North Carolina
Pedestrian Crash Types
2008 - 2012

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

Libby Thomas
Daniel Levitt

Student Contributor, Ed Farley

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Introduction and Purpose

A total of 13,186 collisions between motor vehicles and pedestrians were reported in North Carolina over the five year period of 2008 to 2012. On average, 168 pedestrians were killed and 178 were reported seriously injured each year.[1]

This report summarizes pedestrian-motor vehicle crash types that were developed for 2008-2012 for the entire State. UNC Highway Safety Research Center staff reviewed diagrams and narratives and other details on copies of all crash report forms submitted to NCDOT, and used PBCAT software to code crash type, pedestrian position, and crash location variables for each crash. These data elements were combined with the crash data elements already available in the State's crash database. The results are summarized in figures, tables and text in the following sections.

The report provides information about typical safety issues across the state, and suggests types of countermeasures that might be appropriate. Local agencies can use the information as a guide to analyze and understand their own specific crash issues and potential treatments. The information is for summary purposes only. Appropriate diagnosis and other procedures are necessary before implementing treatments at any location. Additional information on person, environmental, and roadway factors is provided in the companion North Carolina Pedestrian Crash Facts summary report.

Background on Crash Typing

The information from the State crash report forms and reported by public safety officials across the State is stored in electronic crash databases. Analysis of these data can provide information on *where* pedestrian-motor vehicle crashes occur (city street, two-lane roadway, intersection location, etc.), *when* they occur (time of day, day of week, etc.), and *to whom* they occur (age of victim, gender, level of impairment, etc.). Reported crash data were compiled and used to describe such pedestrian-motor vehicle crash characteristics in the companion, *North Carolina Pedestrian Crash Facts* summary report.

However, the data contained in the crash database provides little information about the actual sequence of events leading to crashes between motor vehicles and pedestrians. The development of effective countermeasures to help reduce the frequency and severity of these crashes is limited by insufficient detail on the events leading up to the crash as stored in typical electronic crash databases

[1] The number of pedestrians killed and injured reflects only the "first" pedestrian reported on in the crash. A few crashes each year involve multiple pedestrians, and may include multiple injuries and fatalities. These circumstances are relatively rare, however, and in order not to over-represent the number of crashes, the data contained in this report account for only the first pedestrian, who was also verified as a pedestrian during review of the crash reports.

To address this situation, the National Highway Traffic Safety Administration (NHTSA) developed a system of "typing" pedestrian and bicycle crashes. Each identified crash type is defined by a specific sequence of events, and each has precipitating actions, predisposing factors, and locations that can be targeted for interventions. Certain demographic groups (for example children versus older adults) may also be more highly associated with different types and locations of crashes. The original pedestrian crash typology was developed and applied during the early 1970's (Snyder and Knoblauch, 1971; Knoblauch, 1977; Knoblauch, Moore and Schmitz, 1978). Cross and Fisher (1977) later developed a similar typology for bicycle crashes. Harkey, Mekemson, Chen, and Krull (2000) created the Pedestrian and Bicycle Crash Analysis Tool (PBCAT), interactive software that enables both pedestrian and bicycle crashes to be easily and quickly typed by answering a series of on-screen questions. PBCAT version 2 (sponsored by the Federal Highway Administration, FHWA) was released in 2006 (Harkey, Tsai, Thomas, and Hunter, 2006). For more information on PBCAT and crash typing, including detailed descriptions and images of crash types, see the PBCAT webpage. A companion tool, PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System, also sponsored by FHWA and updated in 2013, is an internet-only interactive tool that helps users identify potentially appropriate countermeasures for the types of crashes and other problems identified by analyzing data from PBCAT and state crash files. Another FHWA tool that can assist with diagnosing problems is the Pedestrian Road Safety Audit Guidelines and Prompt Lists.

Crash Events and Description

Pedestrian Crash Location

Almost half (45 percent) of all pedestrians involved in crashes in NC from 2008-2012 were struck at Non-intersection roadway locations - that is, at midblock locations or segments (Table 1). These segments may include features such as driveway connections, bridges, or exit ramps, but do not include intersections or signalized commercial driveways. About one-fourth (25 percent) of all the pedestrian collisions occurred at an Intersection or within 50 feet of an intersection (Intersection-Related). Another 30 percent occurred at Non-Roadway locations, most often parking lots or public or private driveways. In 2009, the percentage of non-roadway crashes was 33 percent, but has generally been around 30 percent of the total.

Two-thirds (66 percent) of roadway-only crashes (excluding Non-roadway and Unknown) occurred at midblock locations, with 34 percent at or related to an intersection.

Table 1. NC pedestrian crashes by location type.

