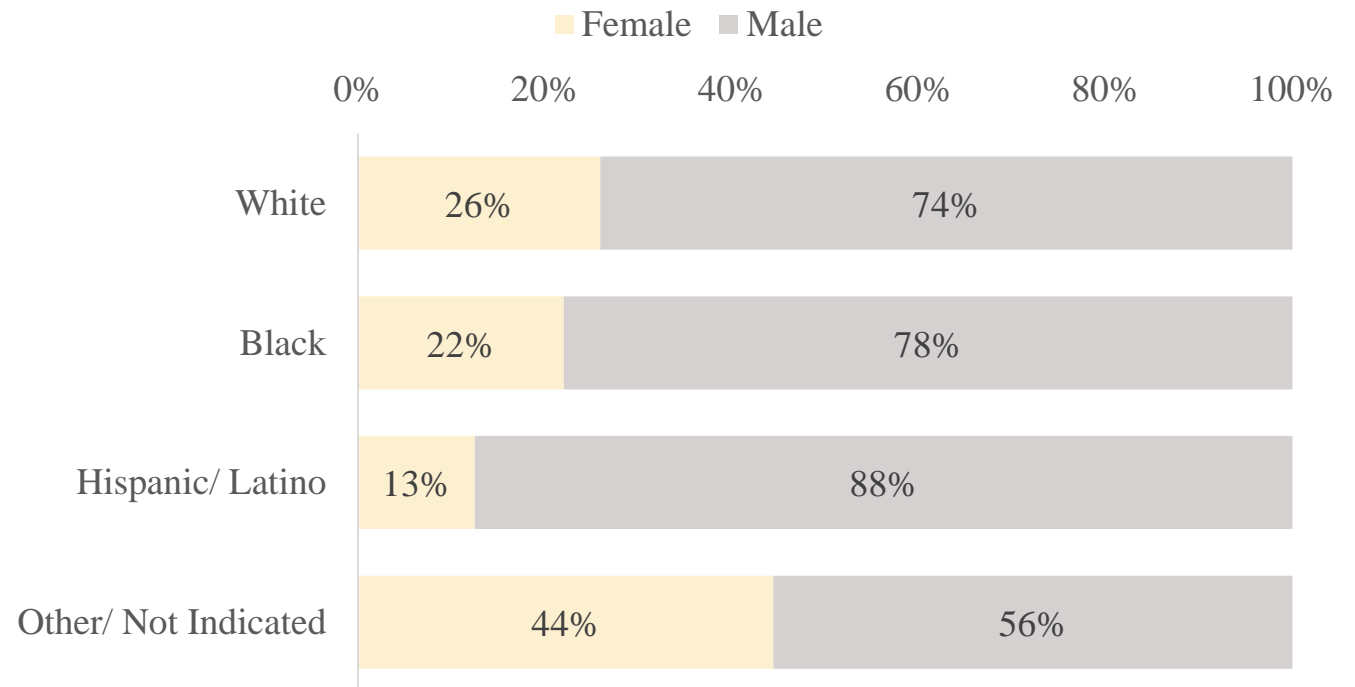
Source: <https://www.census.gov/quickfacts/nc>

*Ethnicity is not disaggregated from race in the crash data.

Sex of bicyclist crash victims

Male North Carolinians make up 50% of the NC population, but 76% of the bicyclist crash victims with a linked hospital encounter record.

Proportion of Injured Bicyclists by Sex and Race/Ethnicity (n=295)

