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Risk Factors for Older Pedestrian Injuries and Fatalities in MA

Principal Investigators
Dr. Elizabeth Dugan
University of Massachusetts Boston

Research and Technology Transfer Section
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16. Abstract

The number of pedestrian crashes in the United States has increased in the past two decades. The number of older people has increased as the Massachusetts population ages and the percentage of older pedestrian crash rates has increased. This research identified risk factors and community characteristics contributing to older pedestrian crashes and suggests leveraging the state's age-friendly efforts to speed the implementation of countermeasures. Based on ten-year statewide crash data (2006-2015) and community indicators from the 2018 Massachusetts Healthy Aging Data Report, this study examined 4,472 crashes across Massachusetts that involved pedestrians age 55 and over. The leading reasons for crashes were driver's inattention, driver's failure to yield right of way, and driver's issues with visibility. Older pedestrians were hit while walking in the road, often in crosswalks at intersections. Many factors were found to contribute to older pedestrian crashes: time of day (rush hour), time of year (winter), and community factors (higher rates of disabilities, higher percentage of racial minority residents, higher number of cultural amenities, and lack of dementia-friendly community efforts. Greater awareness of older pedestrian safety risks is needed. Communities highlighted in this report warrant priority attention from planning, health, aging services, and transportation authorities to improve older pedestrian safety.

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Risk Factors for Older Pedestrian Injuries and Fatalities in MA

Final Report

Prepared by:

Elizabeth Dugan, Ph.D.
Principal Investigator

Shuangshuang Wang, Ph.D., Nina M. Silverstein, Ph.D., Chae Man Lee, Ph.D. & Frank Porell, Ph.D.
Co-Investigators

Gerontology Institute
The McCormack Graduate School for Policy and Global Studies
The University of Massachusetts Boston
100 Morrissey Blvd.
Boston, MA 02125

Prepared for:

Massachusetts Department of Transportation
Office of Transportation Planning
Ten Park Plaza, Suite 4150
Boston, MA 02116

August, 2019

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Disclaimer

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Executive Summary

This study "Risk Factors for Older Pedestrian Injuries and Fatalities in Massachusetts" was undertaken as part of the Massachusetts Department of Transportation (MassDOT) Research Program. This program is funded with Federal Highway Administration (FHWA) State Planning and Research (SPR) funds. Through this program, applied research is conducted on topics of importance to the Commonwealth of Massachusetts transportation agencies.

According to the Healthy Aging Data Report (*2,3,4*), more than one million residents of Massachusetts are age 65 or older, comprising 15% of the population. The HADR 2014-2018 reported that the Commonwealth added more than 125,000 people age 65 or older as the baby boom cohort ages into late life. Compared to earlier generations of older adults, the current older population in Massachusetts is more diverse in terms of race and ethnicity, has a higher percentage of people with high levels of education and higher income (>$50k annual). Massachusetts residents are living longer, healthier lives. This means there are more older pedestrians on the streets and sidewalks.

Walking is the most widely recommended means to increase physical activity in older people. For cardiovascular and metabolic (e.g., diabetes) conditions walking is a key self-management tool. In addition, walking for mobility has environmental benefits as concerns about vehicle emissions and climate change grow. Thus, we expect to see an increase in older pedestrians in the near and long-term. Therefore, research to understand risks to older pedestrian safety is needed. Nationally, nearly one-half (48%) of pedestrian fatalities were pedestrians aged 50 and older (*5*). In Massachusetts, one-half of pedestrian fatalities involved pedestrians age 55 and older (*6*).

The University of Massachusetts Boston Gerontology Institute has been a hub of applied research on aging and policy since its inception. In this study, gerontologists studied the issue of older pedestrian safety using multiple methods (i.e., hotspot analysis, multivariate spatial analysis, site visits, key informant interview) to advance understanding of older pedestrian safety in Massachusetts. Specifically, we investigated factors contributing to pedestrian crashes of adults age 55 and older and identified ways to engage the age-friendly efforts in the state to reduce older pedestrian crashes.

Key Findings:

Several factors contributed to older pedestrian crashes.

- **Time of day and time of year.** Older pedestrian crashes peaked in high vehicle travel hours (e.g., rush hour 5pm), and during the winter months (when light is lowest, there are more hours of darkness, and sidewalks may be obstructed or slippery due to snow).
- **Location of crash.** Most older pedestrians were hit by a vehicle while walking "in a roadway" or "at intersections". This study found that **Cambridg**e (171 crashes, 8 per 1,000 adults age 55+), **Fall River** (141 crashes, 5.6 per 1,000 adults age 55+), **Lynn**

(133 crashes, 6.2 per 1,000 adults age 55+), and **New Bedford** (156 crashes, 6 per 1,000 adults age 55+) had the among the highest total number of older pedestrian crashes and among the highest per capita.

- **Older pedestrian age group differences.** Crash rates increased among "younger old" (ages 55-74) pedestrians, many of whom may still be employed. However, crash rates among "older old" (age 75+) pedestrians remained stable.
- **Race and pedestrian crashes.** Higher rates of older pedestrian crashes were observed in communities with a higher percentage of older people in minority racial and ethnic groups. The social determinants of health contribute to impairments in healthy aging (*3*). Given the strong association between race and residential location, it is possible this disparity is associated with environmental differences.
- **Comparing younger and older drivers in older pedestrian crashes.** Younger drivers (age 25-54) were more likely to be cited for driver error or speed as a contributing factor to the older pedestrian crash. Whereas older drivers (age 55+) had issues of attention or health cited more frequently than younger drivers. Targeting interventions by driver age is indicated.
- **Community population health and pedestrian crashes.** Our past research for the Tufts Health Plan Foundation identified three dimensions of population health related to healthy aging: serious complex chronic conditions, physical and mental disabilities, and indolent conditions (*2,3,4*). This study found that communities with higher disability rates had higher rates of older pedestrian crashes.
- **Community environment.** Older pedestrian crash rates were higher in communities with a higher number of cultural amenities. This may be due to the increased exposure to traffic and walking in areas near cultural amenities.

Recommendations:

1. Convene stakeholders to raise awareness of older pedestrian safety issues and to spur innovations to improve safety. Such a convening could be held in collaboration with the Governor's Council to Address Aging Issue in Massachusetts, to minimize expenses and logistical burdens and to maximize the impact.
2. Raise awareness about older pedestrian safety. Engage stakeholders (e.g., Massachusetts Healthy Aging Collaborative, Massachusetts Councils on Aging, MA Executive Office of Elder Affairs, AgeStrong, Walk Boston, AAA, RMV, MA Department of Public Health, Tufts Health Plan Foundation, Barr Foundation, etc.) on a public awareness campaign during the winter months when pedestrian crashes are highest. Develop focused messages for the older pedestrian, for drivers, and for planners and municipal leaders. Messages can emphasize specific risks identified in this report (i.e., rush hour, intersections, winter, visibility of pedestrian issues, and sensory and disability issues in older pedestrian safety).
3. Urge municipalities to increase the safety and visibility of crosswalks to counteract problems related to a lack of driver attention to older pedestrians.
4. If possible, prioritize infrastructure improvements (e.g., sidewalks, crosswalks) in the communities with the highest risks. This study found that **Cambridge, Fall River, Lynn**, and **New Bedford** had the highest total number of older pedestrian crashes *and*

the highest per capita. New Bedford and Fall River were also hotspots for older pedestrian crashes.

This report identified contributing factors and communities with high risks of crashes involving older pedestrians. However, improving pedestrian safety requires the joint efforts from all sectors of society. In addition to the adoption of complete streets, communities should be encouraged to be creative in meeting safety needs of older pedestrians to allow for innovation.

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List of Acronyms

Acronym	Definition
MassDOT	Massachusetts Department of Transportation
FHWA	Federal Highway Administration
HADR	Healthy Aging Data Report
SHSP	Strategic Highway Safety Plan
NHTSA	National Highway Traffic Safety Administration

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1.0 Introduction

This study of risk factors for older pedestrian injuries and fatalities in Massachusetts (MA) was undertaken as part of the Massachusetts Department of Transportation (MassDOT) Research Program. This program is funded with Federal Highway Administration (FHWA) State Planning and Research (SPR) funds. Through this program, applied research is conducted on topics of importance to the Commonwealth of Massachusetts transportation agencies.

According to a 2019 report from the National Highway Traffic Safety Administration (*5*) on pedestrian fatalities, the number of pedestrian fatalities in the United States increased by 35 percent from 2008 to 2017. Among all pedestrian fatalities in 2017, 48% were pedestrians aged 50 and older, which suggests a disproportionate threat to older residents' health and safety. In Massachusetts for that same period, more than 20% of traffic fatalities were pedestrians, which is among the highest ten states in the United States (*5*).

The safety of pedestrians is also one of the 14 emphasis areas of the 2018 Massachusetts Strategic Highway Safety Plan (*6*). The SHSP framework report notes that over a fifth of fatal crashes involving pedestrians occurred in the urban areas of Springfield, Boston, and Worcester, with pedestrians age 55 and older accounting for 50% of the fatalities.

Addressing the challenge of older pedestrian safety includes pedestrian and driver behaviors, the roadway and infrastructure as well as the characteristics of the broader community. Research is needed to understand the community characteristics and environmental factors that are related to crashes involving older pedestrians which are often overlooked in pedestrian research. Increasing the safety of pedestrians of any age is vital. But with the aging of the population and the greater risk of serious or fatal outcomes when an older person is involved in a pedestrian crash, we suggest prioritizing older pedestrian safety.

There is a growing awareness of the need to address older pedestrian safety. For example, older pedestrian safety was a topic included in the recommendations of the 2015 Massachusetts Older Driver Safety Summit (*9*) (https://mcoaonline.com/wp-content/uploads/2017/05/ODSS_Summary.pdf). Further, in 2017, Governor Charles D. Baker established the Governor's Council to Address Aging in Massachusetts (*10*) (https://www.mass.gov/orgs/governors-council-to-address-aging-in-massachusetts) to support more inclusive, age-friendly communities. Massachusetts has a long history of demonstrating ingenuity in solving difficult problems and aims to leverage that to become the "Silicon Valley" of aging innovations. The Council's transportation workgroup cited the enhancement of older pedestrian safety as a key to making Massachusetts communities more age-friendly. When communities are designed to work for the oldest and youngest residents they work best for all ages. Building on these two statewide efforts that the researchers have led or contributed to, this current project aims to investigate potential contributing factors from driver, pedestrian, roadway, and environmental perspectives for older pedestrian injuries and fatalities. Our goal is to identify ways to enhance older pedestrian safety.

1.1 Literature Review

Previous research has identified a number of factors that may contribute to or inhibit pedestrian safety. Older age and female gender had the most significant effects on crossing speed, and fear of falling had a significant effect on the proportion of downward head pitches (proportion of time pedestrians have their heads down) during crossing (*1*). A recent literature review found that older, disabled, and lower socioeconomic status pedestrians were at higher risks of crash injury and death (*8*). Immigrants and minority populations (Hispanic and African American) are over-represented in pedestrian crashes compared to the size of their population (*12*). Factors found to increase the risk of older pedestrian crashes include: declines in visual acuity, underlying health conditions, frailty, reduced mobility, and reduced speed crossing the roads. In addition, researchers suggested that population density, public land use (e.g., commercial, schools), and wide streets were associated with high pedestrian crash rates (*8; 11*). However, whether these associations are true for Massachusetts remains unknown.

For this project, we combined ten years of MA crash data with the 2018 Massachusetts Healthy Aging Data Report (*2*), which contains 170 indicators of community demographics, population health, transportation providers, and available services for every city and town in Massachusetts. It is the most comprehensive report on healthy aging focused on the local and state level available in the nation.

This project addresses five objectives related to older pedestrians:

1. To provide descriptive information about older pedestrian crashes in Massachusetts and to visualize the distribution of older pedestrian crashes across the state.
2. To describe the extent to which the Federal Highway Administration (FHWA) guidelines and recommendations (*7)* to accommodate older drivers and pedestrians exist in pedestrian crash hotspots (i.e., where high density of crashes occurred).
3. To investigate the extent to which community rates for age-related health and medical conditions are associated with pedestrian crash rates and injury severity, and to explore if community efforts to become dementia- and age-friendly mitigate the association.
4. To investigate if community population health and/or built environment factors are associated with older pedestrian crash rates and injury severity.
5. In collaboration with our MassDOT project champion to recommend countermeasures suggested by the results of analyses.

2.0 Research Methodology

2.1 Data Sources

This study uses two main data sources: ten years of MA crash data (2006-2015) obtained from MassDOT (*11*) (https://apps.impact.dot.state.ma.us/cdp/home) and the 2018 Massachusetts Healthy Aging Data Report (*2*). By merging these two data sources we are able to extend our investigation of older pedestrian crash risk to include 170+ community factors associated with healthy aging (full list of indicators included in Appendix C). In the HADR (*2*) older adults were defined as age 60 or 65 and older depending on the indicator and data source.

2.2 Approach

The characteristics of older pedestrian injuries and fatalities were first described based on the crash data. For the purposes of this report, older pedestrians were defined as pedestrians age 55 and older to allow comparisons of younger (55-74) and older (75+) pedestrians. Maps were created to show the distribution of injuries, fatalities, and hotspots using ArcGIS software. Indicators from the HADR (*2*) were examined to more fully describe the community characteristics of hotspots once identified. Finally, multivariate spatial analyses were conducted to understand population health and environmental factors associated with older pedestrian crash rates in MA and to identify potentially effective countermeasures.