Crash Location	2008	2009	2010	2011	2012	Total
Intersection	352	341	417	448	568	2,126
	14[1]	14	16.4	16.6	19	16.1[2]
Non-Intersection	1,171	1,052	1,195	1,200	1,266	5,884
	46.5	43.3	46.9	44.5	42.2	44.6
Non-Roadway	772	809	748	816	849	3,994
	30.6	33.3	29.4	30.3	28.3	30.3
Intersection-Related	211	225	183	227	306	1,152
	8.4	9.3	7.2	8.4	10.2	8.7
Unknown	13	2	3	4	8	30
	0.5	0.1	0.1	0.1	0.3	0.2
Total	2,519	2,429	2,546	2,695	2,997	13,186
	19.1[3]	18.4	19.3	20.4	22.7	100

[1] Row percent of column total
[2] Row total percent of total
[3] Column percent of row total

Figure 1 shows how the proportions of location types vary from rural to urban crash locations in NC. Non-intersection crash locations make up 66 percent of the total pedestrian crashes in rural areas compared with 38 percent in urban areas, while non-roadway (parking lot crashes) are a lower percentage in rural areas. Proportions of crashes occurring at different location types may also vary across different towns and cities depending on how closely spaced intersections are, the type of infrastructure present, and other factors.

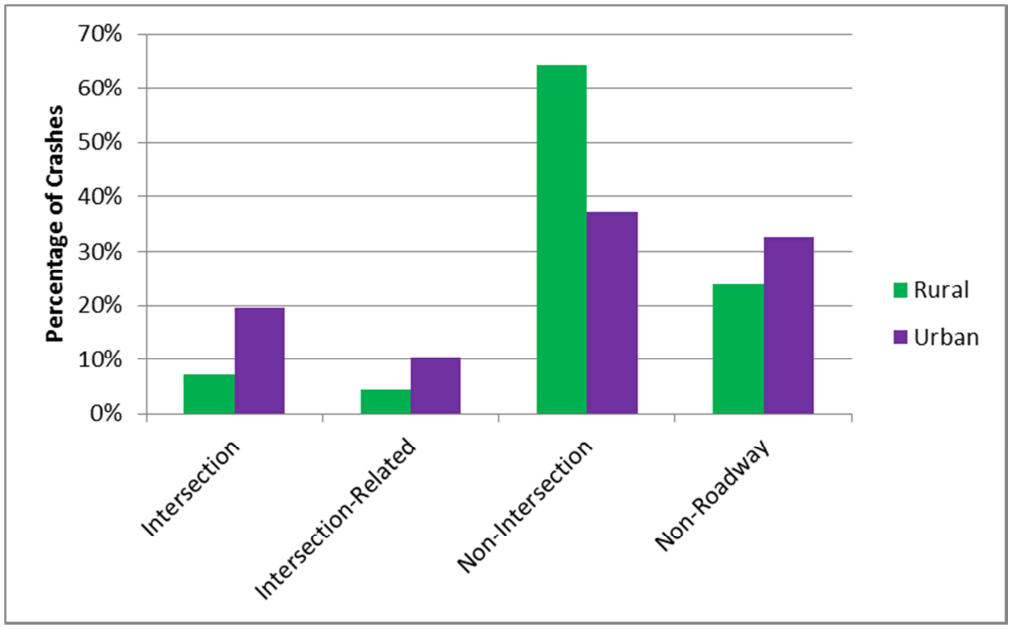


Figure 1. NC rural and urban crash percentages by location type, 2008- 2012 (n = 3,602 rural; 9,584 urban).

In addition to greater numbers of crashes, the fatality rate is much higher for pedestrians struck along road sections (non-intersection locations) compared with intersections. Motorist may be expecting interactions with others and signal changes (at signalized locations), or slowing for turns and other maneuvers at intersections, compared with mid-block/section locations.

The 629 fatal crashes at non-intersection locations represented 78 percent of all NC pedestrian fatal crashes (Figure 2). In part, the higher severity of crashes at non-intersection locations may also reflect pedestrians being struck at a higher frequency at non-intersection locations in rural areas where speeds are typically higher, roadways are often not lighted, and other factors. In addition, there are more intersections in urban areas where speed limits are likely to be lower. Pedestrian crashes at non-intersection locations resulted in fatal injuries more than 12 percent of the time, while those occurring at intersections were fatal about 4 percent of the time. Crashes that occurred close to but not at an intersection resulted in fatal injuries about 7 percent of the time. Crashes at non-roadway locations resulted in fatalities about 1.5 percent of the time. The percentages described were calculated from the numbers shown in Figure 2.

Conflicts with turning vehicles, insufficient crossing time combined with numerous lanes to cross, or widely spaced intersections may reduce the likelihood of pedestrians crossing at intersections, even though traffic controls, design and operations should, in general, provide for safer crossings at intersections.