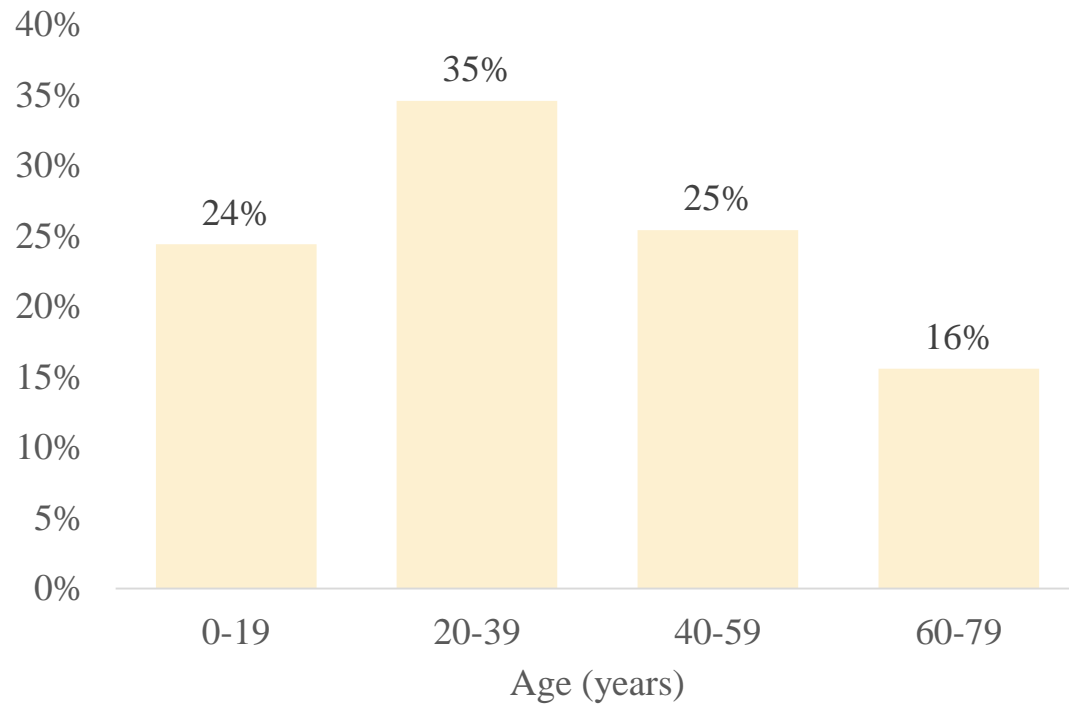


Source: <https://www.census.gov/quickfacts/nc>

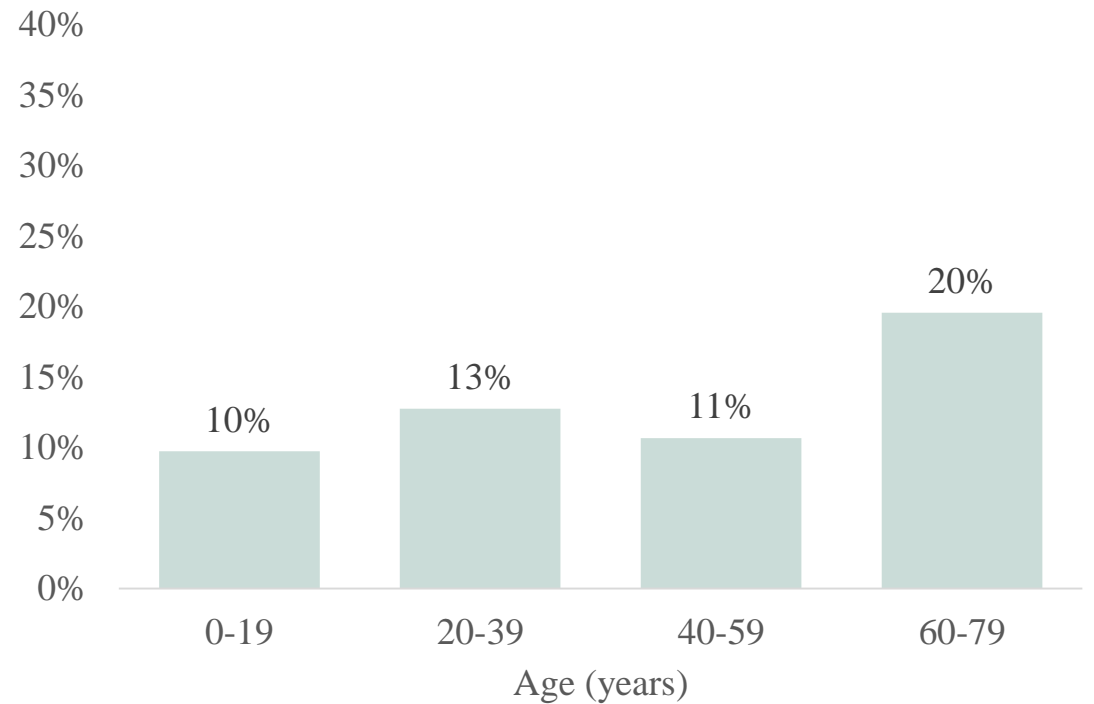
*Ethnicity is not disaggregated from race in the crash data.

Age and hospital admittance for injured bicyclists

Proportion of Injured Bicyclists by Age
(n=295)

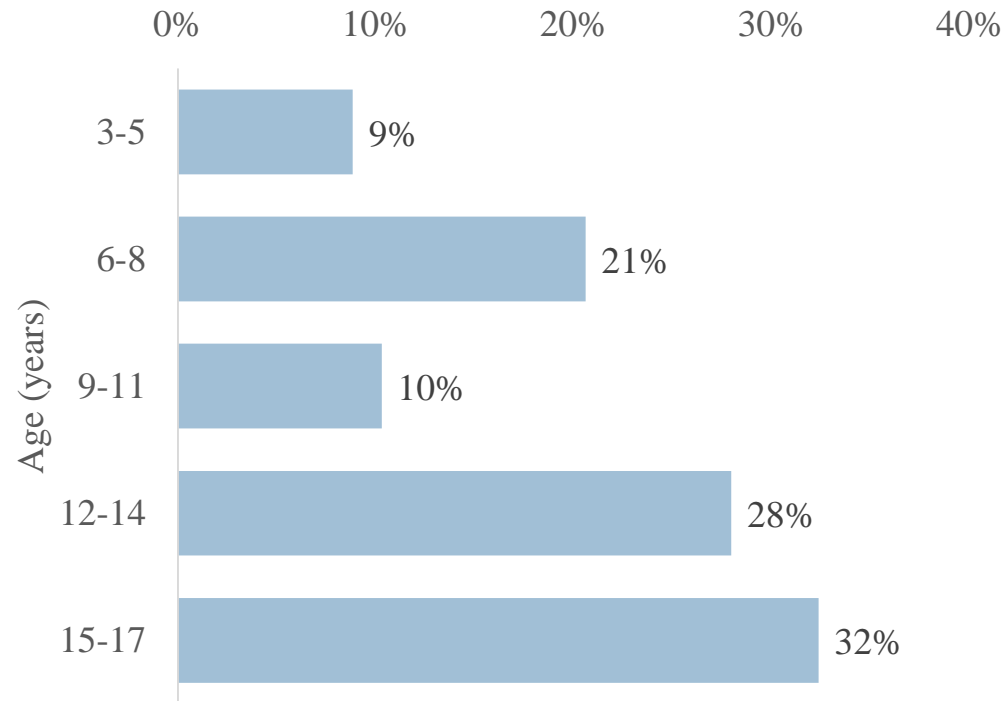


Proportion of Bicyclists Admitted to Hospital by Age (n=295)