2.3 Site Visits

Two field trips to New Bedford, a location with several hotspots, were made (4/23/19 and 6/14/19) to compare the FHWA guidelines (*7*) and the extent to which guidelines were incorporated at the hotspots. A key informant interview with member of the New Bedford municipal government was also conducted.

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3.0 Results

3.1 Description of the aging population in Massachusetts

Massachusetts has more than a million residents who are age 65+, representing about 15% of the state's population (see Figure 3.1) (*2*). This is an increase in the older population of more than 125,000 in just 3 years (from 2014-2017). The population of adults age 65 and older is very heterogeneous. Demographers divide the older population into subgroups (ages 65-74 "young old", ages 75-84 "old", and ages 85+ "oldest old") that roughly corresponds to functional status.

As the baby boom cohort ages there has been an increase in the percentage of people in the 65-74 "*young old*" age group. In addition, the older population is increasingly diverse in terms of race and ethnicity. There was an increase in the percentage of adults 65+ with higher levels of education, and an increase in the percentage who were veterans of military service.

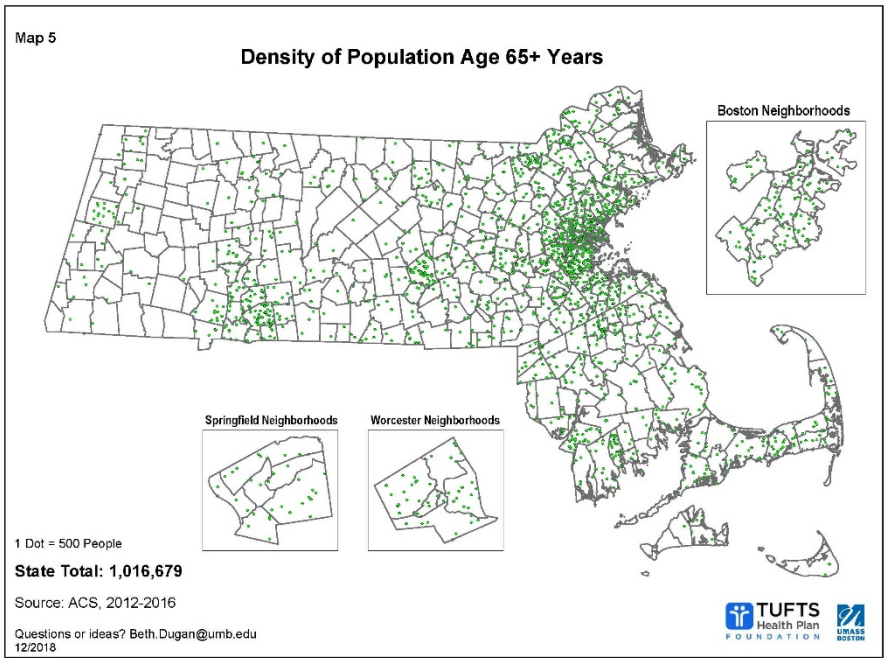

Figure 3.1: Density of Population Age 65+ Years

At the community level there are wide variations in most indicators of healthy aging, many associated with the social determinants of health. Our analyses comparing 2011 and 2015 chronic disease data from the Centers for Medicare and Medicaid Services showed some health indicators improved, but many more got worse (*2, 13*). Community rates for 11 chronic diseases worsened: arthritis, asthma, atrial fibrillation, breast cancer, chronic kidney disease, depression, endometrial cancers, benign prostatic hyperplasia, high cholesterol, hypothyroidism, and lung cancer. Notably, rates of depression significantly increased in more than 40% of communities in the Commonwealth. Nearly 23% of communities experienced

worsening rates in five or more indicators (Arlington, Brockton, Burlington, Fall River, Haverhill, Lawrence, New Bedford, Revere, Swansea, and Wareham). Fall River and New Bedford not only face healthy aging challenges, but issues related to pedestrian safety, too.

3.2 Description of crashes involving older pedestrians

Based on ten-year statewide crash data (2006-2015), 4,472 crashes that involved pedestrians age 55 and over were analyzed. Pedestrian age was dichotomized into 55-74 and age 75+. Analyses showed that the number of occurrences of crashes involving older pedestrians varies by hours and months (Figures 3.2 and 3.3), with a peak at 5pm and in the month of December. Older adults had a marked increase in getting hit by a vehicle in the winter months (November, December, January) when the sun is the lowest in the sky, shadows are greatest, and there are more hours of darkness. Pedestrians are liable to be bundled up in bulky winter clothes that may slow general movement, increasing the time needed to cross streets. Sidewalks and walkways may be obstructed or slippery because of winter weather. Pedestrian safety campaigns should underscore the importance of strategies to increase pedestrian visibility (e.g., wearing bright or high visibility clothes, carrying a flashlight).

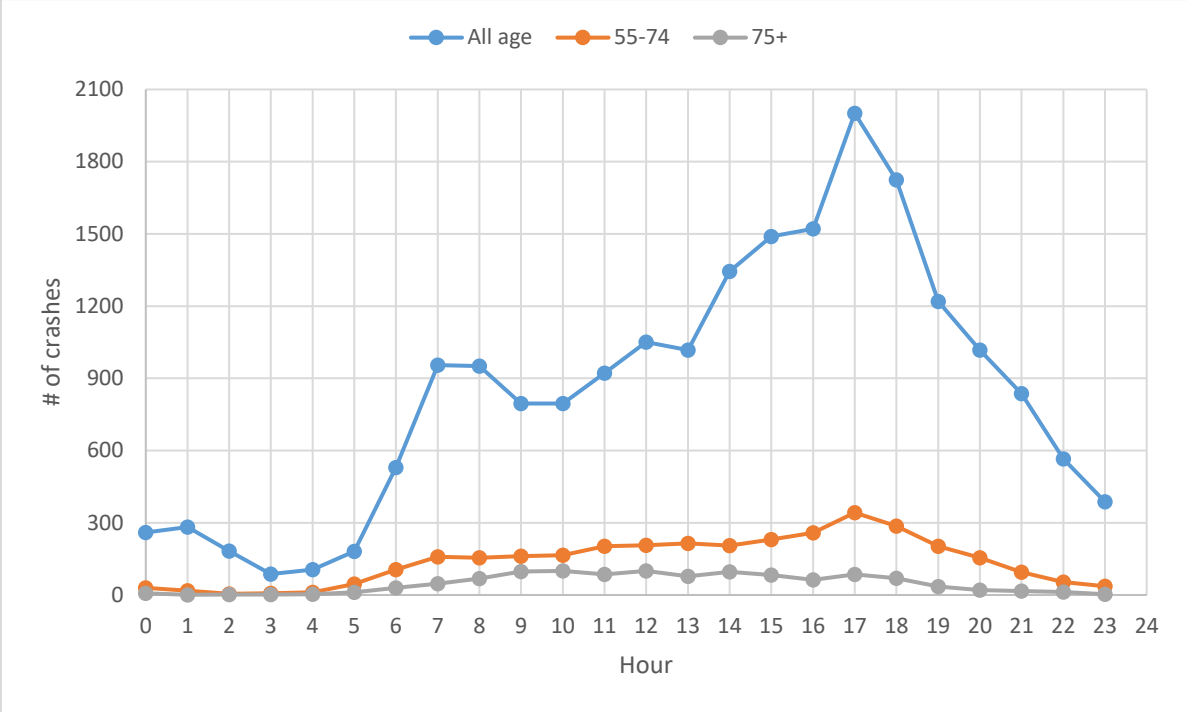

Figure 3.2: Number of Crashes Involving Older Pedestrians by Time of Day

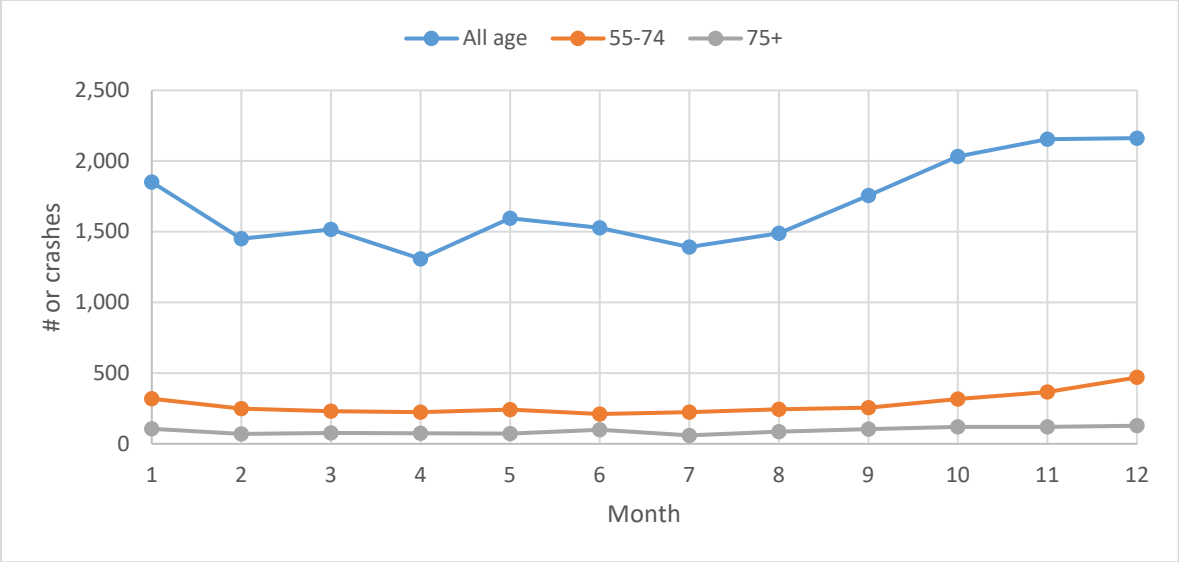

Figure 3.3: Number of Crashes Involving Older Pedestrians by Month

Nationally, NHTSA (*5*) notes a rise in pedestrian deaths. As seen in Figure 3.4, the number and the percent of pedestrian crashes in Massachusetts have mirrored national trends and increased steadily over the decade of study. The percentage of older pedestrian crashes increased from 18% in 2006 to 27% in 2015.

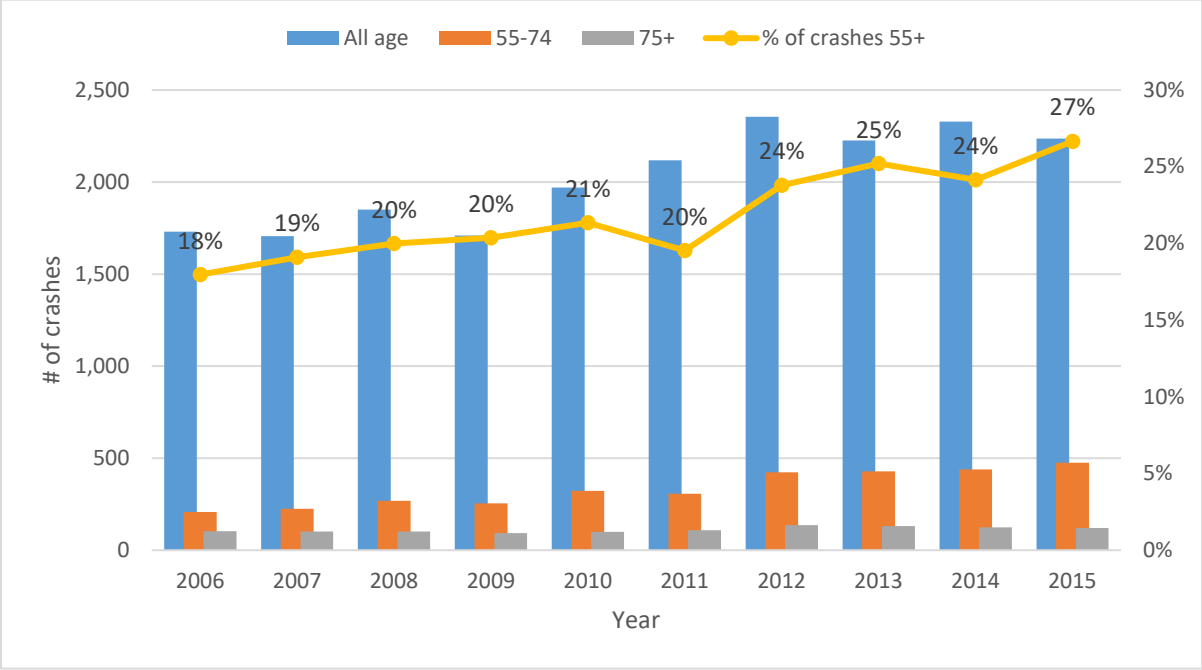

Figure 3.4: Number of Crashes Involving Older Pedestrians by Year

The Fatality Analysis Reporting System (FARS) reports a fatality as a death that occurs within 30 days of a motor vehicle crash and is the direct result of the crash. With respect to the severity of crashes involving older pedestrians in Massachusetts, as Figure 3.5 illustrates,

74% of the crashes involved nonfatal injuries, 7% with fatal injuries, and 15% caused property damage.

More than 60% of older adults in Massachusetts have 4 or more comorbidities (*2*), and complications from injuries sustained in a pedestrian crash may lead to a downward spiral in health that takes longer than 30 days to conclude. Thus, current rates of older pedestrian fatalities based on a 30-day window may be underestimates. Future research could investigate the extent to which a nonfatal injury results in death after 30 days or causes that individual to relocate from a community-based to an institutional setting.