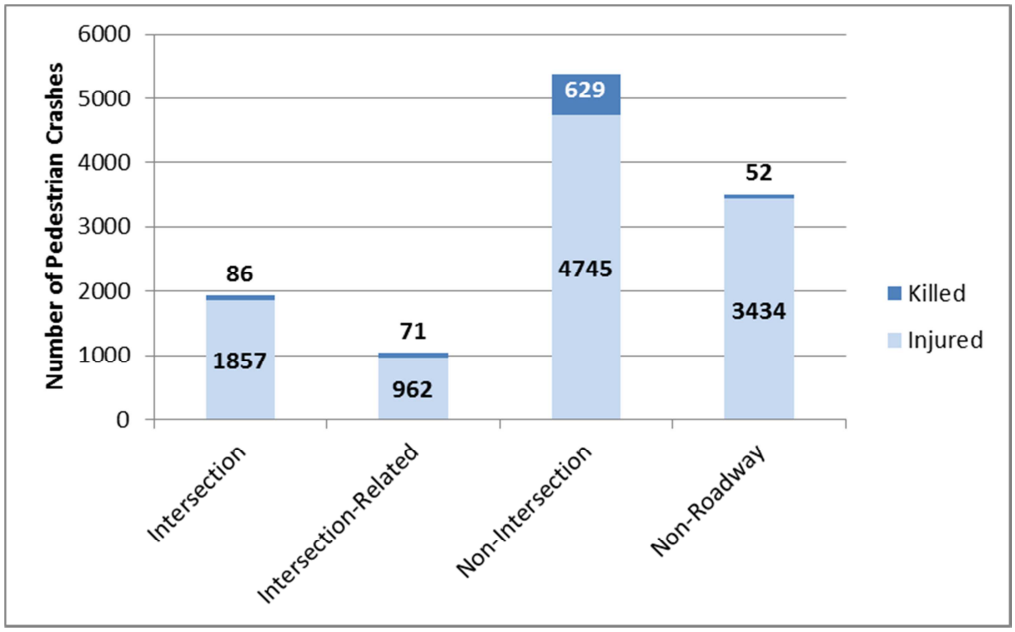


Figure 2. Pedestrian injury severity by location type, 2008-2012.

Pedestrian Position

Table 2 describes, for years 2008 through 2012, the pedestrian's position at the time of the crash. Nearly half (47 percent) of pedestrians were walking/crossing/standing in a regular Traffic lane, but not in a crosswalk or other specially designated area, at the time they were struck. Another 26 percent were in parking lots or other Non-roadway areas that were not within the road right-of-way. About 9 percent were crossing the street in a Crosswalk (marked or implied) as best determined from diagrams and other information on the crash report forms. (Note that the presence of an implied or marked crosswalk is not always discernible from crash reports.) Six percent of pedestrians were walking along or were in the street, in Paved shoulders, Bike lanes, or Parking lanes prior to being struck. Smaller percentages (3 percent) of pedestrians struck were walking along Sidewalks, Shared Use Paths or Driveways or Alleys crossings when struck (usually by motorists turning into or out of the main road). About 3 percent were within the Intersection proper (in the travel lanes within the corners of the intersection, not in the crosswalk area) before they were struck. Less than 1 percent were on Unpaved areas alongside roadways.

Table 2. Pedestrian position prior to the crash, 2008-2012.

Pedestrian Position	2008	2009	2010	2011	2012	Total
Intersection Proper	54	69	42	59	116	340
	2.1	2.8	1.6	2.2	3.9	2.6
Crosswalk Area	184	170	200	250	316	1,120
	7.3	7.0	7.9	9.3	10.5	8.5
Travel Lane	1,216	1,098	1,278	1,273	1,329	6,194
	48.3	45.2	50.2	47.2	44.3	47.0
Paved Shoulder / Bike Lane / Parking Lane	122	173	141	159	230	825
	4.8	7.1	5.5	5.9	7.7	6.3
Sidewalk / Shared Use Path / Driveway Crossing	58	56	69	99	105	387
	2.3	2.3	2.7	3.7	3.5	2.9
Unpaved Right-of-Way	19	22	22	18	16	97
	0.8	0.9	0.9	0.7	0.5	0.7
Driveway / Alley	155	108	109	91	98	561
	6.2	4.4	4.3	3.4	3.3	4.3
Non-Roadway - Parking Lot / Other	575	695	638	725	751	3,384
	22.8	28.6	25.1	26.9	25.1	25.7
Other / Unknown	136	38	47	21	36	278
	5.4	1.6	1.8	0.8	1.2	2.1
Total	2,519	2,429	2,546	2,695	2,997	13,186
	19.1	18.4	19.3	20.4	22.7	

Individual Crash Types

Table 3 shows the numbers of each of 56 different individual crash types for the years 2008–2012. The crash type, as well as the already described location and position information, was developed by using PBCAT software to code the five years of crash data from copies of crash report forms. All of the 13,186 reported pedestrian-motor vehicle crashes were assigned crash types using the PBCAT software. Only 26 had no useful information about where the crash occurred or what happened. Table 3 shows the many ways pedestrian-motor vehicle crashes can occur, including backing vehicles in parking lots, motorists turning across the paths of pedestrians, pedestrian dart-outs and dashes, pedestrians being struck while walking along the roadway, and many others.

There is some year-to-year variability in the frequencies and proportions of each crash type, especially those with smaller numbers. Much of this variation is likely explained by chance. In general, the most frequent crash types tend to occur in fairly consistent proportions across years.

Table 3. Individual NC pedestrian crash types by year.