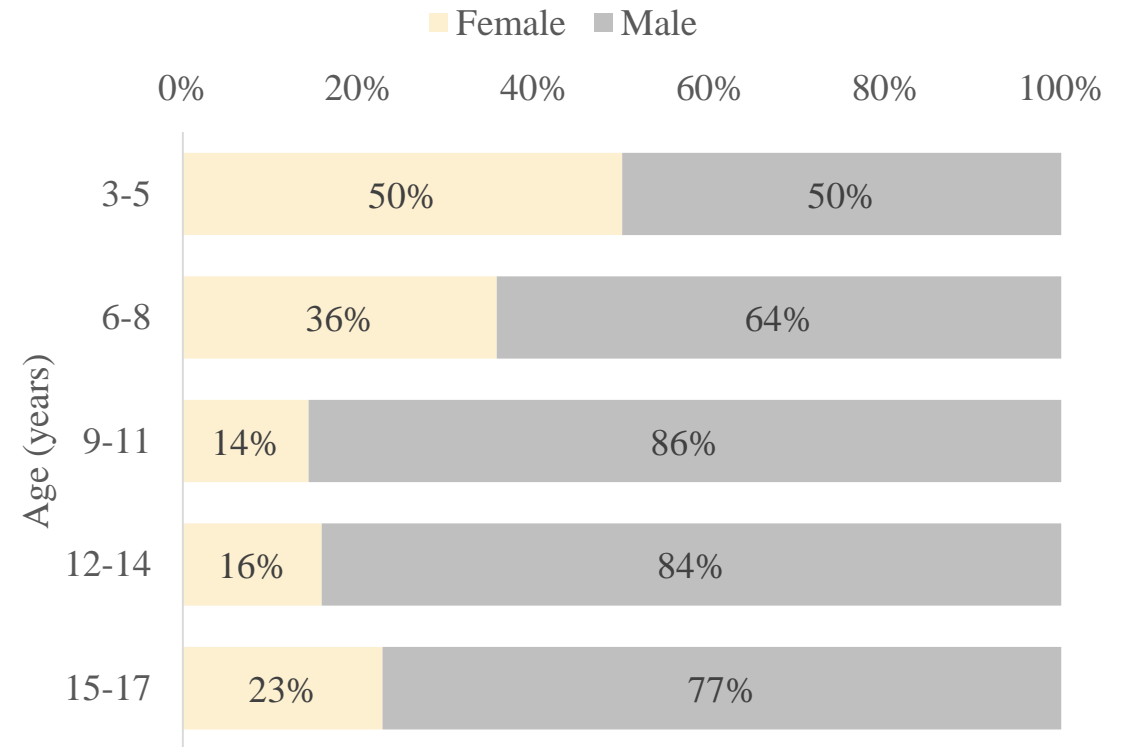


Injured Bicyclists: Children

Ages of Injured Bicyclist Children
(n=68)

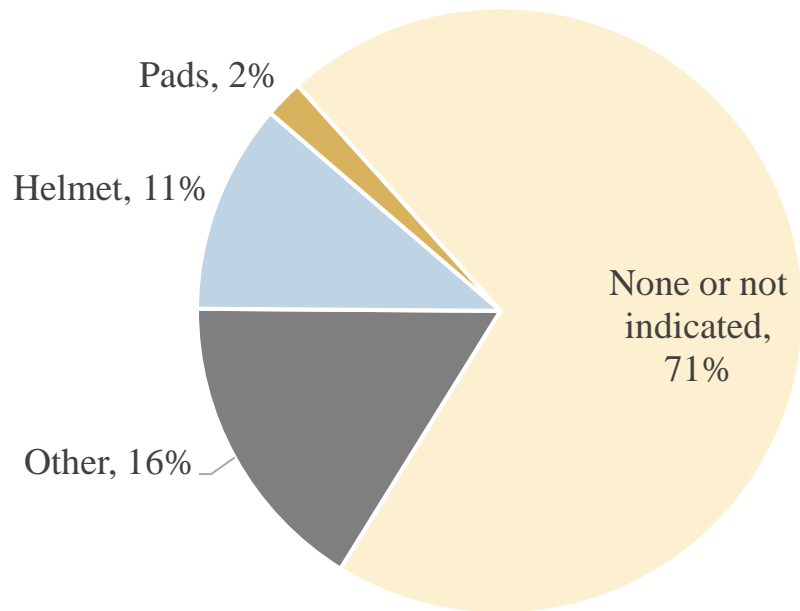


Proportion of Children by Age and Sex (n=68)