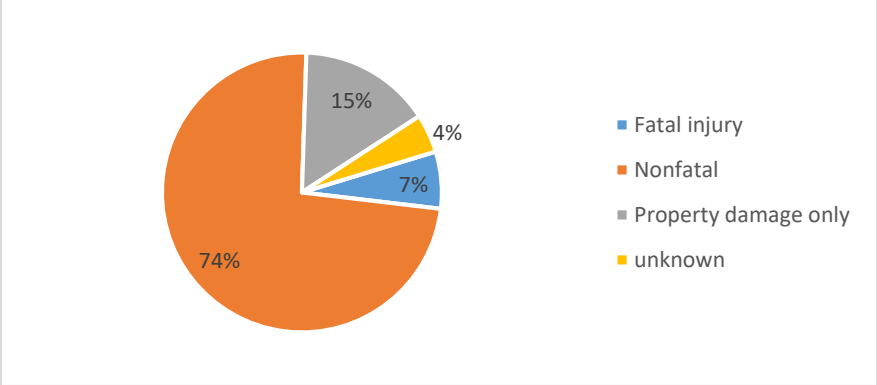

Figure 3.5: Severity of Crashes Involving Older Pedestrians

Table 3.1 shows the frequencies for the number of pedestrians age 55 or older involved in crashes. Most crashes (96.6%) involved a single pedestrian, however one crash involved seven pedestrians.

Table 3.1: Number of Older Pedestrians Involved in a Single Crash

Number of pedestrians	Frequency	Percent of total older pedestrian crashes
1	4,320	96.6
2	129	2.88
3	15	0.34
4	5	0.11
5	2	0.04
7	1	0.02

3.3 Drivers involved in crashes with older pedestrians

Figure 3.6 shows the ages of drivers that were involved in crashes with older pedestrians. About one-half of the drivers involved in older pedestrian crashes were younger (ages 25-54) and about 37% of the drivers were older than age 55. These rates correspond to the

percentage of the driving population for each age group in MA (54% licensed drivers between age 25 and 55, and 38% 55 and older).

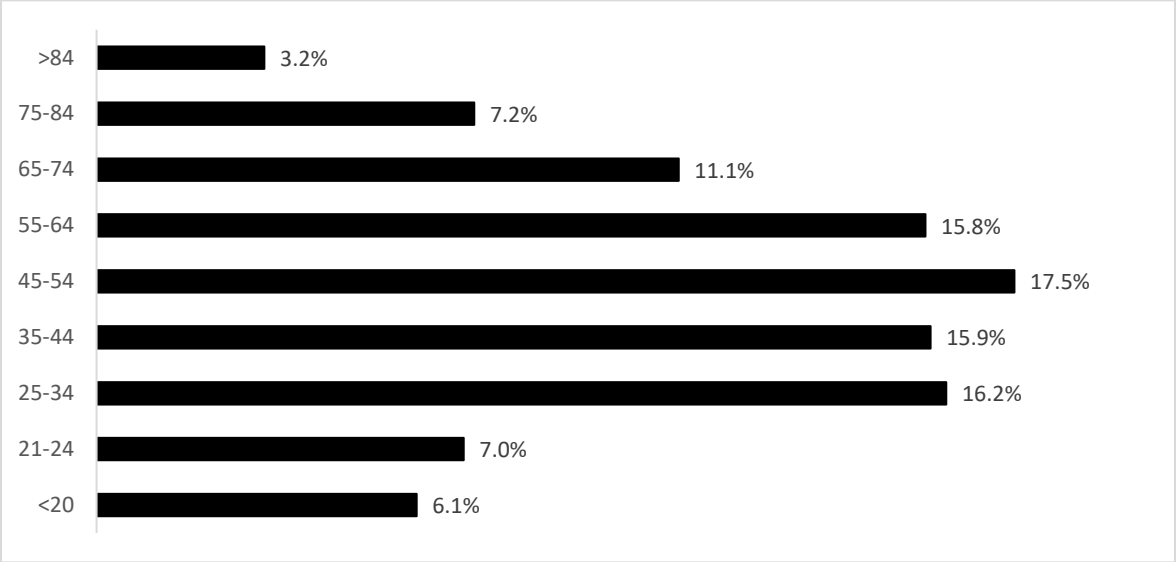

Figure 3.6: Distribution of Drivers' Ages

When pedestrian crashes happened, over a third (35.4%) of the drivers were not cited for any improper driving behaviors. However, when a driver was cited, the leading reasons were driver inattention (21.8%), driver failure to yield right of way (12.4%), and glare (5.4%).

Driver problems contributing to older pedestrian crashes can be collapsed into 5 categories:

- attention (inattention, distraction, disregarded traffic signals/signs),
- speed (driving too fast, exceeding speed limit),
- health-related (physical impairment, illness, history heart/epilepsy/fainting, emotional, fatigued/sleep),
- vision-related (glare and visibility obstructed), and
- driver errors (fail to yield right of way, operating in erratic, reckless, careless, negligent, aggressive manner, improper turn, swerving, wrong way, followed too closely, overcorrecting, other improper action).

Countermeasures aimed at driver issues should address these 5 categories, with priority given to interventions related to problems with driver attention. Table 3.2. compares driver issues in older pedestrian crashes by age group (25-54, 55+). The older drivers were less frequently cited for speed, driver error, or vision issues, but had were more often cited for attention and health-related problems in older pedestrian crashes.

Table 3.2: Drivers' Factors Contributing to Crash by Drivers' Age Group

Reason	Age 25-54 (%)	55 and older (%)
Attention	**51.1**	**53.3**
Disregarded traffic signs, signals, road markings	7.0	4.8
Distracted	5.6	3.8
Inattention	38.5	44.6
Speed	**1.5**	**1.3**
Driving too fast for conditions	0.9	1.0
Exceeded authorized speed limit	0.5	0.3
Health related	**1.8**	**2.6**
Emotional	0.4	0.7
Fatigued/asleep	0.6	0.0
History heart/epilepsy/fainting	0.5	0.1
Illness	0.0	0.0
Physical impairment	0.7	1.8
Driver errors	**47.7**	**44.4**
Failed to yield right of way	25.4	22.6
Failure to keep in proper lane or running off road	1.7	1.4
Followed too closely	0.3	0.1
Made an improper turn	1.1	0.7
Operating vehicle in erratic, reckless, careless, negligent or aggressive manner	7.5	8.1
Other improper action	9.5	10.5
Overcorrecting/oversteering	0.2	0.1
Swerving or avoiding due to wind, slippery surface, vehicle, object, nonmotorist in roadway, etc.	0.9	0.3
Wrong side or wrong way	0.6	0.5
Operating defective equipment	0.4	0.0
Vision	**20.3**	**19.2**
Glare	10.3	9.2
Visibility obstructed	9.9	10.1

3.4 Description of older pedestrians involved in crashes

We examined the location of older pedestrians in a crash. Results showed that pedestrians were hit mostly in the roadway (38.4%), at a marked crosswalk at an intersection (34.6%), fewer were not in the roadway at the time of the crash (7.8%), or at intersections without crosswalks (7.7%), as illustrated in Figure 3.7. These findings were consistent with the previously mentioned SHSP report that found pedestrians were in the roadway (44%) or at a marked crosswalk (27%) (*6*, p.23).

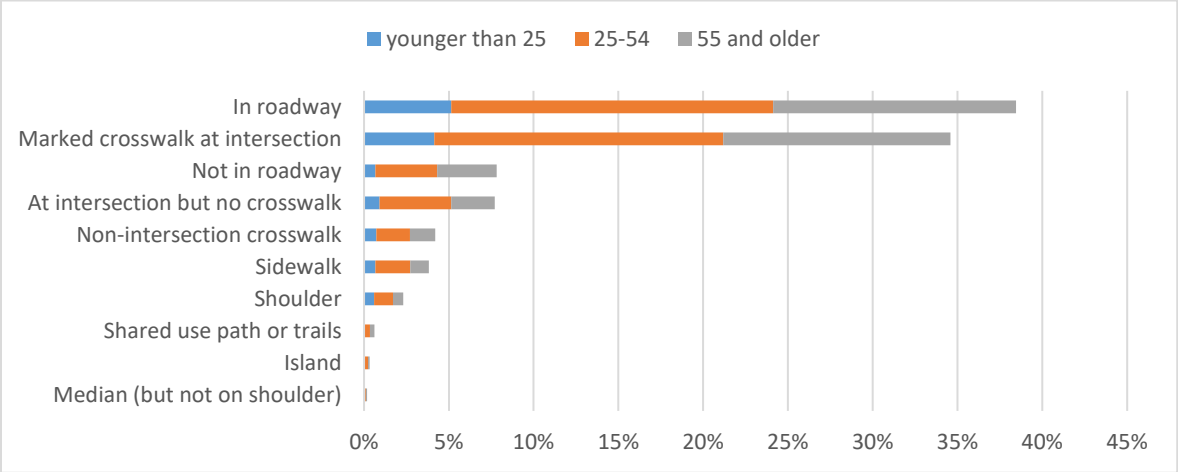

Figure 3.7: Older Pedestrians' Locations when Crashes Happened by Drivers' Age

We next examined what behavior or pedestrian action occurred at the time of the crash. We found that most were entering or crossing specified locations (44.4%), walking, running, or cycling (42.9%) as illustrated in Figure 3.8 (Note: While the category is walking, running, or cycling we assume most were walking).

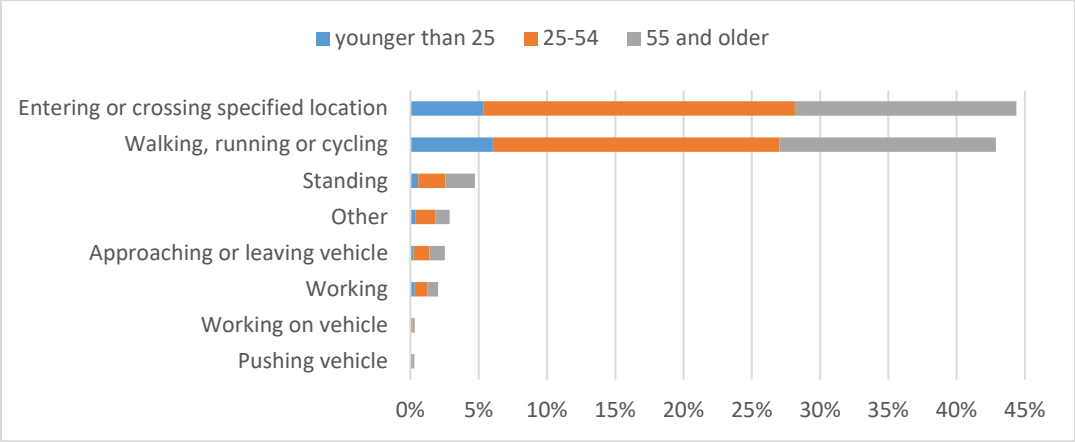

Figure 3.8: Older Pedestrians' Actions when Crashes Happened by Drivers' Age

Figure 3.9 shows the results of cross-tabulation of older pedestrians' behavior at different locations when involved in crash. Overall, we found that older pedestrians were hit walking

in the road, often in crosswalks at intersections. Pedestrian safety awareness campaigns could emphasize a variety of ways to improve safety in the road (e.g., dress to be seen, increase visibility, walk facing traffic) and crossing intersections (e.g., increase visibility, look both ways and all around, make eye contact with drivers, signal intention to cross with a wave or gesture).

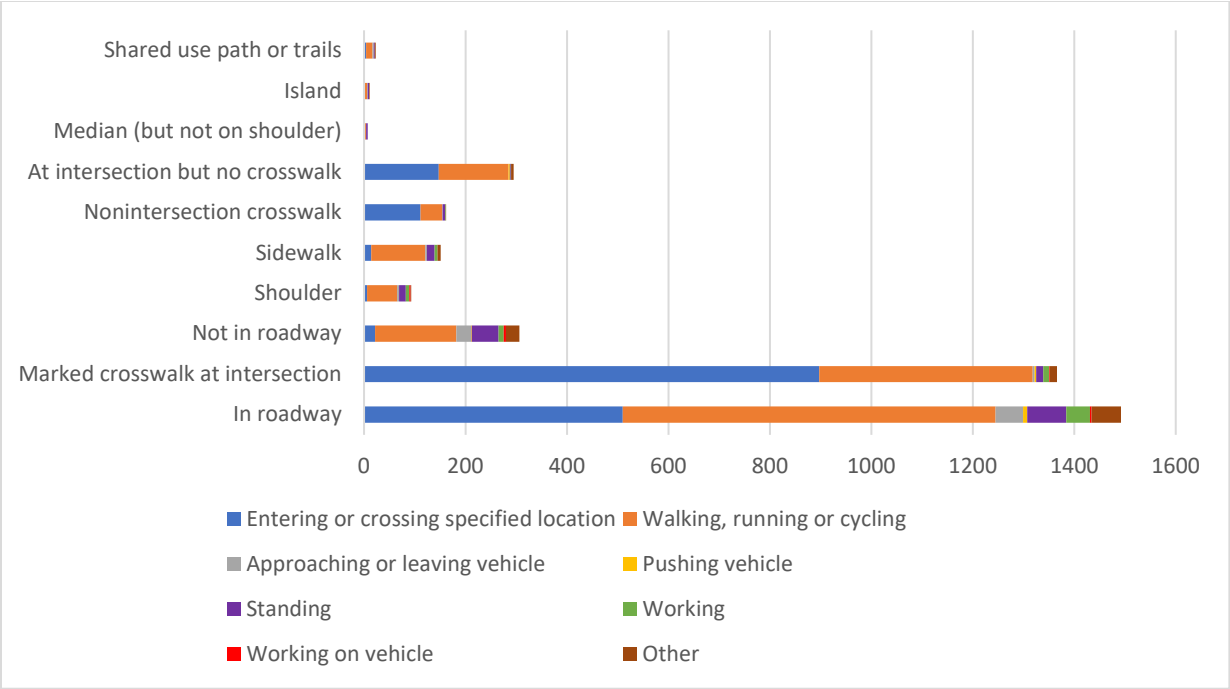

Figure 3.9: Older Pedestrians' Location by Action when Crashes Happened

3.5 Community level examination

Using ArcGIS software, the number of crashes involving older pedestrians and crash rate by community were presented on shaded maps of Massachusetts. Figure 3.10 shows the density of individuals over age 65 throughout Massachusetts. The range of pedestrian crashes per community ranged from 0-293 as seen in the map in Figure 3.11, which shows the number of older pedestrian crashes by town (2006-2015). Communities with higher numbers of crashes clustered toward the eastern area of the state aligning closely with population density data.