Crash Type	2008	2009	2010	2011	2012	Total
Assault with Vehicle	17	30	25	23	33	128
	0.7	1.2	1	0.9	1.1	1
Dispute-Related	70	55	59	64	101	349
	2.8	2.3	2.3	2.4	3.4	2.6
Pedestrian on Vehicle	39	51	29	36	23	178
	1.5	2.1	1.1	1.3	0.8	1.3
Vehicle-Vehicle / Object	80	74	83	70	97	404
	3.2	3	3.3	2.6	3.2	3.1
Motor Vehicle Loss of Control	111	107	123	119	126	586
	4.4	4.4	4.8	4.4	4.2	4.4
Pedestrian Loss of Control	29	22	18	26	28	123
	1.2	0.9	0.7	1	0.9	0.9
Other Unusual Circumstances	49	14	14	14	14	105
	1.9	0.6	0.5	0.5	0.5	0.8
Backing Vehicle - Driveway	31	28	35	35	35	164
	1.2	1.2	1.4	1.3	1.2	1.2
Backing Vehicle - Driveway / Sidewalk Intersection	7	5	5	10	4	31
	0.3	0.2	0.2	0.4	0.1	0.2
Backing Vehicle - Roadway	37	28	45	36	36	182
	1.5	1.2	1.8	1.3	1.2	1.4
Backing Vehicle - Parking Lot	175	198	162	218	221	974
	6.9	8.2	6.4	8.1	7.4	7.4
Backing Vehicle - Other / Unknown	24	23	12	7	6	72
	1	0.9	0.5	0.3	0.2	0.5
Driverless Vehicle	53	41	51	40	60	245
	2.1	1.7	2	1.5	2	1.9
Disabled Vehicle-Related	37	40	47	46	41	211
	1.5	1.6	1.8	1.7	1.4	1.6
Emergency Vehicle-Related	15	10	8	13	12	58
	0.6	0.4	0.3	0.5	0.4	0.4
Play Vehicle-Related	25	21	27	22	42	137
	1	0.9	1.1	0.8	1.4	1
Working in Roadway	29	35	33	35	44	176
	1.2	1.4	1.3	1.3	1.5	1.3
Playing in Roadway	4	1	7	13	3	28
	0.2	0	0.3	0.5	0.1	0.2
Lying in Roadway	17	17	17	18	13	82
	0.7	0.7	0.7	0.7	0.4	0.6
Entering / Exiting Parked Vehicle	3	5	8	4	10	30
	0.1	0.2	0.3	0.1	0.3	0.2
Mailbox-Related	7	8	4	7	10	36
	0.3	0.3	0.2	0.3	0.3	0.3
Commercial Bus-Related	9	11	5	7	8	40
	0.4	0.5	0.2	0.3	0.3	0.3

Crash Type	2008	2009	2010	2011	2012	Total
School Bus-Related	8	17	18	20	18	81
	0.3	0.7	0.7	0.7	0.6	0.6
Ice Cream / Vendor Truck-Related	5	4	4	5	1	19
	0.2	0.2	0.2	0.2	0	0.1
Walking Along Roadway With Traffic - From Behind	205	117	168	183	230	903
	8.1	4.8	6.6	6.8	7.7	6.8
Walking Along Roadway With Traffic - From Front	6	2	2	2	0	12
	0.2	0.1	0.1	0.1	0	0.1
Walking Along Roadway Against Traffic - From Behind	12	1	5	10	12	40
	0.5	0	0.2	0.4	0.4	0.3
Walking Along Roadway Against Traffic - From Front	62	36	47	49	76	270
	2.5	1.5	1.8	1.8	2.5	2
Walking Along Roadway - Direction / Position Unknown	4	5	4	4	3	20
	0.2	0.2	0.2	0.1	0.1	0.2
Motorist Entering Driveway or Alley	5	7	1	9	5	27
	0.2	0.3	0	0.3	0.2	0.2
Motorist Exiting Driveway or Alley	28	37	30	50	60	205
	1.1	1.5	1.2	1.9	2	1.6
Driveway Crossing - Other / Unknown	0	0	1	0	0	1
	0	0	0	0	0	0
Waiting to Cross - Vehicle Turning	0	1	3	2	1	7
	0	0	0.1	0.1	0	0.1
Waiting to Cross - Vehicle Not Turning	2	2	3	1	2	10
	0.1	0.1	0.1	0	0.1	0.1
Waiting to Cross - Vehicle Action Unknown	0	0	0	1	0	1
	0	0	0	0	0	0
Standing in Roadway	42	42	62	51	76	273
	1.7	1.7	2.4	1.9	2.5	2.1
Walking in Roadway	2	163	96	126	128	515
	0.1	6.7	3.8	4.7	4.3	3.9
Non-Intersection - Other / Unknown	37	18	16	13	10	94
	1.5	0.7	0.6	0.5	0.3	0.7
Intersection - Other / Unknown	30	23	26	21	27	127
	1.2	0.9	1	0.8	0.9	1
Multiple Threat	44	24	29	14	25	136
	1.7	1	1.1	0.5	0.8	1
Trapped	4	12	6	8	3	33
	0.2	0.5	0.2	0.3	0.1	0.3
Dash	166	126	133	161	147	733
	6.6	5.2	5.2	6	4.9	5.6
Dart-Out	25	29	37	22	30	143
	1	1.2	1.5	0.8	1	1.1
Pedestrian Failed to Yield	384	339	405	396	434	1,958
	15.2	14	15.9	14.7	14.5	14.8