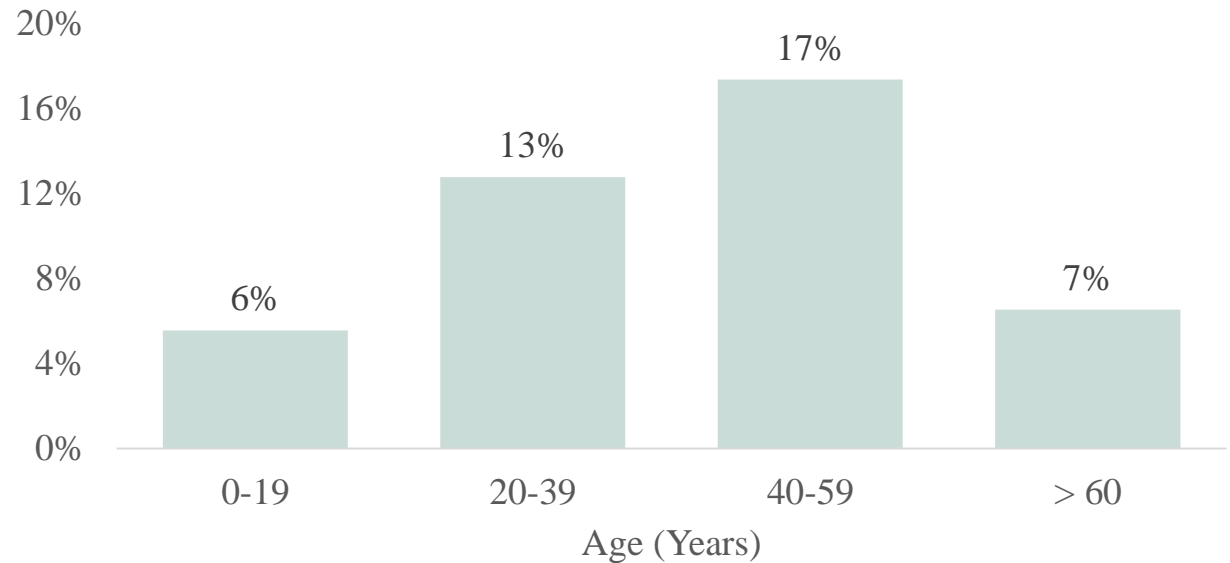
Protective equipment use by bicyclists

Proportion of Bicyclists using Protective Equipment (n=295)



In North Carolina, bicyclists under the age of 16 years are required by law to wear a helmet. However, only **8%** of injured bicyclists under the age of 16 (n=52) were wearing a helmet.

Bicyclist Helmet Use by Age Group (n=295)

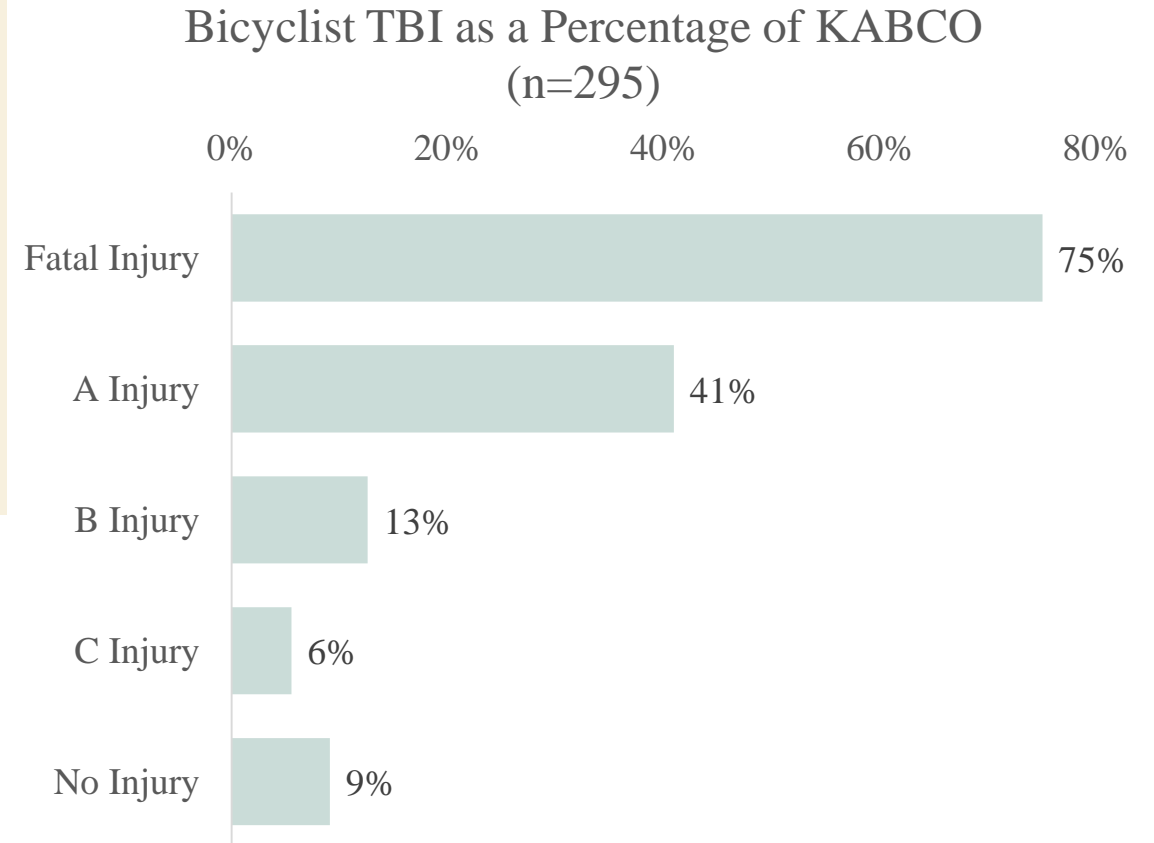


Traumatic brain injuries in bicyclists

14% of injured bicyclists met the 2016 CDC proposed definition* for traumatic brain injuries (TBIs).

90% of bicyclists with TBIs were not wearing a helmet.