The ten communities with the **highest numbers** of crashes involving older pedestrians were urban areas and are listed in Table 3.3.

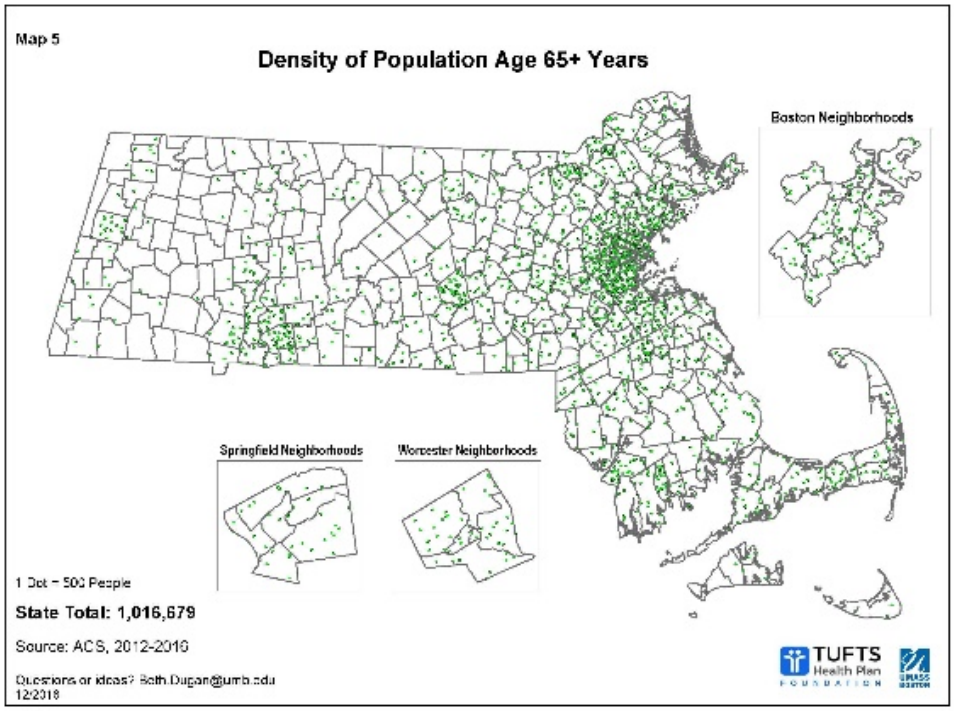

Figure 3.10: Density of Population Age 65+ Years

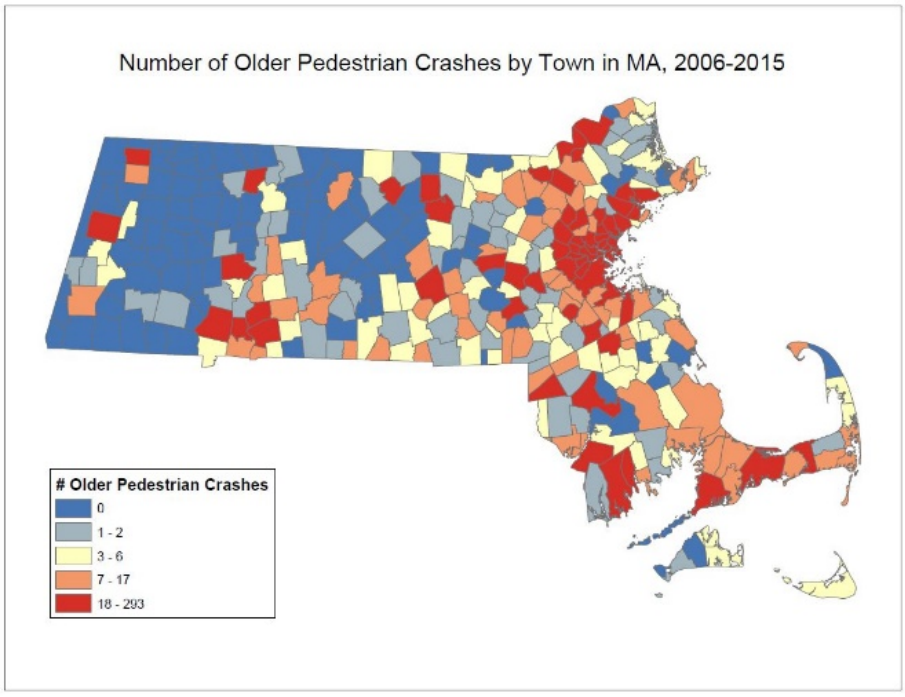

Figure 3.11: Map of the Number of Crashes Involving Older Pedestrians by Town in Massachusetts

Table 3.3: Top 10 communities with most older pedestrian crashes

Rank	Community	No. of Crashes
1	Boston	293
2	Worcester	194
3	Cambridge	171
4	New Bedford	156
5	Quincy	144
6	Fall River	141
7	Lynn	133
8	Newton	121
9	Brockton	119
10	Springfield	112

To account for the increased risk of exposure in densely populated areas we also calculated per capita rates of pedestrian crashes. Rates were calculated for crashes involving older pedestrians per 1000 older adults aged 55 and over for each community in Massachusetts. In the per capita analyses illustrated in Figure 3.12 we found that the communities with higher pedestrian crash rates are scattered across the state. The **highest per capita crash rates** are shown in Table 3.4:

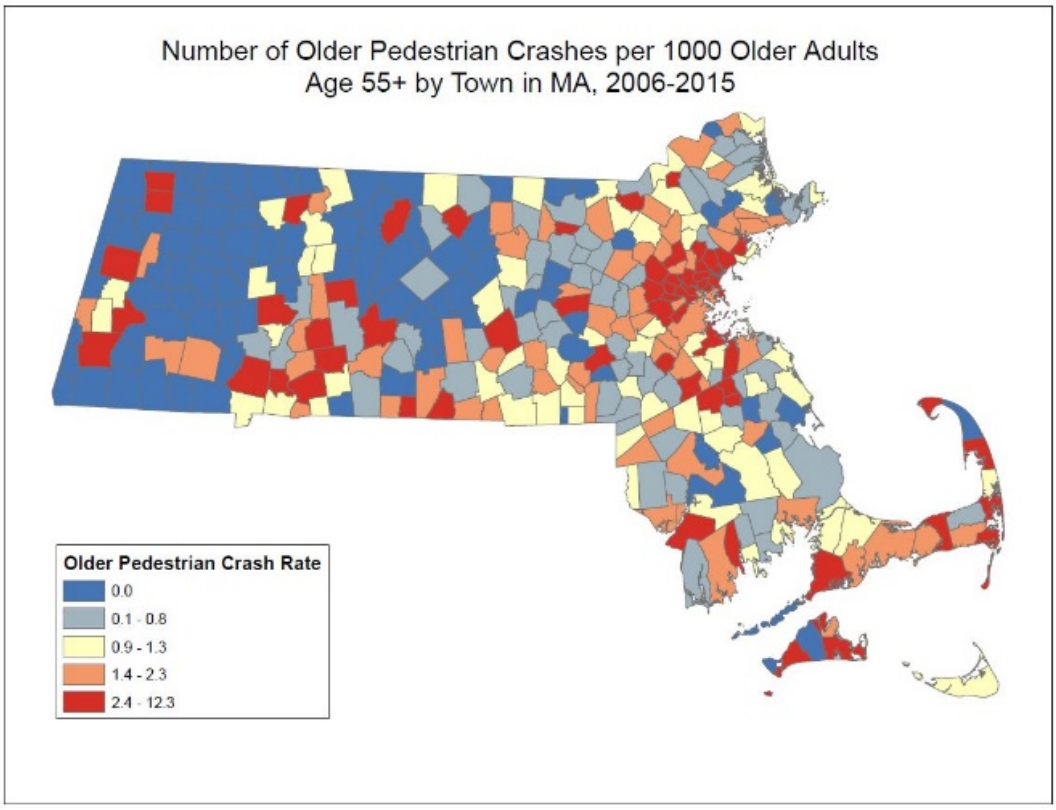

Figure 3.12: Map of Older Pedestrian Crash Rate by Town in Massachusetts

Table 3.4: Top 10 communities for older pedestrian crashes per 1000 adults age 55+

Rank	Community	No. of Crashes
1	Chelsea	12.3
2	Holliston	11.0
3	Holland	10.7
4	Provincetown	10.2
5	Pelham	10.2
6	Cambridge	8.0
7	Lynn	6.2
8	New Bedford	6.0
9	Waltham	5.8
10	Fall River	5.6

Communities that were in the top ten in Massachusetts for both the count *and* per capita rate of older pedestrian crashes **should be priority targets for countermeasures**. They were:

- **Cambridge** (171 crashes, 8 per 1,000 adults age 55+),
- **Fall River** (141 crashes, 5.6 per 1,000 adults age 55+),
- **Lynn** (133 crashes, 6.2 per 1,000 adults age 55+), and
- **New Bedford** (156 crashes, 6 per 1,000 adults age 55+).

Crash locations involving older pedestrians were mapped using ArcGIS software. Optimized Hot Spot analysis relevant with the Getis-Ord Gi* statistical calculation was performed. With the pedestrian crash locations, the Optimized Hot Spot analysis first collapsed coincident or nearest neighbor points together. Then, it computed the average and the median distance between collapsed points of crash and tested the significance of the hot spot by providing z-scores generated by the Getis-Ord Gi* statistical method. Hot spot analysis identified three areas with statistically significant high density of crashes: **(1) northern Boston and nearby communities, (2) Fall River, and (3) New Bedford**. Red and orange dots (the top two items in the legend) in Figure 3.13 indicate high cluster of crashes. Figure 3.14 and 3.15 provide enlarged views of hot spots for the three areas. Red and blue dots show significant hot or cold spots based on different confidence intervals.