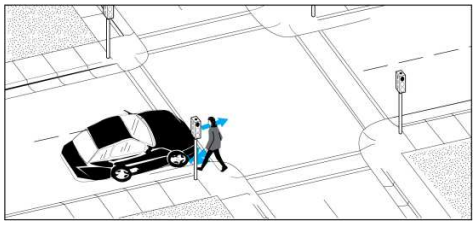
Crash Type	2008	2009	2010	2011	2012	Total
Motorist Failed to Yield	61	66	86	76	102	391
	2.4	2.7	3.4	2.8	3.4	3
Motorist Left Turn - Parallel Paths	110	107	119	134	160	630
	4.4	4.4	4.7	5	5.3	4.8
Motorist Left Turn - Perpendicular Paths	4	4	3	4	6	21
	0.2	0.2	0.1	0.1	0.2	0.2
Motorist Right Turn - Parallel Paths	26	23	26	24	33	132
	1	0.9	1	0.9	1.1	1
Motorist Right Turn on Red - Parallel Paths	2	2	4	1	4	13
	0.1	0.1	0.2	0	0.1	0.1
Motorist Right Turn on Red - Perpendicular Paths	10	12	15	17	17	71
	0.4	0.5	0.6	0.6	0.6	0.5
Motorist Right Turn - Perpendicular Paths	20	20	15	23	29	107
	0.8	0.8	0.6	0.9	1	0.8
Motorist Turn / Merge - Other / Unknown	11	2	6	3	4	26
	0.4	0.1	0.2	0.1	0.1	0.2
Off Roadway - Parking Lot	204	228	233	299	271	1,235
	8.1	9.4	9.2	11.1	9	9.4
Off Roadway - Other / Unknown	111	127	103	68	82	491
	4.4	5.2	4	2.5	2.7	3.7
Other - Unknown Location	11	2	3	4	6	26
	0.4	0.1	0.1	0.1	0.2	0.2
Crossing an Expressway	10	7	20	31	28	96
	0.4	0.3	0.8	1.2	0.9	0.7
Total	2,519	2,429	2,546	2,695	2,997	13,186
	19.1	18.4	19.3	20.4	22.7	100

Table 4 shows the top 11 most frequent individual crash types for all five years combined. This set of crash types accounted for 67 percent of reported pedestrian – motor vehicle collisions statewide. These types could therefore be among the priorities for targeting safety treatments. Other crash types, some closely related to the top 11 also account for sizable numbers and may be targets for similar measures or others. The resources mentioned in the Background and at the end of this report, provide further guidance for selecting appropriate treatments.

Table 4. Top 11 most frequent NC pedestrian crash types, 2008-2012.

Rank	Crash Type	Total	% of NC Total
1	Pedestrian Failed to Yield	1,958	14.8
2	Off Roadway - Parking Lot	1,235	9.4
3	Backing Vehicle - Parking Lot	974	7.4
4	Walking Along Roadway With Traffic - From Behind	903	6.8
5	Dash	733	5.6
6	Motorist Left Turn - Parallel Paths	630	4.8
7	Motor Vehicle Loss of Control	586	4.4
8	Walking in Roadway	515	3.9
9	Off Roadway - Other / Unknown	491	3.7
10	Vehicle-Vehicle / Object	404	3.1
11	Motorist Failed to Yield	391	3.0
	Total Top 11 types for frequency	8,820	66.9

The most frequent crash types encompass a mix of typical roadway crashes involving pedestrians crossing the roadway (Pedestrian Failed to Yield and Dashes, Motorist Failed to Yield), Walking along and *In* the Roadway crashes, Motorists striking pedestrians while making Left Turns, and off-roadway and parking lot crashes including those with Backing vehicles, and a couple of more unusual types.

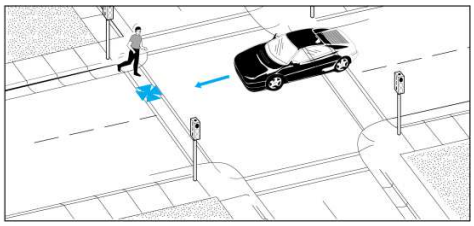


The most frequent type, **Pedestrian Failed to Yield**, accounted for nearly 15 percent of the total across North Carolina. This type describes all instances where a pedestrian was attempting to cross the roadway and apparently failed to yield the right-of-way to a through (not turning) motorist, but did not clearly run into the street or dart-out from an obscured location. This crash type includes crashes where the pedestrian is trying to cross at an uncontrolled midblock location and attempts to cross with an insufficient gap in traffic or fails to detect an approaching motorist (who could be speeding). Sixty-five percent of these crashes occurred at mid-block locations. Other instances are when a pedestrian crosses against a traffic signal at a signalized intersection or other controlled location and does not appear to have right-of-way (see illustration). Thirty-five percent of these types occurred at intersections or related to an intersection. The crash type should not, however, necessarily be construed to imply fault. Additionally, there are many locations on roadways across the State, in rural areas, but also in many urban and suburban areas, with there are few controlled crossings for long intervals, so pedestrians may need to cross at uncontrolled locations between junctions.

Potential Countermeasures for pedestrian failed to yield type includes providing marked crosswalks and other enhancements (such as pedestrian signals, HAWK signals or rapid flash beacons, median refuge islands and yield signs) at appropriate locations. Appropriate measures

may also include lighting (if nighttime crashes are a problem), roadway narrowing through bulb-outs or curb extensions, reductions in lane number or width (with and without provision of bike lanes), and potentially other traffic calming measures to slow traffic speeds. In some instances, such as where crossings of high-speed, high volume roads are needed, pedestrian overpasses may be the most appropriate solution. In others, addition of signals, or changes in signal timing and phasing, bus stop relocation, and other measures may be more appropriate. In all cases, engineering or multi-stakeholder review, (such as through roadway safety audits), speed studies, and in-depth diagnosis are needed to fully assess the problems and identify the most appropriate solutions. Another valuable resource to help with problem diagnosis is Pedestrian Road Safety Audit Guidelines and Prompt Lists.

