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Pedestrian Safety in Environmental Justice Communities in Boston

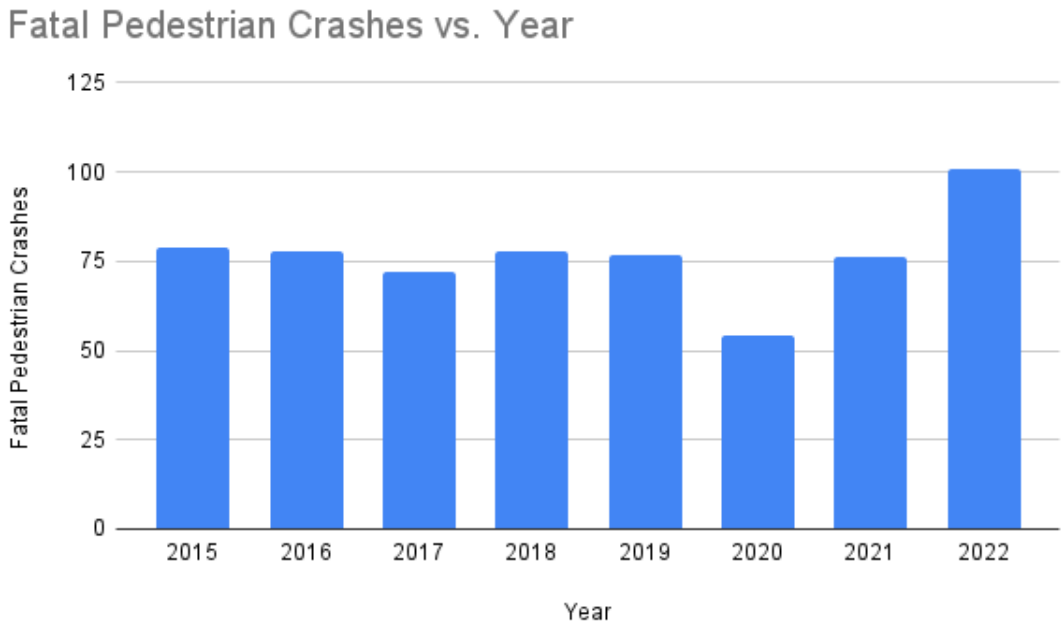
Introduction

Pedestrian safety is a critical issue in the city of Boston and the commonwealth of Massachusetts. As a densely populated city, Boston has a high volume of foot traffic from residents, commuters, and visitors alike. Factors such as the dense urban environment, complex road networks, and high volumes of both vehicular and pedestrian traffic contribute to this issue.

The city has made significant efforts to improve pedestrian safety through various initiatives, such as the Vision Zero program, which aims to eliminate traffic fatalities and serious injuries by 2030.[1] These efforts involve implementing traffic calming measures, improving infrastructure for pedestrians, enhancing public awareness, and enforcing traffic laws.

Despite these efforts, pedestrian safety remains a pressing concern, with incidents continuing to occur. Between 2021 and 2022, pedestrian deaths in the state jumped from 75 to 101 fatalities, according to a study by the advocacy group WalkBoston[2]. The bar graph below shows fatal crashes in Massachusetts by year, from 2015 to 2022.

[1] https://www.boston.gov/transportation/vision-zero
[2] https://www.bostonglobe.com/2023/03/31/metro/here-are-five-ways-mass-could-reduce-pedestrian-deaths-according-experts/?event=event12



Source: WalkBoston (https://storymaps.arcgis.com/stories/5ef0c0ec60764c85a7e6ace69b752fd4

Certain populations may be more vulnerable to a lack of safety for people on foot. Environmental justice communities, defined by the state based on low-income status, high percentage of minority population, and/or low rates of English fluency,[3] may face barriers to accessing safe and reliable transportation options, forcing residents to rely more heavily on walking as a mode of transportation. This can increase the likelihood of accidents, especially when there is also a lack of pedestrian-friendly infrastructure. By addressing the relationship between pedestrian accidents and disadvantaged populations, we can work towards creating safer streets for everyone and ensure that walking in Boston is a safe and enjoyable experience.