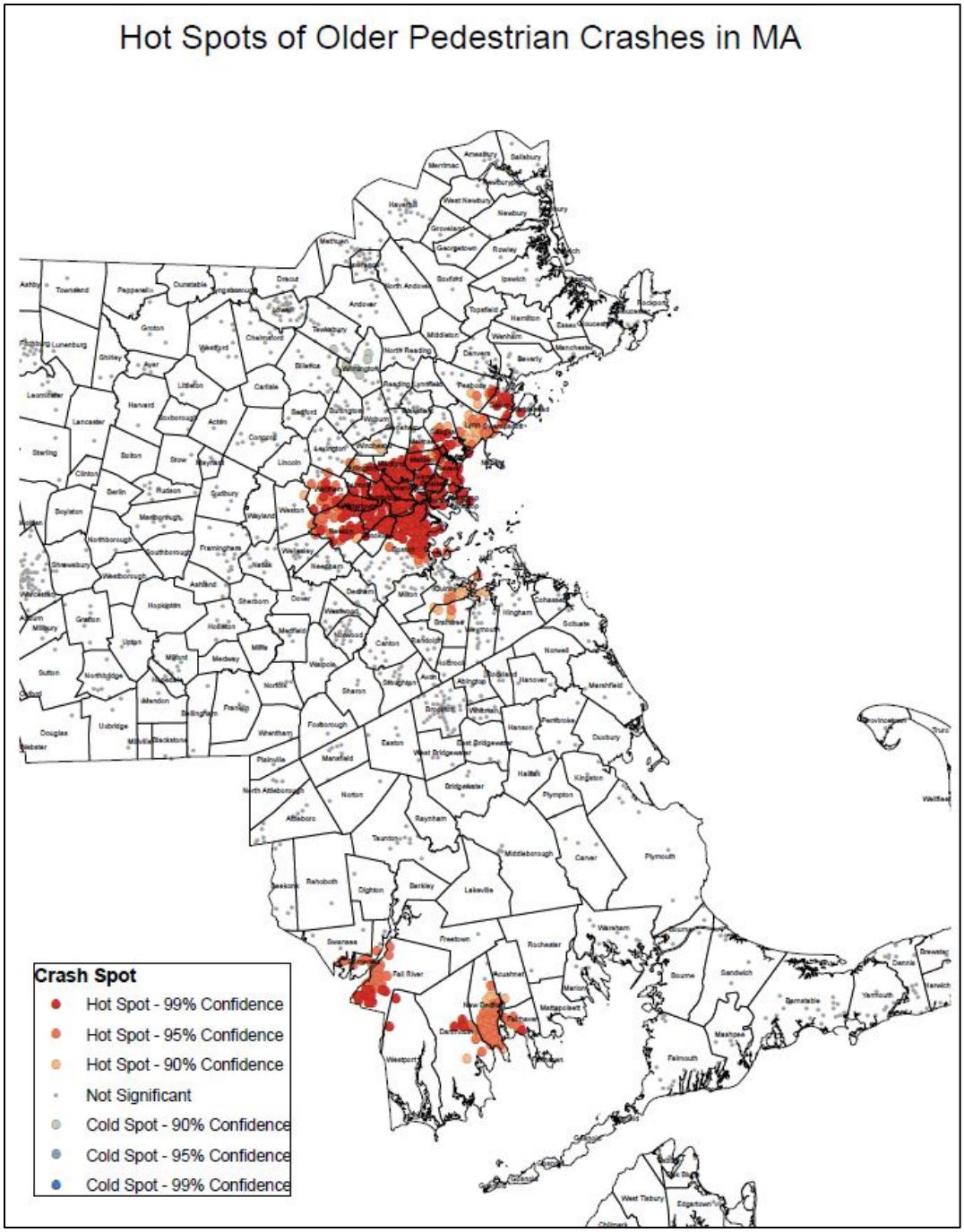

Figure 3.13: Hot Spot Analysis of Older Pedestrian Crashes

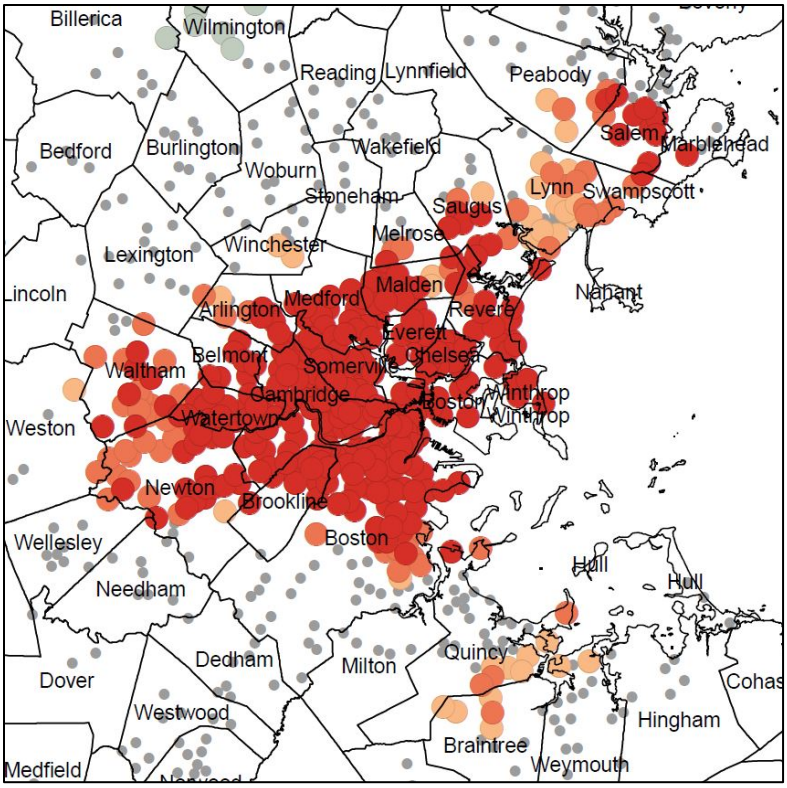

Figure 3.14: Hot Spots of Older Pedestrian Crashes in Boston Area

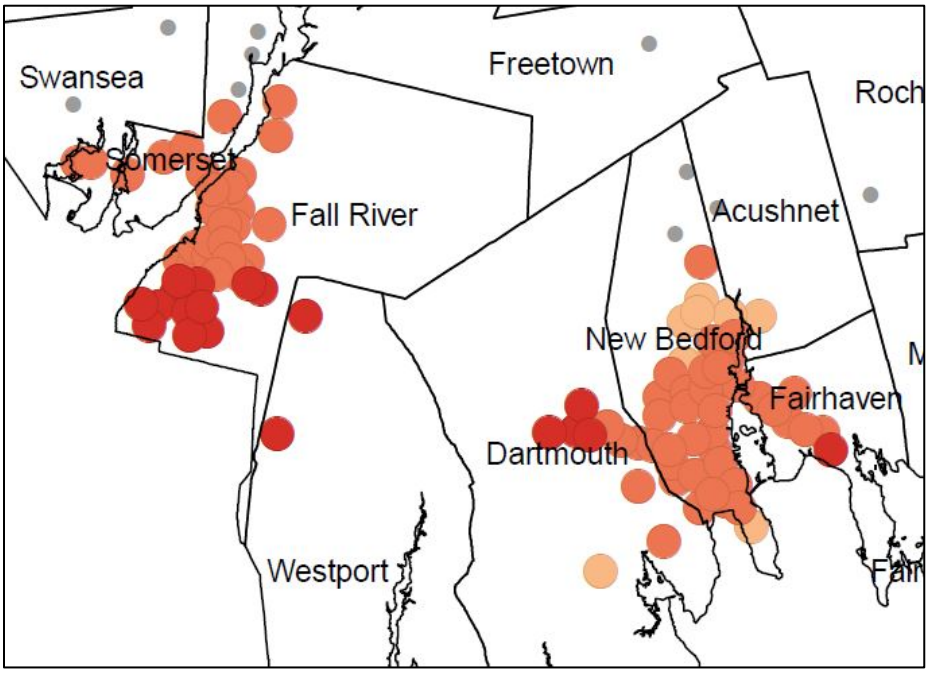

Figure 3.15: Hot Spots of Older Pedestrian Crashes in Fall River and New Bedford

3.6 Case Study from New Bedford

We selected New Bedford for a case study because it was a community with one of the highest number of crashes, a high per capita rate of older pedestrian crashes, and was identified as a hotspot for older pedestrian crashes. Between 2006 and 2015, New Bedford experienced 156 crashes involving older pedestrians. Only Boston, Worcester, and Cambridge had more pedestrian crashes involving older pedestrians.

New Bedford is a Gateway City in Massachusetts with a total population of 94,988. Gateway Cities are urban hubs around the state previously known for their mills and industry. The Massachusetts Legislature defines the 26 Gateway Cities as: Attleboro, Barnstable, Brockton, Chelsea, Chicopee, Everett, Fall River, Fitchburg, Haverhill, Holyoke, Lawrence, Leominster, Lowell, Lynn, Malden, Methuen, New Bedford, Peabody, Pittsfield, Quincy, Revere, Salem, Springfield, Taunton, Westfield, and Worcester.

Approximately 21% of New Bedford residents are aged 60 or older. New Bedford is actively working to become an Age-Friendly Community, with good ratings of transportation performance (alltransit.cnt.net) and walkability scores (walkscore.com). However, compared to Massachusetts state averages New Bedford has higher crime rates, a higher rate of older adults with low income, and a lower rate of older adults who always drive wearing a seatbelt. To learn more about healthy aging in New Bedford, see Appendix C.

The crash locations in New Bedford are highly clustered. For the New Bedford case study three areas with the highest density and severity of crashes were identified (see Figure 3.16). We physically examined 18 crash locations, including 7 from Area 1, 7 from Area 2, and 4 from Area 3 (selected locations are marked with a "√"). Among the 18 locations, two had multiple crashes that happened within a 10-year period. Four out of the 18 locations had fatal crashes, and the other 14 locations had nonfatal crashes.

We reviewed FHWA *Guidelines and Recommendations to Accommodate Older Drivers and Pedestrians* (*7*) and the research literature to develop a data collection form (see Appendix A for the checklist). The form recorded the following: the presence of pedestrian control signals, audio command, placard explaining signals, manual controllers, refuge islands, curb cuts, striping crosswalks, lights, sidewalks, traffic calming signs, "no turn on red" signs, and the environmental settings such as nearby bus stops, commercial stores, and miscellaneous services. Researchers from the Gerontology Institute at the University of Massachusetts Boston rated the locations throughout the process and reached consensus on all items recorded. In addition, street width and signal timing were measured using the "Measure" App and the "stopwatch" function in the "Clock" App on researchers' iPhones. Data were collected between 11:30 am and 2:30 pm on Tuesday April 23rd, 2019 a cloudy, overcast afternoon.

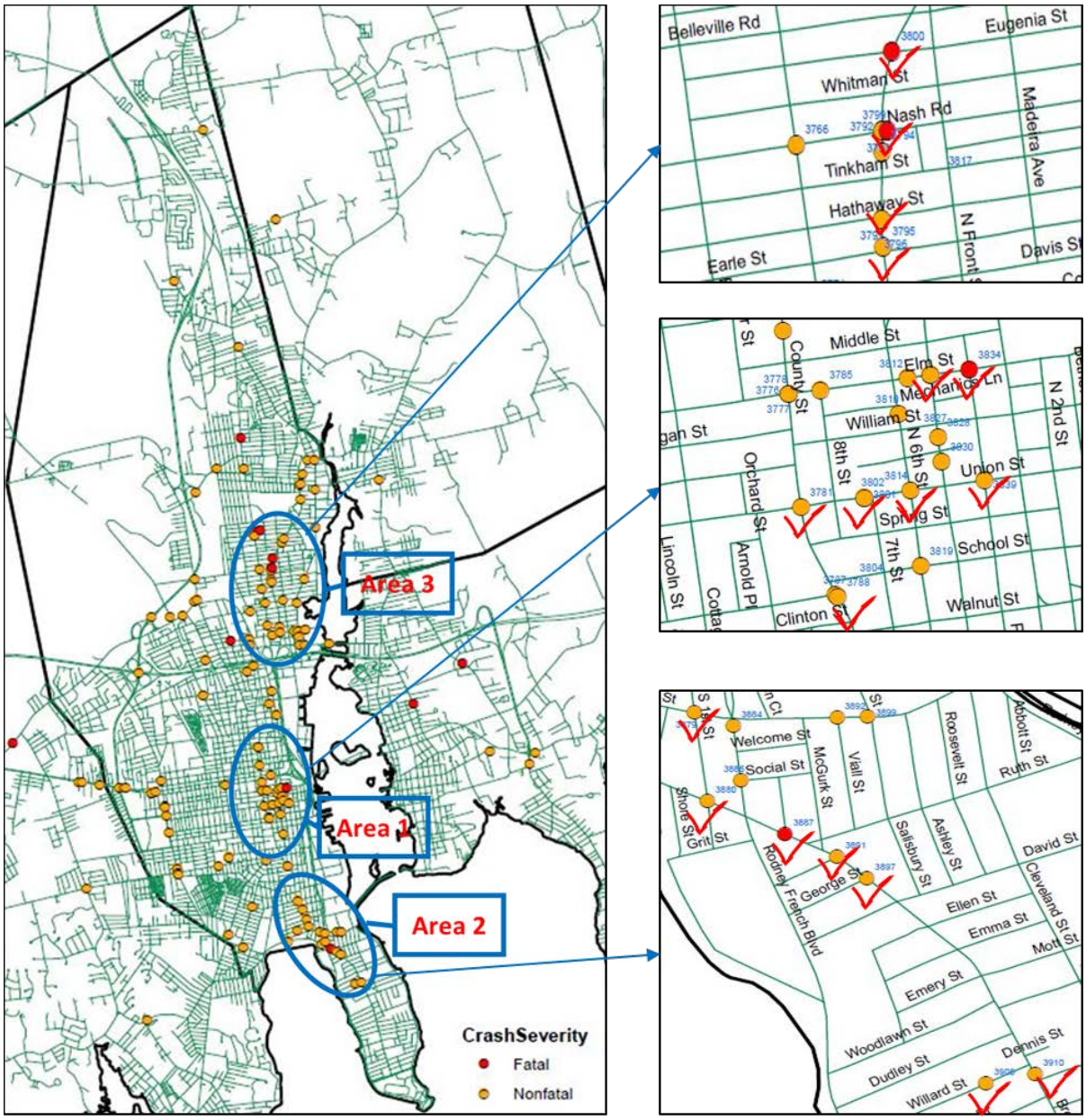

Figure 3.16: Selection Process for Crash Locations Examined in New Bedford

3.6.1. Improvements benefiting older pedestrians in New Bedford

An intersection of five roads known as the "octopus" (Figure 3.17) underwent major renovation that was completed in 2015 and includes many of the elements recommended for older pedestrian safety by the FHWA guidelines and recommendations (*7*). The photos illustrate the noteworthy improvements.

Figure 3.17: The "octopus" (Pleasant, Kempton, Mill, 6th st., and Rte. 6)

There were pedestrian control signals, audio command, placards explaining signals, manual controllers, refuge islands, curb cuts, striping crosswalks, lights, sidewalks, traffic calming signs, and "no turn on red" signs in a pedestrian heavy intersection of 5 streets.

We also conducted a key informant interview with a New Bedford municipal employee who is familiar with infrastructure improvements recently made in New Bedford (identity withheld for privacy protections). These improvements utilize FHWA best practices and can be a model for other municipalities aiming to improve older pedestrian safety.

3.6.2 The characteristics of hotspots

Among the 18 crash locations, a majority (11) have two lanes for traffic plus one lane of parking on each side of the road. This wide street design means that the speed of traffic tends to be higher and older pedestrians face a sizable distance to cross the street. More than half (10/18) of the locations had bus stops nearby, and 15 were in areas with commercial/retail stores. Overall, sidewalks and lighting were present in most locations. Some sidewalk pavement was uneven, and some did not have curb cuts which could be a problem for older pedestrians using a mobility assistance device (i.e., a cane, walker, or wheelchair). One third of the locations did not have a cross walk. For the 2/3 with a crosswalk, most had striping that was faded and less obvious to drivers.

In contrast to the 2015 improvement at the “octopus” intersection, the four photos in Figure 3.18 – 3.21 illustrate safety concerns at the locations of fatal pedestrian crashes. Figures 3.18 and 3.19 illustrate missing crosswalk and/or pedestrian control signage at places with a high volume of pedestrians. Figure 3.18 shows an intersection near a senior apartment building that could benefit from more aggressive pedestrian safety measures given the density of older adults. Figure 3.19 shows a wide intersection which was difficult to cross because there was heavy traffic but no pedestrian control signal or driver guidance regarding pedestrians.