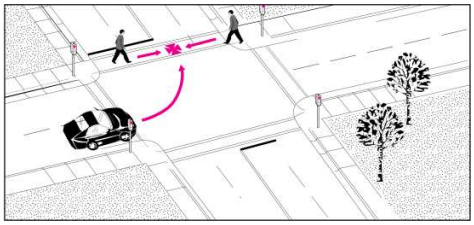
The **Dash**, #5 in the list, also describes a crossing situation, but one where the pedestrian runs into the roadway and is struck by a vehicle; the driver's view of the pedestrian was not obviously obstructed just prior to the crash. Dashes may also occur at both midblock and intersection locations.



Potential Countermeasures. Most of the countermeasures are similar to those for Pedestrian Failure to Yield. Additional educational measures targeting child pedestrians may be warranted since children are frequently over-represented in this type of crash. Access management treatments to restrict motorist through movements or reduce volumes on neighborhood streets, and street furniture (plantings, barriers) may also be used to limit pedestrians from crossing or dashing out unexpectedly. Parking should also be assessed with respect to this crash type since parking can obscure shorter pedestrians.

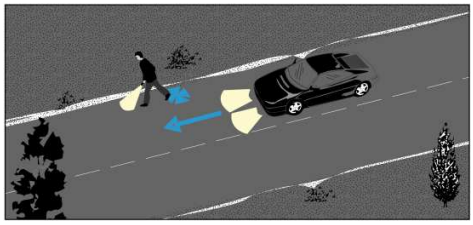
Motorist Failed to Yield was 11th on the list, and as with Pedestrian Failed to Yield and Dashes involves motorists traveling straight through at either intersections or mid-block locations while a pedestrian is crossing the road. However, in this case the pedestrian appeared to have had right-of-way. Most of these types (80 percent) occurred at intersections, whereas a majority of Pedestrian Failed to Yield occurred at midblock locations.

Potential countermeasures. Many of the ***countermeasures*** are similar, whether the motorist or pedestrian had legal right-of-way. Measures should aim to provide safe locations and times to cross, and encourage pedestrians to use these locations, and to follow rules of the road. Treatments to ensure adequate sight distance and visibility between pedestrians and motorists, and shorten crossing distance such as bulb-outs or curb extensions, median refuges, or lane reductions, and raised crosswalks should also help to encourage motorist compliance with speed limits and traffic laws (yielding). Measures should minimize the chance of harm by providing sufficient crossing opportunities, encouraging safe speeds, and appropriate level of separation for the road type, speed and volume of users present. Other crossing treatments involving signs, signals, and pavement markings may be appropriate as well.



Another frequently occurring crash type involves **Motorists** making **Left Turns** and striking **Parallel Path** pedestrians (#6 in list). Crashes involving turning motorists occur at both intersections and at driveways or other junctions where pedestrians may be struck while crossing an intersecting road or driveway. Over the entire State, 77 percent of these crashes occurred at intersections. Pedestrians typically have the right-of-way at both driveways and intersections unless they are crossing against a signal.

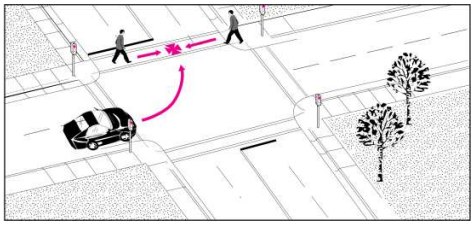
Potential Countermeasures for crashes involving turning vehicles include providing leading pedestrian intervals or providing a fully protected left turn phase separate from the pedestrian walk phase at signalized locations. Other potential remedies include roundabout intersection design, narrowing curb radii and realigning skewed intersections or driveways to slow turning vehicles, enhanced crosswalk markings, sidewalk level driveway crossings at driveways, and sign improvements (Yield to Pedestrians when Turning). Median refuge islands may also help to slow turns and provide refuge space for pedestrians during their crossing. Median barriers on the main road to restrict turning movements could be considered in some situations. Law enforcement and motorist education, as with many crash types, may also be needed.



Walking Along Roadway With Traffic - From Behind (#4 in list), involves, not surprisingly, pedestrians walking along an edge or shoulder of a roadway with their backs to traffic - typically in locations lacking sidewalks. These types of collisions also often occur at night. Situations in which the pedestrian is struck while walking along a roadway, but facing traffic, occur less frequently, and primarily involve the pedestrian being struck from the front (about 2 percent of total crashes; see Table 3).