[3] https://www.mass.gov/info-details/massgis-data-2020-environmental-justice-populations#overview-

Methodology

To investigate pedestrian safety in Boston, I gathered relevant datasets, including pedestrian accident data, demographic information, pedestrian infrastructure, and geographic data such as roads and transit networks. I mapped the locations of pedestrian accidents and overlayed them with demographic data to identify areas with higher concentrations of accidents and potential disparities in safety. Though I explored many datasets, I primarily used the following ones for my analysis:

- Vision Zero Boston Crash Reports, from arcgis.com
- Pedestrian Facilities, from MassDOT's Open Data Portal
- Vision Zero Safety Concerns, from arcgis.com
- Environmental Justice Populations in Massachusetts, from Mass.gov

The Vision Zero Boston Crash Reports Feature Layer contains records of the date, time, location, and type of crash for incidents requiring public safety response which may involve injuries or fatalities. The dates of dispatch range from January 2015 to October 2022. The data include crashes involving pedestrians, motor vehicles, and/or bikes, so I used "Select by Attributes" to filter on only incidents involving pedestrians.

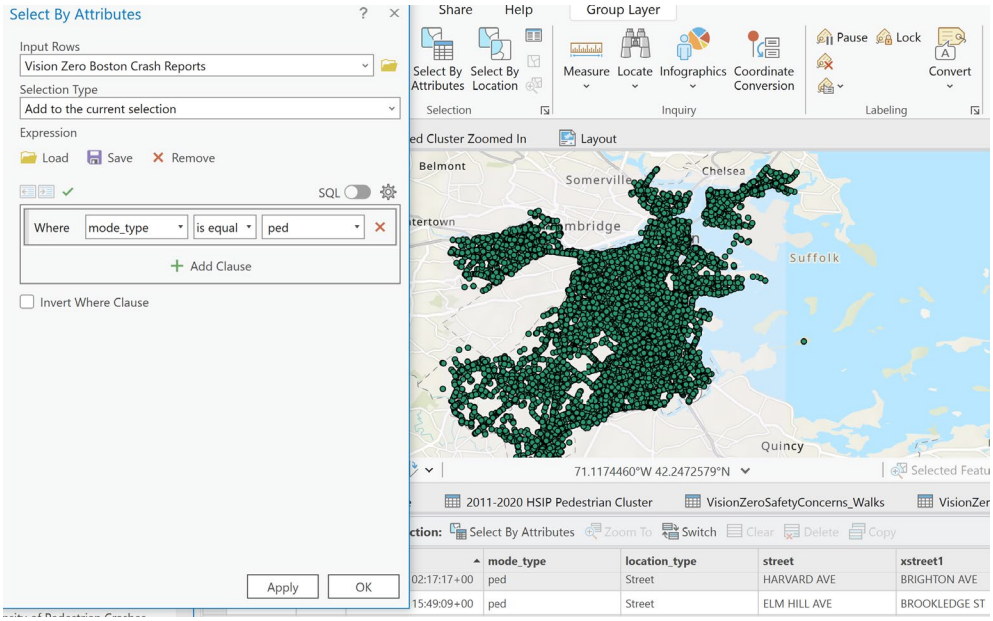


Figure 1: Filtering on pedestrian crashes

As part of my data exploration, I used the crash points to create a kernel density plot, which shows densities of pedestrian-related crashes, as shown below.

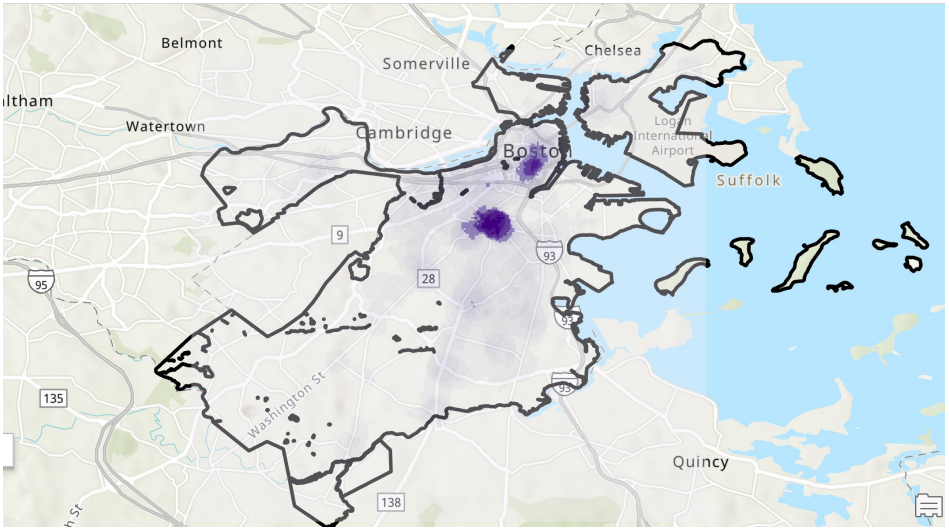


Figure 2: Kernel density plot of pedestrian crashes

I also found a layer of pedestrian clusters from MassDOT. The clusters represent the top locations where reported collisions between pedestrians and motor vehicles have