*Hedegaard H, Johnson RL, Warner M, et al. Proposed framework for presenting injury data using the International Classification of Diseases, Tenth Revision, Clinical Modification diagnosis codes. National health statistics reports; no 89. Hyattsville, MD: National Center for Health Statistics. 2016



KABCO and Maximum Abbreviated Injury Scale (MAIS) for bicyclists in hospital encounter data (n=268)*

The **Maximum Abbreviated Injury Scale (MAIS)** is a recognized injury severity ranking system, developed by the Association for the Advancement of Automotive Medicine (AAAM). The MAIS maps injury severity to ICD-10-CM injury diagnosis codes. The MAIS is the highest (i.e. most severe) AIS severity score in a patient with multiple injuries.

The linked data show similar distributions for the KABCO and MAIS injury severity scales:

- 11% of injured bicyclists had a law enforcement officer-assigned KABCO score of “K” or “A.”
- 10% of injured bicyclists had a MAIS ≥ 3 , indicating that the injury was serious to critical.

Injury Severity Rating Based on Law Enforcement Assessment		
KABCO	N	%
K - Fatal injury	7	3%
A - Serious injury	22	8%
B - Minor injury	138	51%
C - Possible injury	93	35%
O - No injury	8	3%

Injury Severity Rating Based on ICD-10-CM Injury Diagnosis Codes in Hospital Encounter Data		
MAIS	N	%
6 - Not survivable	0	0%
5 - Critical	3	1%
4 - Severe	0	0%
3 - Serious	24	9%
2 - Moderate	81	30%
1 - Minor	145	54%
0 - No injury	15	6%

*27 bicyclists were excluded from analysis due to missing KABCO designations (n=2), missing classifiable injury diagnosis codes (n=24), or missing both (n=1).

Most common injury diagnosis code* for bicyclist hospital encounters per KABCO designation, (n=339)

Among patients with KABCO scores K-C, the most frequent diagnosis code was indicative of a head injury. Bicycle helmets prevent head injuries and *save lives!*

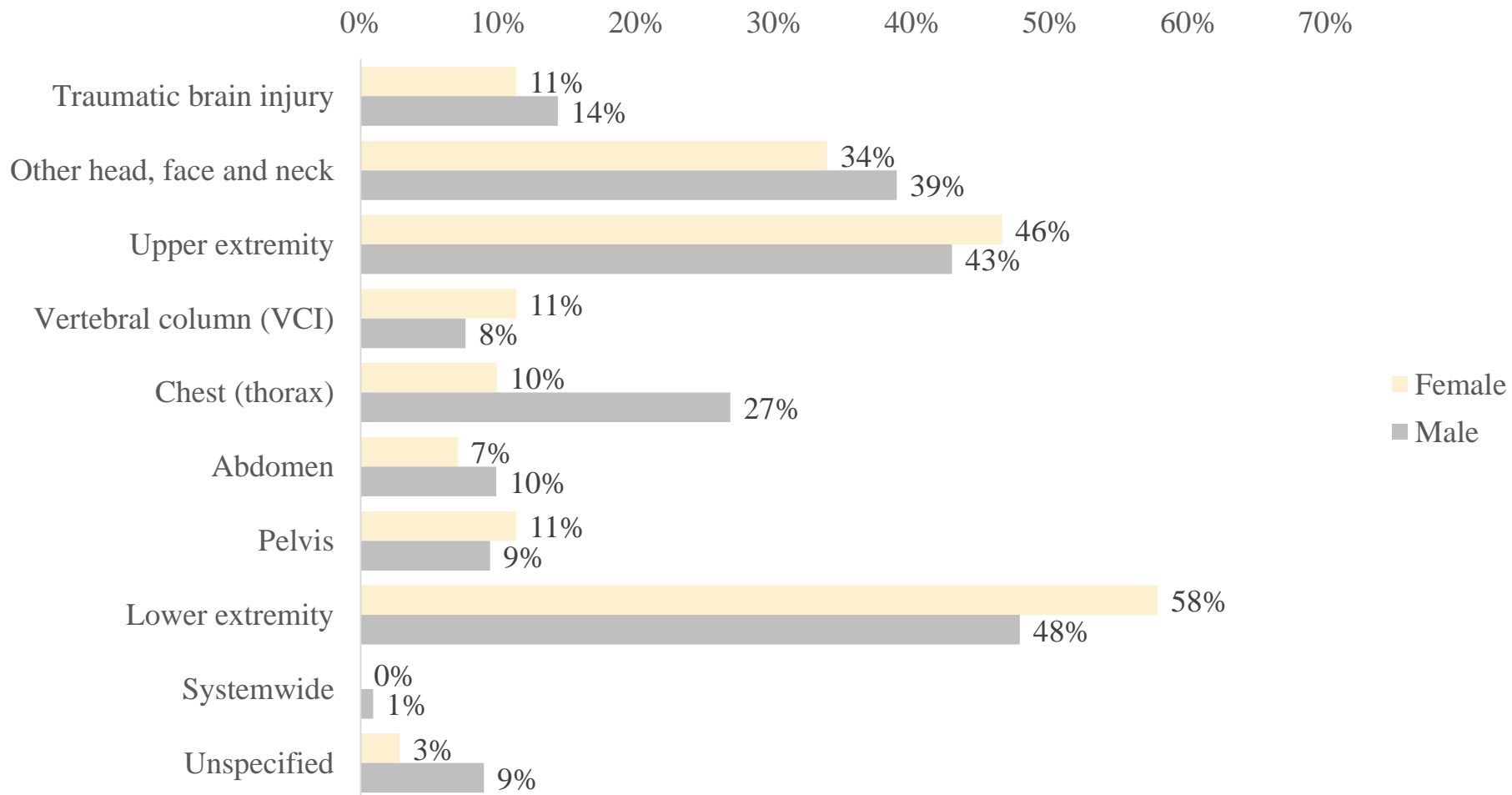
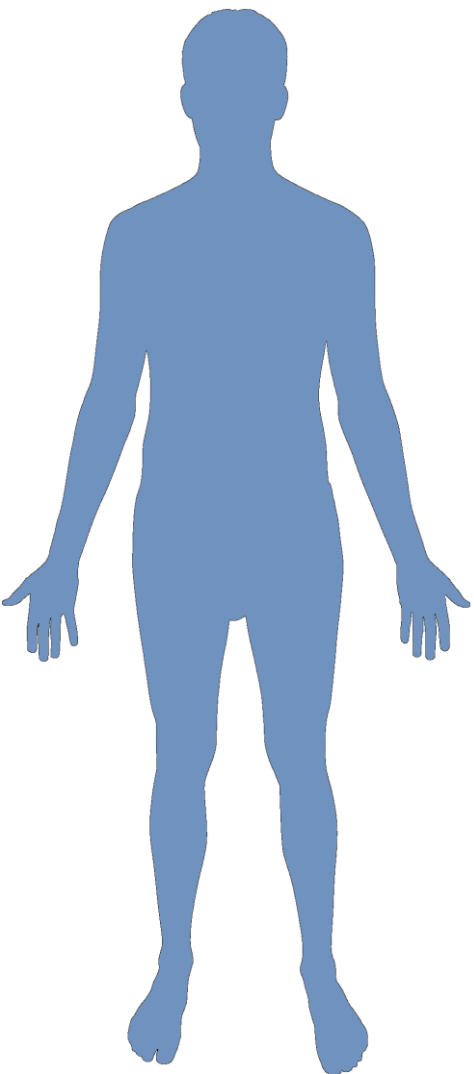
<https://www.cdc.gov/motorvehiclesafety/calculator/factsheet/bikehelmet.html>