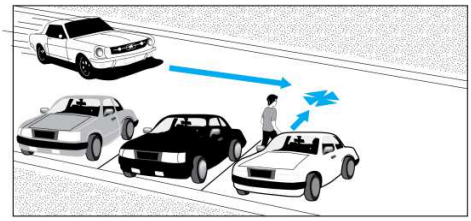
Potential Countermeasures. Primary countermeasures for walking along or in the roadway crashes are to provide space for pedestrians to walk separated from the vehicle trafficway, either sidewalks, separated paths, or wide shoulders, depending on the area type, speed of traffic, and other conditions present; and to provide lighting in areas with frequent nighttime pedestrian activity. Pedestrians who must walk in areas with no separated facilities should also be reminded about the importance of being conspicuous at night, and to walk facing traffic and move off the roadway when vehicles approach. Active lighting and reflective gear and clothing are much more effective than white or light-colored clothing for helping pedestrians to be seen by motorists.

Walking in Roadway (#8 in the list) is a crash type that encompasses cases for which it was not readily evident whether the pedestrian was walking along the road, intending to cross the road, or otherwise just walking in the roadway. Providing facilities, similar to those for Walking Along Roadway, may be of assistance, as well as providing cross facilities, depending on the circumstances present.

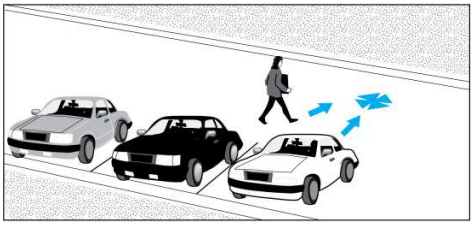


Another frequently occurring crash type involves **Motorists** making **Left Turns** and striking **Parallel Path** pedestrians (#6 in list). Crashes involving turning motorists occur at both intersections and at driveways or other junctions where pedestrians may be struck while crossing the driveway or while crossing the roadway at such locations. Over the entire State, 75 percent occurred at intersections. Pedestrians typically have the right-of-way at both driveways and intersections unless they are crossing against a signal.

Potential Countermeasures include providing leading pedestrian intervals or providing a protected left turn phase separate from the pedestrians walk phase at signalized locations, roundabout intersection design, narrowing curb radii to slow turns, enhanced crosswalk markings, sidewalk level driveway crossings at driveways, and sign improvements (Yield to Pedestrians when Turning). Median barriers to restrict turning movements could be considered in some situations. Law enforcement and motorist education may also be needed.



A significant proportion of crashes occurred off the street and highway network. The second, third, and ninth most frequent crash types involving pedestrians occurred in **Off-Roadway** locations including **Parking Lots**, involved **Backing Vehicles** (mostly) in **Parking Lots,** or occurred on other **Off-Roadway** locations such as public and private driveways, unpaved areas such as yards, and others. These three crash types combined accounted for one-fifth (20 percent) of reported pedestrian crashes statewide. There are likely to be far more of these types of collisions that were not reported.



Potential Countermeasures. Although many treatments are typically not within the purview of roadway authorities, parking lot design and design of pedestrian access from parking areas and from the street to businesses may improve conditions for pedestrians in off-road areas. Lighting, driver and pedestrian education, and other measures may also be appropriate. Event planners should also provide guidance in how to set up safe temporary parking facilities.

Motorist Loss of Control (#7 in list) involves motorists losing control of their vehicle due to drugs/ alcohol, surface irregularities, too high speed, or other factors. This crash type often results in the vehicle departing the regular trafficway lanes and may include a road departure that results in a pedestrian walking next to the roadway (on a sidewalk or shoulder) being struck. Turning errors resulting in the motorist turning into the wrong lane is its own crash type and would not be included here, unless there were clear indications that the motorist lost control of the vehicle.

Potential Countermeasures. Enforcement of speed, alcohol and reckless or distracted driving laws, are important countermeasures. In urban areas, wider buffers, street trees, and other design elements between the travel lanes and pedestrian walkways may help to buffer pedestrians from this type of crash.

Other "weird" crash types include **Vehicle-Vehicle or Vehicle-Object** (10th in list). This crash type describes situations in which the pedestrian is struck as the result of a vehicle first striking another vehicle or an object (and include some crashes involving motorists crashing into buildings). Pedestrians standing near the scene of a prior crash may also be struck because of a vehicle striking one of the disabled vehicles at the crash scene.

Potential Countermeasures. Apart from educating drivers and responders who work or stand near crash scenes, there may be few to measures to address this type of crash. In general, buffers between the travel way and pedestrian areas, and good facility design for the type and speed of roadway may help to minimize both the primary impacts and secondary impacts resulting from prior collisions.

Many other crash types accounted for relatively small numbers. However, some of the other types may be amenable to treatment. In addition, a number of the individual crash types may benefit from the same or similar types of treatments as those described here.

More discussion on potential countermeasures is provided in the next section.

Pedestrian Age Group and Crash Type (group) Involvement

Examination by age group of the pedestrian reveals variation in the extent to which different ages are involved in different types of crashes. This table, a summary for all five years is shown in Table 5 in the Appendix. The information provided below makes use of combinations of related crash types into crash type groups, a variable also provided through PBCAT crash typing. As might be expected, adults and children tend to be more involved in different types of crashes, often at different types of locations. Among the more predominant crash types, age-related trends are as follows:

- **Backing vehicle** –Young children, those 5 and under, and older adults (61 and over) are most involved in this type of crash, compared to all other ages. Backing vehicle crashes accounted for about 17 percent of age five and under reported crashes, about 20 percent of older adults' crashes, but about 11 percent over all ages. Both groups can be vulnerable to serious injury in this crash type.
- **Off Roadway** – Young children and older adults are also the most over-represented in Off Roadway crashes in general, including crashes in driveways and parking lots (when the vehicle is not backing). This group accounts for 24 percent of age 5 and under crashes and 18 percent of aged 61 and older crashes, compared with about 13 percent of crashes overall.