Figure 3.18: Safety concerns at locations of fatal pedestrian crashes (County St & Clinton St)

Figure 3.19: Safety concerns at locations of fatal pedestrian crashes (Brock Ave & 1st St)

Figure 3.20: Safety concerns at locations of fatal pedestrian crashes (Acushnet Ave & Hathaway St)

Figure 3.21: Safety concerns at locations of fatal pedestrian crashes (Purchase St & Elm St)

In Figures 3.20 and 3.21 crosswalks are present, however the painting or striping in the crosswalks are fading. In addition, the pavement is uneven presenting a potential falls risk for older pedestrians.

While some locations in New Bedford are now models of best practices, others present higher risks to older pedestrians. New Bedford is officially taking steps to become age-

friendly harnessing the insight and contributions of stakeholders to make the community a great place to grow up and grow older.

- There are opportunities to leverage this status to extend New Bedford's focus to enhancing pedestrian safety and senior mobility and secure funding to make improvements (e.g., via community compact, AARP grants, Tufts Health Plan Foundation momentum funds, and MassDOT).

3.7 Population Health and Environmental Factors

3.7.1 Bivariate Analyses

Next, our analyses used the MA Healthy Aging Data Report (*2*) to understand how community factors may be related to pedestrian crashes. First, we calculated bivariate correlations and found positive associations between older pedestrian crashes and:

1. community prevalence of Alzheimer's disease and related disorders;
2. hearing and visual impairment rates;
3. percentage of older adults injured in a fall within a year, and
4. the number of senior housing sites.

Maps illustrating the statewide distribution of the conditions in older adults are as follows (Figures 3.22 – 3.25, green pins designate communities with the highest rates).

- The state rate for Alzheimer's disease or a related dementia was 13.6%, and ranged from 6% in Wellfleet to 23.6% for neighborhoods in Springfield (South End, Six Corners, Metro Center, Memorial Square, Brightwood).
- The state rate for percentage of resident's age 60 or older injured in a fall in the last 12 months was 10.6%, and ranged from 6.7% (Taunton) to 18% (Marblehead).
- The state rate for the percentage of Medicare beneficiaries age 65+ with vision difficulty was 5.8%, and ranged from 0% (Westminster) to 41.9% (Monroe), and the rate for deafness or hearing impairment was 16.1%, and ranged from 9.39% (Gill) to 23.96% (Needham).

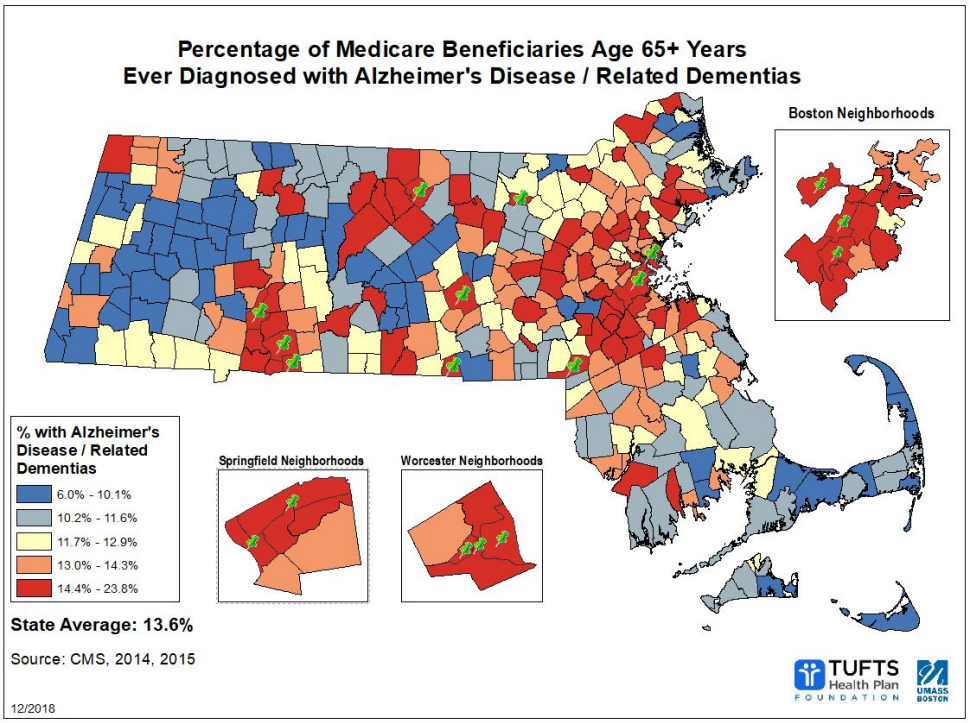

Figure 3.22: Percentage of 65+ Years Diagnosed w/ Alzheimer's Disease or RD

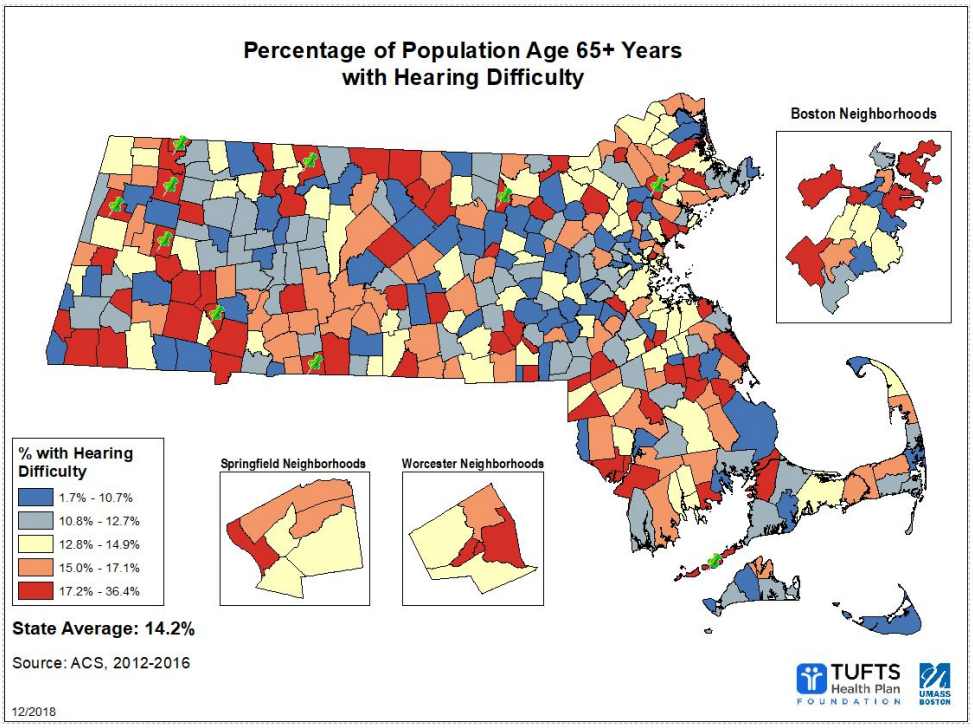

Figure 3.23: Percentage of Population Age 65+ Years with Hearing Difficulty

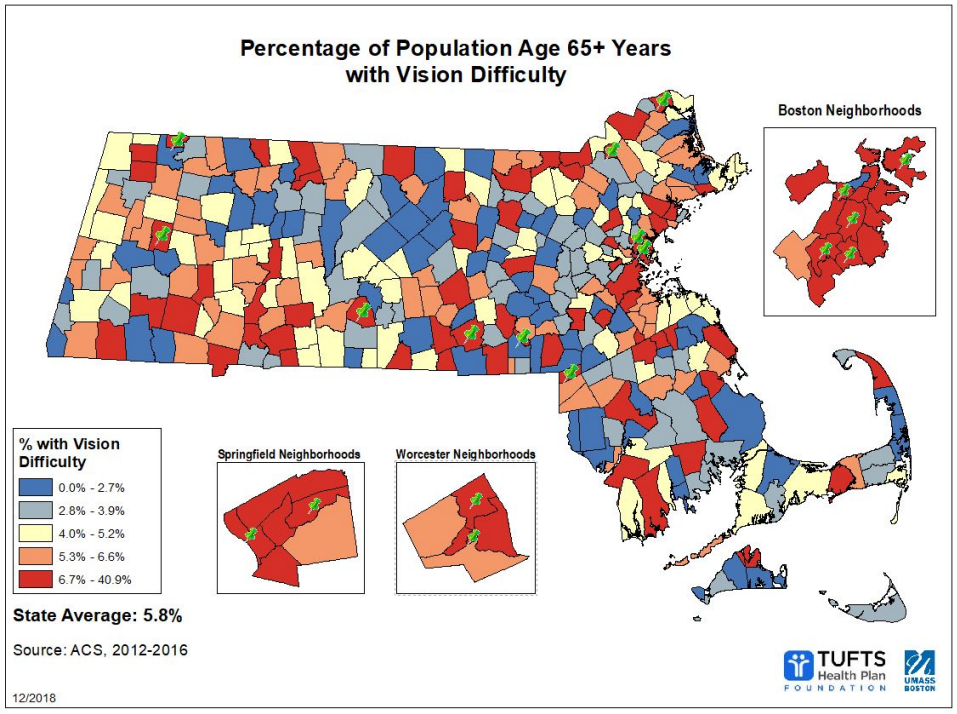

Figure 3.24: Percentage of Population Age 65+ Years with Vision Difficulty

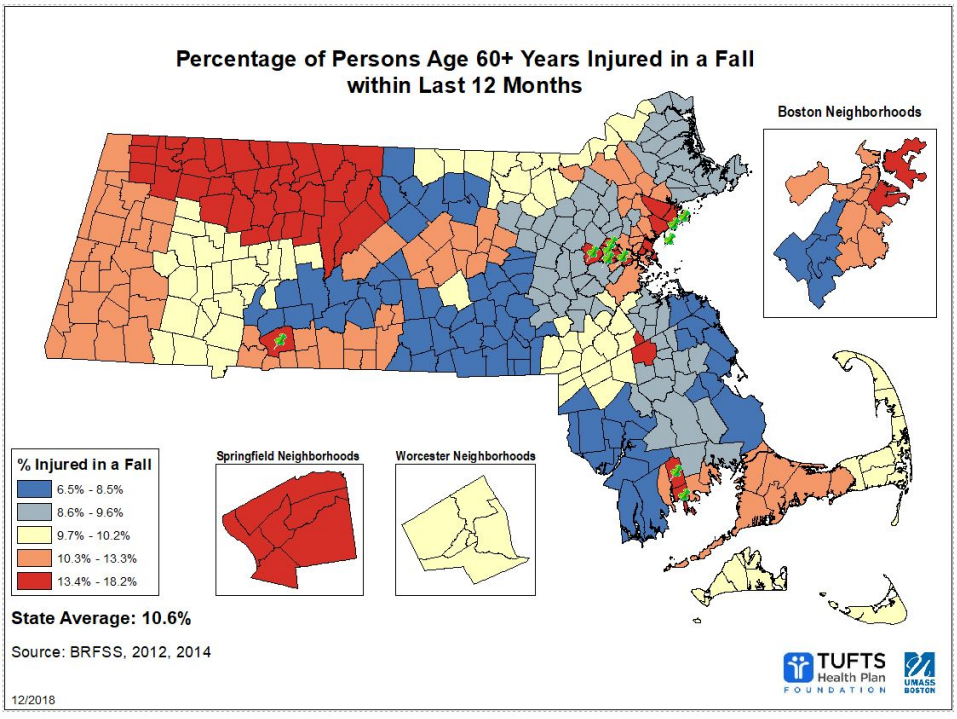

Figure 3.25: Percentage of Persons Age 60+ Years Injured in a Fall w/in past year

3.7.2 Population Healthy Aging and Older Pedestrian Safety

In our previous research (*2,3,4*) for the Tufts Health Plan Foundation we were able to distill the information from 61 chronic diseases, disability, and health service utilization indicators into a summary three factor model of population healthy aging. The three dimensions consistently emerge in MA, NH, and RI data and are strongly related to geographic difference in health outcomes (e.g., mortality rate). The three dimensions were: serious complex chronic disease, physical and mental disability, and indolent disease.

Serious complex chronic disease dimension includes rates of cardiovascular disease (stroke, ischemic heart disease, congestive heart failure, heart attack), mortality, chronic obstructive pulmonary disease, diabetes, lung and colon cancer and use of expensive medical treatments. Communities with the highest rates tend to be industrial areas where the older population has less education and lower incomes.

Physical and mental disability dimension is determined by indicators related to physical and mental disability. It includes vision, cognition, ambulation, self-care, impairments in independent living, Alzheimer's disease, alcohol use disorders, personality disorders, schizophrenia, and bipolar disorders. Communities with the highest rates tend to be densely populated urban areas, including 3 neighborhoods in Boston and two neighborhoods in Worcester.

Indolent disease dimension of population health reflects a higher prevalence of chronic diseases that progress slowly. Most can be managed effectively with medication and regular visits to a doctor. The diagnosis of these condition is associated with good access to medical care. Communities with the highest rates of indolent disease tend to have more education and higher incomes.

Multivariate spatial analyses predicting number of crashes involving older pedestrians using the HADR population health measures and community indicators (*2)* found that after adjusting for the total number of older adults in the communities, significant associations were found for the following indicators (see Appendix B for a table of results):

1. Communities with higher rates of disabilities experienced more crashes (see Table 3.5). The urban neighborhoods of **Boston, Lawrence**, and **Chelsea** had the worst rates on the disability dimension of population health and also had high per capita rates of older pedestrian crashes. Older pedestrians are vulnerable road users, and any impairments in sensory perception or cognitive processing increases the vulnerability. Communities with high rates on the disability dimension of population healthy aging should be alerted to the risks for older pedestrians.