K: Fatality, n=10	A: Suspected serious injury, n=30	B: Suspected minor injury, n=163	C: Possible injury, n=123	O: No injuries, n=13
S022XXA: Fracture of nasal bones, initial encounter for closed fracture (40%)	S0990XA: Unspecified injury of head, initial encounter (33%)	S0990XA: Unspecified injury of head, initial encounter (17%)	S0990XA: Unspecified injury of head, initial encounter (11%)	S80212A: Abrasion, left knee, initial encounter (23%) S60511A: Abrasion of right hand, initial encounter (23%)

*Using the Carolina Center for Health Informatics 'Trauma' case definition: ICD-10-CM diagnosis codes starting with S - Injury, poisoning, and certain other consequences of external causes

Injury Percentages by Area of Injury and Sex*

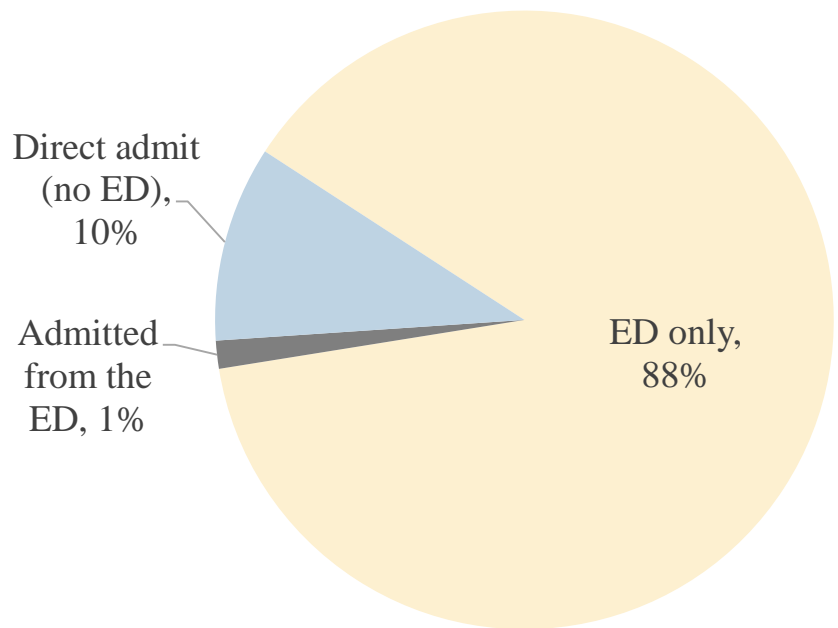
(1,013 diagnosis codes for 295 bicyclists)