- **Pedestrian Dart-out or Dash** – Children under age 16 are highly over-represented in this crash type, which accounts for 28 percent the crashes among 0 to five year olds, 31 percent for 6 to 10 year olds, 19 percent for 11 to 15 year olds. Even 16 to 20 year olds (8 percent of their crashes) are somewhat more highly involved in this type compared to all ages (7 percent of crashes).
- **Crossing Roadway – Vehicle Turning –** Older adults are also somewhat over-represented in this crash type, most probably because older adults more often cross in crosswalks at intersections than other ages.
- **Walking along Roadway -**Youth and adults tend to be more involved in these types which account for 13 percent of crashes among 16 to 20 year olds, 12 percent of those 21 to 30 years, and 10 percent of those 31 to 60 compared to 9 percent for all ages.
- **Unusual circumstances** – Adults of all ages, but particularly those from about 21 to 30 years are most involved in this group of crashes (about 23 percent of their crashes are these types). These include such circumstances as assault with vehicle, dispute-related crashes, pedestrians on or clinging to a vehicle that began moving, the results of vehicle striking vehicle or vehicle striking object crashes, and vehicles leaving the road and striking pedestrians on a sidewalk or off-road area, as well as collisions involving emergency vehicles, vehicles without drivers and others. This age group is also most involved in crashes where they were in the roadway but other circumstances are unknown.

Countermeasures. Educating youngsters about how to walk safely should start at an early age and continue throughout the school years. Education and enforcement of speed laws and yielding at crosswalks and before making turns by motorists, and reinforcement of safe walking behaviors for pedestrians are important behavioral countermeasures. Some of these have already been described under specific crash types. Young children should also be closely supervised by parents and other caregivers, and taught about hazards of being or playing around any motor vehicle, even those that seem parked. More information on behavioral countermeasures is available in Countermeasures That Work (NHTSA, 2011). Engineering types of countermeasures are described in PEDSAFE, developed for the U.S Department of Transportation, Federal Highway Administration. Another resource is the Crash Modification Factors Clearinghouse, which provides estimates of expected crash reductions for various treatments.

In order to develop countermeasures for particular locations, crash data specific to those locations needs to be examined. A comprehensive diagnosis that includes site visits, such as through interdisciplinary roadway safety audits (Nabors et al.,2007) is also needed to fully assess the problems before any treatments are selected or implemented.

See the NC Pedestrian Crash Facts summary report for more information on pedestrian crash characteristics and associated environmental and roadway crash factors.

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Appendix

Table 5. Crash type (group) involvement by age group of pedestrians, 2008-2012.

Percentages are the row percentage (crash type) of the column (age group) total. Gray highlights show over-represented categories.

Crash Type by Pedestrian Age	0-5	6 to 10	11 to 15	16-20	21 - 30	31 to 60	61 +	Total
Backing Vehicle	16.9%	6.1%	4.0%	7.3%	9.2%	11.2%	20.4%	10.8%
Bus-Related	1.7%	6.5%	4.9%	1.2%	0.4%	0.2%	0.2%	0.9%
Crossing Driveway or Alley	1.0%	0.2%	1.1%	1.9%	1.3%	2.0%	3.1%	1.8%
Crossing Expressway	0.0%	0.2%	0.5%	0.4%	0.7%	1.0%	0.5%	0.7%
Crossing Roadway - Vehicle Not Turning	10.5%	15.5%	22.8%	19.2%	14.8%	18.7%	18.7%	17.8%
Crossing Roadway - Vehicle Turning	1.7%	2.1%	4.3%	6.9%	7.6%	8.5%	10.8%	7.6%
Dash / Dart-Out	27.9%	31.2%	19.0%	7.8%	4.4%	3.3%	1.3%	6.6%
Multiple Threat / Trapped	0.5%	2.3%	2.5%	2.6%	1.0%	1.0%	0.9%	1.3%
Off Roadway	24.2%	13.6%	8.5%	11.4%	11.8%	12.9%	17.7%	13.1%
Other / Unknown - Insufficient Details	1.5%	0.8%	0.7%	2.7%	2.2%	1.9%	1.5%	1.9%
Pedestrian in Roadway - Circumstances Unknown	0.7%	1.5%	5.7%	6.7%	9.6%	7.0%	3.2%	6.6%
Unique Midblock	1.5%	2.3%	0.7%	0.3%	0.3%	0.7%	0.7%	0.6%
Unusual Circumstances	9.8%	14.5%	15.2%	18.1%	23.4%	19.7%	15.4%	19.1%
Waiting to Cross	0.0%	0.2%	0.1%	0.1%	0.1%	0.2%	0.1%	0.1%
Walking Along Roadway	1.0%	1.0%	8.9%	13.0%	11.6%	10.1%	4.3%	9.4%
Working or Playing in Roadway	1.2%	1.9%	1.2%	0.4%	1.7%	1.9%	1.3%	1.5%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	1	100.0%	100.0%

Note that Unknown ages were omitted for presentation.


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