Table 3.5: Communities with High Disability Scores and Older Pedestrian Crash Rates

Community name	Disability score	Crash rate
Chelsea	2.5	12.25
Watertown	1.22	5.27
Somerville	1.6	5.03
Malden	1.88	3.76
Woburn	1.23	3.29
Everett	1.46	3.26
Lawrence	2.64	3.23
Springfield	1.5	3.12
Boston	3.6	2.09
Milton	1.35	1.2

2. Communities with a higher percentage of residents of Other Races had more crashes than communities with high rates of White or Asian adults. This is consistent with past research finding members of racial minority groups had higher risk for pedestrian crashes. Housing in Massachusetts, like the nation, is racially segregated. In the 2015 HADR (*3*), we found that only 10% of the communities in Massachusetts had sufficient numbers of people in two or more racial groups to be able to calculate community level racial comparisons in healthy aging. Table 3.6 shows that 7/10 communities with higher percentages of older residents of Other Races also had among the state's highest rates for adults age 65+ who were Black or of Hispanic ethnicity. **Chelsea, Lynn, New Bedford, Brockton**, **Lawrence,** and **Springfield** are diverse Gateway Cities with high older pedestrian crash rates.

Table 3.6: Communities with High Density of Older Adults of "Other" Race and Older Pedestrian Crash Rate

Community name	% Other race	Crash rate	Rank in % of Hispanic or Black
Chelsea*	15.79	12.25	3rd Hispanic
Lynn*	12.24	6.22	12th Hispanic
New Bedford*	11.18	5.97	NA
Brockton*	6.45	4.97	10th Black
Lawrence*	25.23	3.23	1st Hispanic
Springfield*	6.53	3.12	10th Hispanic, 14th Black
Boston	7.24	2.09	19th Hispanic, 8th Black
Wareham	7.01	1.82	NA
Marion	6.71	1.33	NA
Aquinnah	30.43	0	NA

Note. *indicates a Gateway city (*14*).

3. Higher numbers of cultural amenities (e.g., colleges, libraries, fitness centers) in community were associated with more older pedestrian crashes. Cultural amenities may attract older people with more discretionary or leisure time available to enjoy them (Table 3.7). Municipal leaders should collaborate with cultural amenities to raise awareness of older pedestrian safety and consider ways to maximize safety near amenities.

Table 3.7: Community Cultural Amenities and Older Pedestrian Crashes

Community name	Cultural amenities	Crash rate
Cambridge	19	8.01
New Bedford	8	5.97
Quincy	7	5.42
Brockton	9	4.97
Newton	8	4.64
Worcester	19	4.33
Springfield	20	3.12
Boston	79	2.09
Beverly	7	2.03
Barnstable	10	1.90

4. The number of dementia-related support groups was associated with lower older pedestrian crash rates in the multivariate analyses. Access to dementia-related support

groups is a key step that communities take to become more dementia-friendly and to support caregivers of persons with dementia. Wandering behavior is a serious concern for adults with Alzheimer's disease or a related dementia. It may be that caregivers participating in support groups learn strategies to minimize wandering behavior, thus protecting a vulnerable portion of the pedestrian population.

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4.0 Implementation and Technology Transfer

4.1 Discussion

This research investigated factors contributing to pedestrian crashes of adults age 55 and older. The recommendations that follow are focused on older pedestrian safety. However, given the ageism that is embedded in American culture we recommend that countermeasures be aimed at "pedestrian safety" rather than "older pedestrian safety". Most adults do not consider themselves old, and if they do, they may have internalized negative ageist attitudes. To avoid these macro issues, we frame our recommendations for all pedestrians and "those needing a little more time" which is analogous to how airlines board disabled and older customers.

Overall, we found that older pedestrians were hit while walking in the road, often in crosswalks at intersections. Walking is recommended for health reasons, it is a type of physical activity that is available to nearly all people. The environmental benefits of walking for transportation instead of driving are significant. The population is aging and there are more older pedestrians on the streets and sidewalks. Based on the results of this research we propose the following recommendations.

4.1.1 Recommendations

Recommendation 1: Convene stakeholders to raise awareness of older pedestrian safety issues and to spur innovations to improve safety.

Such a convening could be held in collaboration with the Governor's Council to Address Aging Issues in Massachusetts to minimize expenses and logical burdens and to maximize its reach. For example, what if the button that pedestrians press to trigger the walk signal at a crosswalk offered options that corresponded to functional ability? So press up for the regular time, press down for extra time. Such an option would help older adults with slower gait, parents with young children, or people with disabilities.

Municipal stakeholders could share best practices ideas or cooperate with neighboring communities to make limited funding stretch farther. Technical and business development innovators may create new solutions that further establish Massachusetts as the Silicon Valley of aging innovations. Philanthropic stakeholders focused on health, aging, and environmental concerns should be engaged as well. The convening would inform recommendation #2.

Recommendation 2: Raise awareness about older pedestrian safety.

Engage stakeholders (e.g., Massachusetts Healthy Aging Collaborative, Massachusetts Councils on Aging, MA Executive Office on Elder Affairs, AgeStrong Boston, Walk Boston, AAA, RMV, MA Department of Public Health, Massachusetts Medical Society, Tufts Health

Plan Foundation, Barr Foundation, the Boston Foundation, etc.) on a public awareness campaign during the winter months when pedestrian crashes are highest. Develop focused messages for older pedestrians, for drivers, and for related professionals (e.g., planners, aging service providers, housing developers, municipal leaders, policy makers). An emphasis on risky locations (intersections) and the need to be alert to safety threats is warranted. Preliminary planning is underway with stakeholders to blitz social media in November, December, and January with safety messages.

Recommendation 3: Collaborate with municipalities to increase the number, safety, and visibility of crosswalks to counteract the problems related to driver inattention to older pedestrians.

Driver inattention and driver distraction are serious threats to pedestrian safety. Finding ways to help municipalities mitigate the risk of inattentive or distracted drivers is indicated. We identified ten communities with the highest per capita (per 1,000 adults age 55+) of older pedestrian crash rates and suggest starting with these communities: **Boston, Brockton, Cambridge, Fall River, Lynn, New Bedford, Newton, Quincy, Springfield, and Worcester**.

Recommendation 4: If possible, prioritize infrastructure improvements (e.g., sidewalks, crosswalks) in the communities with the highest risks: Cambridge, Fall River, Lynn, and New Bedford.

Provide technical and financial support to help these communities take a complete streets approach to improve pedestrian safety. Examples of countermeasures include: low-speed street designs, shortened crossings, raised and/or enhanced crosswalks, longer signal timing, adding intersection lighting and lighting along roadway, prohibiting right turn on red, and prohibiting parking near intersections and crosswalks (*12*).

4.1.2 Limitations

Some limitations to note. First, there are limitations described fully in the technical report of the MA Healthy Aging Data Report (*2*) related to data sources and our hierarchical approach to reporting geographic units. Those limitations will apply to the analyses reported here using that data. Second, we understand that there are some reporting inconsistencies in the greater Boston crash data. Those reporting issues are why we did not do a site visit in Boston. Third, we did not take a closer look at the range of non-fatal injuries (74%) in older pedestrians, but think future research should. That examination may provide a greater understanding of the implication of crash involvement on quality of life. For example, did the older pedestrian return home following crash involvement? Or did the individual now reside in a rehab or skilled nursing facility? Or, did death occur within six months following crash involvement? We think the long-term consequences of older pedestrian crashes warrant further research. Fourth, it may be helpful for future analyses to be able to have separate codes for pedestrian mobility modes (walking, running, and cycling) (see Figure 3.8) at the time of crash involvement because each mode might suggest different strategies for countermeasures.

5.0 Conclusions

This study had five aims that were accomplished.

1. Analyses identified where, when, how, and who were impacted by crashes involving older pedestrians. December and January were the months with the highest number of crashes involving older pedestrians. Among all older pedestrian crashes nearly all (97%) involved a single pedestrian. Most crashes were not fatal. Problems with attention among drivers was cited in more than half of the crashes. We identified ten communities with the highest number of crashes and communities with the highest per capita crash rate for older pedestrian crashes.
2. We conducted a field visit to New Bedford, a crash hot spot to collect data on the presence of Federal Highway Administration (FHWA) guidelines and recommendations for older pedestrian safety (*7*). Numerous issues related to roadway design and pedestrian behavior were observed. The case study in New Bedford revealed that driver speed, wide crossing areas with few or no marked crosswalks, pedestrian signals, or curb cuts. We followed up a key informant interview and with a second field visit to get feedback on our observations and to learn about recent innovations.
3. We examined if the community rates for age-related medical conditions associated with older pedestrian crash rates and injury severity, and if there was any relationship to community efforts to become dementia- and age-friendly. We found that Alzheimer's Disease and related dementias, vision and hearing impairment, and falls were related to older pedestrian crash rates. No significant relationships were found to be associated between rate of crash involvement and a community's effort to become dementia and/or age-friendly.
4. We examined how community population health and/or built environment factors were associated with older pedestrian crash rates and injury severity. Communities with the highest rates of physical and mental disability had the highest risks for crashes involving older pedestrians. These communities tended to be in urban areas and could be priority targets for intervention.
5. In collaboration with our MassDOT partners we identified potential countermeasures suggested by the results of analyses.

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6.0 References

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7.0 Appendices

7.1 Appendix A: University of Massachusetts Boston Pedestrian Safety Checklist

					Legend:1=present, 0=not present
Case #					
Street name					
# of lanes to cross					
Pedestrian control signal[1]					
Adequate timing to cross street (2.8ft/s) [1]					
Audio command[1]					
Placard explaining signal, manual controller[1]					
Pedestrian refuge islands[1]					
Curb cut					
Painted cross walk					
Even pavement on roadway					
Lighting exists					
Sidewalks					
Bus stop within 300m					
Commercial within 300m					
"Yield to pedestrian" sign at potential right-turn and pedestrian conflicts[1]					
NTOR at intersections with high volumes of pedestrian and vehicles[1]					
Speed limit					
Notes/Problems observed					

Note. **[1]** Taken from the FHWA guidelines and recommendations (*7*).

7.2 Appendix B: Results from Multivariate Spatial Analyses Predicting Number of Crashes Involving Older Pedestrians

Indicators	Coefficient	Significance
Population health		
Serious and complex chronic disease	0.07	
Disability	4.32	**
Indolent disease	-3.18	**
Environment factors		
Social environment	-0.89	
Medical providers	1.54	
Environmental amenities	3.75	**
% food desert	-0.02	
Population characteristics		
Number of population 55+	0.00	***
% females	-0.31	
% living alone	0.17	
% White	reference	
% African American	-0.47	***
% Asian	-0.15	
% other race	1.03	*
% Hispanics	-0.48	
Age- and dementia-friendly effort		
Age-friendly effort	0.35	
Number of dementia-related support groups	-2.53	**

Note. *$p < .05$; **$p < .01$; ***$p < .001$.

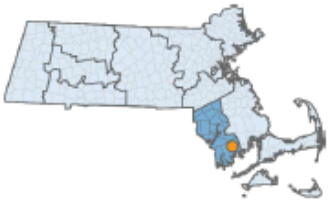
7.3 Appendix C. New Bedford Community Profile

2018 MASSACHUSETTS HEALTHY AGING COMMUNITY PROFILE

TUFTS Health Plan FOUNDATION

New Bedford (Bristol)

New Bedford is a Gateway City in Massachusetts with 14,541 residents aged 65 or older. The transit score suggests there is good transit (6/10). Compared to state averages, older residents have lower rates of PTSD, leukemias/lymphomas, breast cancer, ulcers, traumatic brain injury, and glaucoma. Yet, they have higher rates of tooth loss, obesity, high cholesterol, depression, diabetes, anxiety/bipolar disorders, schizophrenia/other psychotic disorders, stroke, substance/tobacco use disorders, Alzheimer's disease, COPD, asthma, hypertension, heart attack, congestive heart failure, ischemic heart disease, peripheral vascular disease, arthritis, osteoporosis, prostate cancer, benign prostatic hyperplasia, anemia, liver disease, fibromyalgia, epilepsy, cataract, and hearing/mobility impairments. They are also less likely to engage in physical activity, sleep adequately, have a shingles vaccine, or annual dental exams. It has been designated an Age-Friendly Community and some resources include a walking club, YMCA, and arts/cultural center.