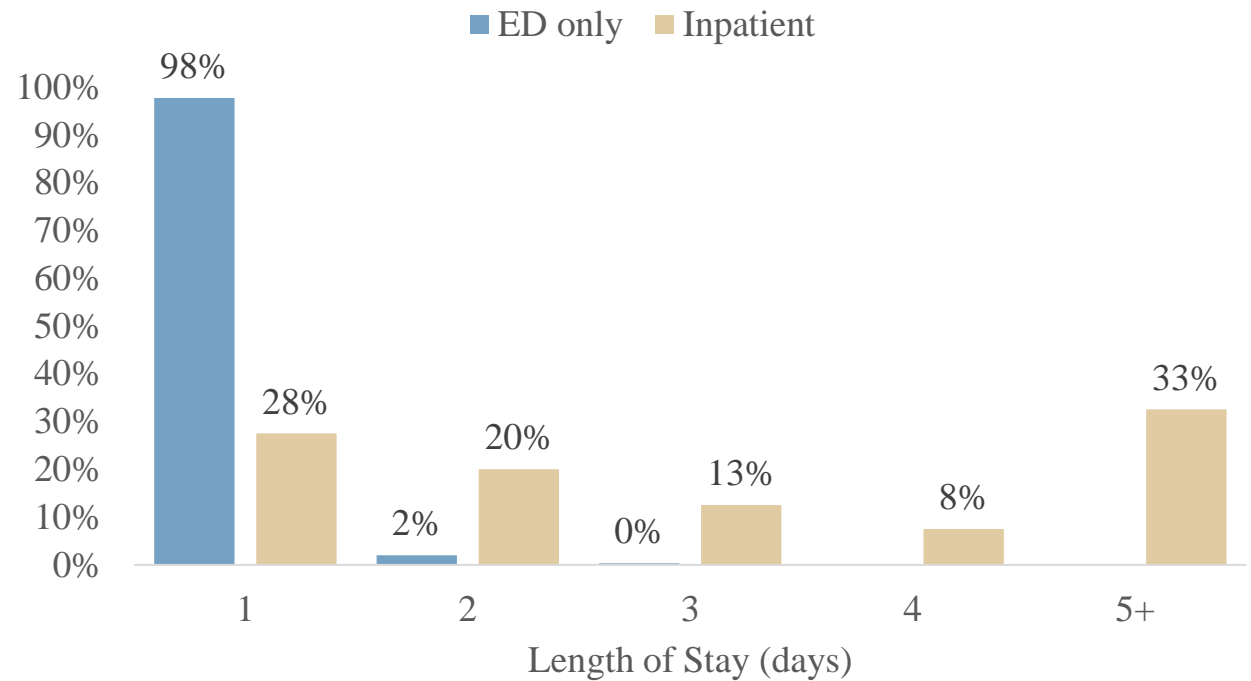
*Data do not add to 100%; bicyclists may sustain injuries to multiple parts of the body. Mapped using S and T diagnosis codes using CDC injury mapping: Injury Data and Resources - Tools and Frameworks. (n.d.). Retrieved February 4, 2019, from https://www-cdc-gov.libproxy.lib.unc.edu/nchs/injury/injury_tools.htm

Admittance to hospital and length of stay for bicyclists

Proportion of Bicyclists with Emergency Department (ED) Visits vs. Hospital Admissions (n=342)