POPULATION CHARACTERISTICS	BETTER / WORSE STATE RATE[1]	COMMUNITY ESTIMATE	STATE ESTIMATE
Total population all ages		94,988	6,742,143
Population 60 years or older as % of total population		20.8%	21.2%
Total population 60 years or older		19,779	1,428,144
Population 65 years or older as % of total population		15.3%	15.1%
Total population 65 years or older		14,541	1,016,679
% 65-74 years		49.6%	55.3%
% 75-84 years		29.7%	29.4%
% 85 years or older		20.7%	15.2%
Gender (65+ population)			
% female		60.7%	57.2%
Race/Ethnicity (65+ population)			
% White		85.0%	90.0%
% African American		3.6%	4.3%
% Asian		0.2%	3.2%
% Other		11.2%	2.5%
% Hispanic/Latino		4.8%	3.8%
Marital Status (65+ population)			
% married		44.2%	52.5%
% divorced/separated		15.5%	14.0%
% widowed		32.4%	25.5%
% never married		7.9%	8.0%
Education (65+ population)			
% with less than high school education		43.1%	16.5%
% with high school or some college		44.9%	52.6%
% with college degree		12.0%	30.9%
% of 60+ LGBT (county)		2.6%	3.2%
% of 65+ population living alone		36.9%	30.2%
% of 65+ population who speak only English at home		61.5%	83.3%
% of 65+ population who are veterans of military service		15.2%	18.8%
Age-sex adjusted 1-year mortality rate	W	4.9%	4.2%

HEALTHY AGING INDICATORS	BETTER / WORSE STATE RATE[1]	COMMUNITY ESTIMATE	STATE ESTIMATE
Geographic Migration (65+ population) in the past 12 months			
% moved within same county		5.3%	3.6%
% moved from different county in Massachusetts		0.3%	1.1%
% moved from different state		0.4%	0.8%
WELLNESS & PREVENTION			
% 60+ with any physical activity within last month	W	57.4%	73.3%
% 60+ met CDC guidelines for muscle-strengthening activity	W	13.4%	27.7%
% 60+ met CDC guidelines for aerobic physical activity	W	41.4%	56.8%
% 60+ met CDC guidelines for both types of physical activities	W	8.8%	20.8%
% 60+ getting recommended hours of sleep	W	53.2%	62.7%
% 60+ injured in a fall within last 12 months		11.8%	10.6%
% 65+ had hip fracture		3.5%	3.7%
% 60+ with self-reported fair or poor health status	W	32.0%	18.0%
% 60+ with 15+ physically unhealthy days last month		18.9%	12.7%
% 60+ with physical exam/check-up in past year		90.2%	89.3%
% 60+ met CDC preventive health screening goals		28.0%	35.0%
% 60+ flu shot past year		54.1%	60.8%
% 65+ with pneumonia vaccine		62.9%	72.0%
% 60+ with shingles vaccine	W	28.8%	39.7%
% 60+ with cholesterol screening		93.8%	95.7%
% 60+ women with a mammogram within last 2 years		84.4%	84.8%
% 60+ with colorectal cancer screening		65.8%	63.3%
% 60+ with HIV test		14.5%	15.6%
% 60+ current smokers		14.9%	8.5%
% 60+ living in a home where smoking is not allowed		80.9%	84.7%
Oral Health			
% 60+ with loss of 6 or more teeth	W	46.3%	32.5%
% 60+ with annual dental exam	W	65.7%	77.5%
# of dentists per 100,000 persons (all ages)		34	84
NUTRITION/DIET			
% 60+ with 5 or more servings of fruit or vegetables per day		15.9%	21.5%
% 60+ self-reported obese	W	33.1%	23.1%
% 65+ clinically diagnosed obese	W	21.5%	19.0%
% 65+ with high cholesterol	W	83.5%	75.0%
% 60+ excessive drinking		5.6%	9.3%
% 65+ with poor supermarket access		10.4%	29.3%

HEALTHY AGING INDICATORS	BETTER / WORSE STATE RATE[1]	COMMUNITY ESTIMATE	STATE ESTIMATE
BEHAVIORAL HEALTH			
% 60+ with 15+ days poor mental health last month		11.4%	7.0%
% 65+ with depression	W	35.4%	31.5%
% 65+ with anxiety disorders	W	33.8%	25.4%
% 65+ with bipolar disorders	W	5.3%	4.5%
% 65+ with post-traumatic stress disorder	B	1.4%	1.8%
% 65+ with schizophrenia & other psychotic disorders	W	9.0%	5.9%
% 65+ with personality disorders		1.4%	1.4%
# opioid deaths (all ages)		44	1,873
% 65+ with substance use disorders (drug use +/or alcohol abuse)	W	7.5%	6.6%
% 65+ with tobacco use disorders	W	13.2%	10.2%
CHRONIC DISEASE			
% 65+ with Alzheimer's disease or related dementias	W	15.7%	13.6%
% 65+ with diabetes	W	42.3%	31.7%
% 65+ with stroke	W	14.4%	12.0%
% 65+ with chronic obstructive pulmonary disease	W	29.7%	21.5%
% 65+ with asthma	W	19.6%	15.0%
% 65+ with hypertension	W	84.0%	76.2%
% 65+ ever had a heart attack	W	6.5%	4.6%
% 65+ with ischemic heart disease	W	45.8%	40.2%
% 65+ with congestive heart failure	W	27.6%	22.4%
% 65+ with atrial fibrillation		16.1%	15.9%
% 65+ with peripheral vascular disease	W	22.5%	19.4%
% 65+ with osteoarthritis/rheumatoid arthritis	W	56.7%	52.4%
% 65+ with osteoporosis	W	22.2%	20.7%
% 65+ with leukemias and lymphomas	B	1.6%	2.3%
% 65+ with lung cancer		2.2%	2.1%
% 65+ with colon cancer		3.1%	2.9%
% 65+ women with breast cancer	B	8.9%	10.9%
% 65+ women with endometrial cancer		1.8%	1.9%
% 65+ men with prostate cancer	W	16.4%	13.8%
% 65+ with benign prostatic hyperplasia	W	52.0%	40.9%
% 65+ with HIV/AIDS		0.2%	0.2%
% 65+ with hypothyroidism		20.3%	21.1%
% 65+ with anemia	W	52.5%	46.6%
% 65+ with chronic kidney disease		27.5%	27.3%
% 65+ with liver diseases	W	10.3%	8.6%
% 65+ with fibromyalgia, chronic pain and fatigue	W	21.9%	19.8%

HEALTHY AGING INDICATORS	BETTER / WORSE STATE RATE[1]	COMMUNITY ESTIMATE	STATE ESTIMATE
% 65+ with migraine and other chronic headache		4.8%	4.6%
% 65+ with epilepsy	W	4.6%	2.9%
% 65+ with traumatic brain injury	B	1.1%	1.5%
% 65+ with autism spectrum disorders		0.1%	0.1%
% 65+ with glaucoma	B	22.1%	25.7%
% 65+ with cataract	W	69.1%	65.4%
% 65+ with pressure ulcer or chronic ulcer	B	7.4%	8.5%
% 65+ with 4+ (out of 15) chronic conditions	W	69.6%	60.7%
% 65+ with 0 chronic conditions	W	4.8%	7.3%
LIVING WITH DISABILITY			
% 65+ with self-reported hearing difficulty		14.9%	14.2%
% 65+ with clinical diagnosis of deafness or hearing impairment	W	17.6%	16.1%
% 65+ with self-reported vision difficulty		5.2%	5.8%
% 65+ with clinical diagnosis of blindness or visual impairment		1.7%	1.5%
% 65+ with self-reported cognition difficulty		11.4%	8.3%
% 65+ with self-reported ambulatory difficulty		27.0%	20.2%
% 65+ with clinical diagnosis of mobility impairments	W	4.9%	3.9%
% 65+ with self-reported self-care difficulty		12.2%	7.9%
% 65+ with self-reported independent living difficulty		22.6%	14.3%
ACCESS TO CARE			
Medicare (65+ population)			
% Medicare managed care enrollees	*	27.5%	23.1%
% dually eligible for Medicare and Medicaid	*	35.7%	16.7%
% 60+ with a regular doctor		93.6%	96.4%
% 60+ who did not see doctor when needed due to cost		6.5%	4.1%
# of primary care providers within 5 miles		319	10,333
# of hospitals within 5 miles		0	66
# of nursing homes within 5 miles		12	399
# of home health agencies		46	299
# of community health centers		1	116
# of adult day health centers		5	131
# of memory cafes		0	95
# of dementia-related support groups		0	136
SERVICE UTILIZATION			
Physician visits per year		7.7	7.8
Emergency room visits/1000 persons 65+ years per year	*	731	639

HEALTHY AGING INDICATORS	BETTER / WORSE STATE RATE[1]	COMMUNITY ESTIMATE	STATE ESTIMATE
Part D monthly prescription fills per person per year	*	63.8	52.4
Home health visits per year	*	4.8	4.0
Durable medical equipment claims per year	*	2.7	1.9
Inpatient hospital stays/1000 persons 65+ years per year	*	346	294
Medicare inpatient hospital readmissions (as % of admissions)		19.5%	17.9%
# skilled nursing facility stays/1000 persons 65+ years per year	*	130	106
# skilled nursing home Medicare beds/1000 persons 65+ years		85	43
% 65+ getting Medicaid long term services and supports	*	10.3%	4.9%
COMMUNITY VARIABLES & CIVIC ENGAGEMENT			
Age-friendly efforts in community		Yes	Yes
Air pollution: annual # of unhealthy days for 65+ (county)		4	N/A
Open space in community		16.9%	18.0%
Walkability score of community (0-100)		66	N/A
% of grandparents raising grandchildren		1.2%	0.8%
% of grandparents who live with grandchildren		3.0%	2.9%
# of assisted living sites		1	238
% of vacant homes in community		9.2%	9.8%
# of universities and community colleges		2	163
# of public libraries		5	470
# of YMCAs		1	83
% in county with access to broadband (all ages)		98.0%	97.0%
% 60+ who used Internet in last month	*	55.2%	71.3%
Voter participation rate in 2016 presidential election (age 18+)		56.6%	71.3%
SAFETY & TRANSPORTATION			
Violent crime rate /100,000 persons		1175	396
Homicide rate /100,000 persons (county)		2	2
# firearm fatalities (county)		96	1,126
Property crime rate /100,000 persons		3,569	1,825
% of licensed drivers who are age 61+		26.7%	28.7%
% 65+ who own a motor vehicle		71.4%	82.4%
% 60+ who always drive wearing a seatbelt		81.3%	86.3%
# of fatal crashes involving adult age 60+/town		12	529
# of fatal crashes involving adult age 60+/county		67	529
Total # of all crashes involving adult age 60+/town		2,550	132,351
# of senior transportation providers		29	324
# of medical transportation services for older people		38	268
# of nonmedical transportation services for older people		83	252
Summary transportation performance score		5.6	N/A

HEALTHY AGING INDICATORS	BETTER / WORSE STATE RATE[1]	COMMUNITY ESTIMATE	STATE ESTIMATE
ECONOMIC & HOUSING VARIABLES			
% 65+ with income below the poverty line past year		16.2%	8.7%
% 60+ receiving food stamps past year		22.4%	12.3%
% 65+ employed past year		16.1%	24.3%
Household income (65+ householder)			
% households with annual income < $20,000		41.0%	23.6%
% households with annual income $20,000-$49,999		32.5%	32.5%
% households with annual income > $50,000		26.5%	43.9%
% 60+ own home		59.6%	72.7%
% 60+ have mortgage on home		23.8%	34.1%
% 65+ households spend >35% of income on housing (renter)		17.3%	11.6%
% 65+ households spend >35% of income on housing (owner)		18.4%	20.4%
COST OF LIVING	$ COUNTY ESTIMATE	$ STATE ESTIMATE	RATIO (COUNTY/STATE)
Elder Economic Security Standard Index			
Single, homeowner without mortgage, good health	$23,376	$24,636	0.95
Single, renter, good health	$25,932	$28,248	0.92
Couple, homeowner without mortgage, good health	$35,556	$36,168	0.98
Couple, renter, good health	$38,112	$39,780	0.96

TECHNICAL NOTES

**See our technical report (online at http://mahealthyagingcollaborative.org/data-report/explore-the-profiles/data-sources-and-methods/#technical) for comprehensive information on data sources, measures, methodology, and margin of errors.*

*For most indicators the reported community and state values are both estimates derived from sample data. Thus, it is possible that some of the differences between state and community estimates may be due to chance associated with population sampling. We use the terms "better" and "worse" to highlight differences between community and state estimates that we are confident are not due to chance. "Better" is used where a higher/lower value has positive implications for the health of older residents. "Worse" is used where a higher/lower score has negative implications for the health of older people, and when the implication is unclear we use an *.*

General Notes

We balance two goals. First, we aim to report data at very local levels because we believe change is often locally driven. Second, we vowed to protect the privacy of the people providing the information reported. Thus, given the constraints of the data analyzed we used a hierarchical approach to reporting. When possible we report estimates for 379 geographic units (i.e., every Massachusetts city/town and 16 Boston neighborhoods, 6 Worcester neighborhoods, and 6 Springfield neighborhoods). For example, the population characteristics and information from the US Census were reported for all 379 units. For other data (i.e., highly prevalent chronic disease, health services utilization) we could report for 310 geographic units. For less prevalent conditions we report for 201 geographic units. For the BRFSS data we report for 41 geographic units, and for the lowest prevalence conditions (e.g., HIV) we report for 18 geographic units. The same estimate is reported for all cities/towns within aggregated geographic areas. Maps of the different geographic groupings and the rationale behind the groupings are in the Technical Report.

Data Sources. The Technical Report describes the all of the data sources for the report, but three to note are: (1) the American Community Survey (2012-2016); (2) Centers for Medicare and Medicaid Services Master Beneficiary Summary File (2014-2015); and (3) The Behavioral Risk Factor Surveillance System (2010-2015).

Healthy Aging Data Report Team. Many people contributed to this research. The 2018 research team: Beth Dugan PhD, Frank Porell PhD, Nina Silverstein PhD, Chae Man Lee PhD, Shuang Shuang Wang PhD, Bon Kim, Natalie Pitheckoff, Haowei Wang, Sae Hwang Han, Richard Chunga, & Shiva Prisad from the Gerontology Institute in the McCormack Graduate School of Policy and Global Studies at the University of Massachusetts Boston. The Tufts Health Plan Foundation supported the research and provided important guidance. We thank our Advisory Committee members for contributing ideas and advice on how to make the Data Report best address the needs of Massachusetts. We thank our colleagues at JSI for their continued partnership. Questions or suggestions? Beth.dugan@umb.edu