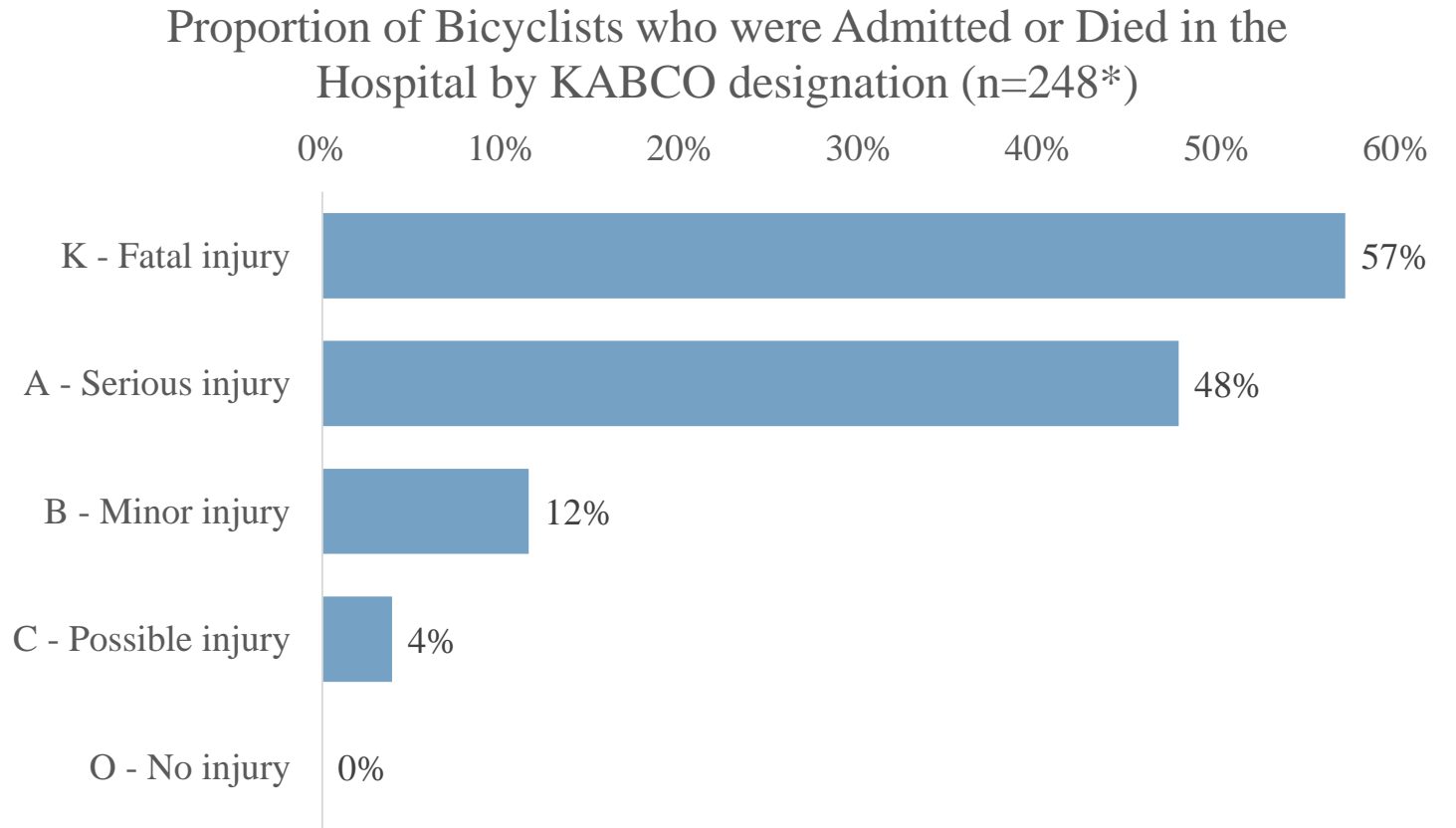


Bicyclist Hospital Encounter Length of Stay (n=342)



Bicyclist hospital admittance by KABCO

57% of the bicyclist crash hospital encounters coded by law enforcement officers as “K-Fatality” were admitted or died in the hospital. The remaining 43% were discharged home or transferred to another hospital.



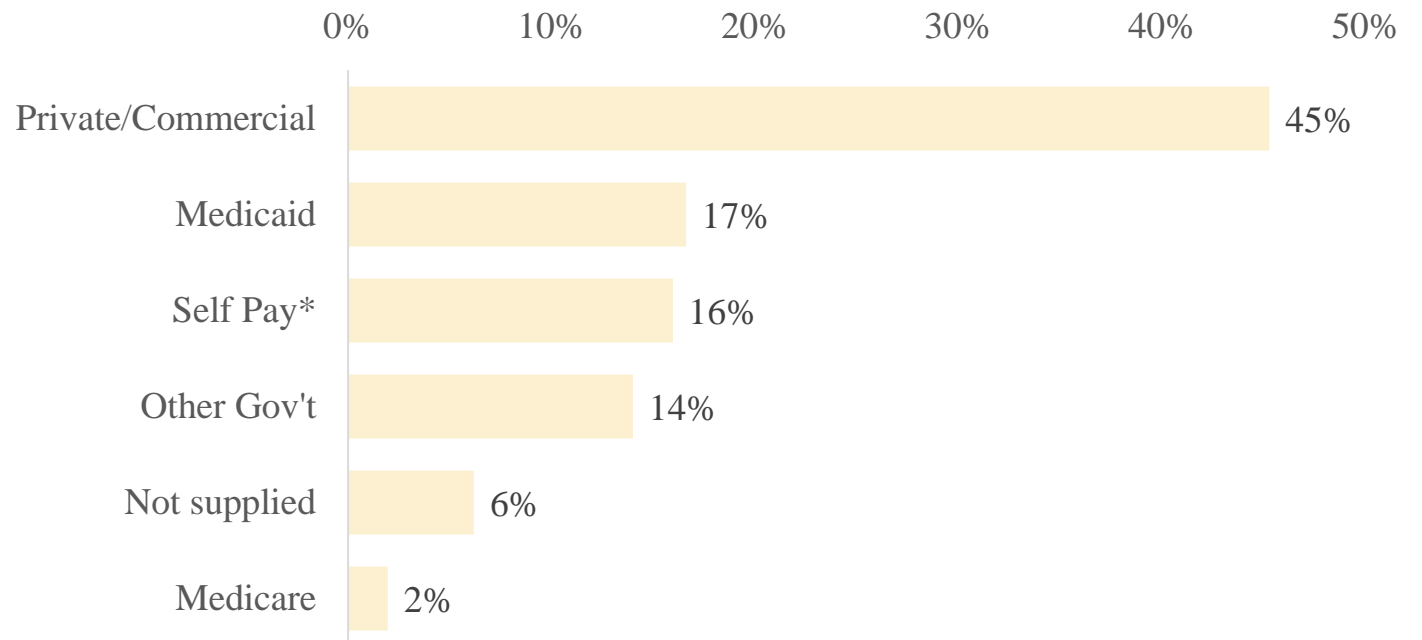
*94 hospital encounter records were excluded from analysis due to disposition codes which could not be mapped.

Insurance used by injured bicyclists

13% of the North Carolina population was uninsured in 2018.

16% of bicyclist crash-related hospital encounters were self pay.

Primary Payor for Injured Bicyclist Hospital Encounters under Age 65 (n=307)



*Discharges with the expected primary payer of self-pay, charity, and no charge are classified as uninsured by the Healthcare Cost and Utilization Project (HCUP) of the Agency for Healthcare Research and Quality.

Source: <https://www.census.gov/quickfacts/nc>

Funding and Acknowledgements

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Images:

Bike lane: https://commons.wikimedia.org/wiki/File:ParkBlvd_BikeLane.jpg

Bicyclist on road: <https://media.defense.gov/2015/Aug/19/2001279897/780/780/0/150814-F-HC995-266.JPG>

Hospital signs: <https://www.publicdomainpictures.net/en/view-image.php?image=114690&picture=hospital-entrances>

Bicyclists in road: <https://www.nps.gov/articles/bike-your-park.htm>

Human body: https://commons.wikimedia.org/wiki/File:Human_body_silhouette.svg