been identified. Because of the relatively small number of reported pedestrian crashes in the crash data file, the clustering analysis used crashes from the ten-year period from 2011 to 2020. The map below shows this layer projected and clipped onto a map of Boston:

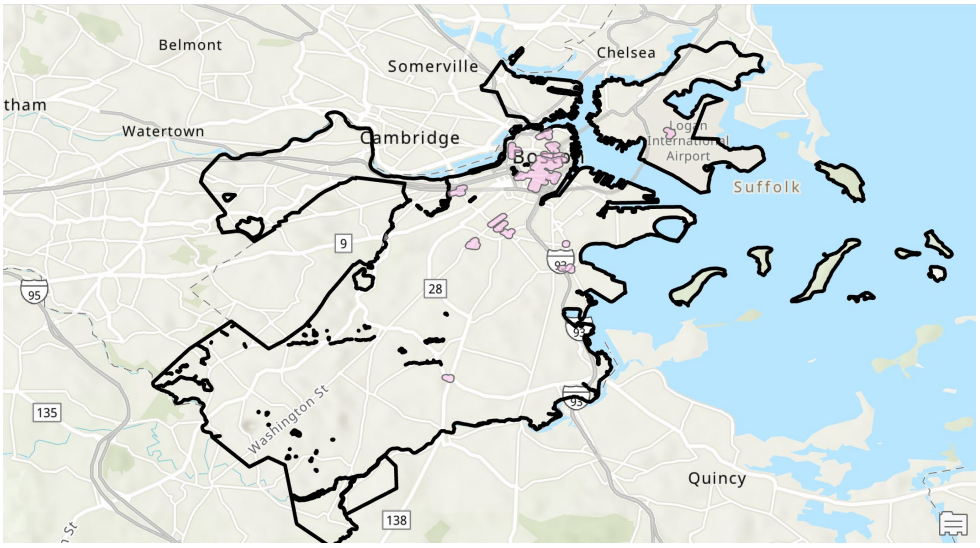


Figure 3: Pedestrian crash clusters, from MassDOT

As mentioned, the dataset covers pedestrian crashes from 2011 to 2020, and it includes information about the location, date, time, and severity of the crashes. It is possible that not all pedestrian crashes were reported, leading to underestimation. The dataset contains a small number of reported pedestrian crashes, relative to the Vision Zero crash records. Considering this, as well as the similar density distributions in their respective maps, I chose to continue with the Vision Zero crash data in my analysis.

In my search for pedestrian infrastructure data, I found a layer of Pedestrian Facilities from MassDOT's Massachusetts Road Inventory. This layer portrays the location and quality of sidewalks and pedestrian ramps throughout the commonwealth of Massachusetts. The facilities are represented as points, and I clipped the layer to show

only those within the city of Boston. The dataset contains an attribute that denotes the condition of each sidewalk, ranging from good to fair to poor. I used this to select only the sidewalks in poor condition, for which major maintenance is required. When the quality of the pedestrian infrastructure in a community is subpar, the safety of pedestrians is compromised. This is likely to result in more pedestrian accidents, especially in areas where car ownership is lacking, whether by necessity or by choice.

Another relevant data source is the Vision Zero Safety Concerns layer, which denotes the locations of concerning spots related to traffic safety. These points are reported by users in the Vision Zero application on boston.gov. It covers a significant portion of safety issues related to traffic and infrastructure for a variety of travel modes. Since the data includes areas outside of the Boston city boundaries, I clipped the layer to show only those data points with the city limits.

Like the crash reports data, this data contains an attribute denoting the mode of transport as walking, driving, or biking. Therefore, I selected only the results which included “walking” and saved it as a layer. In addition to the travel mode attribute, there are attributes containing additional details explaining the nature of the issue (speeding, poor visibility, lack of walk signal, etc.).

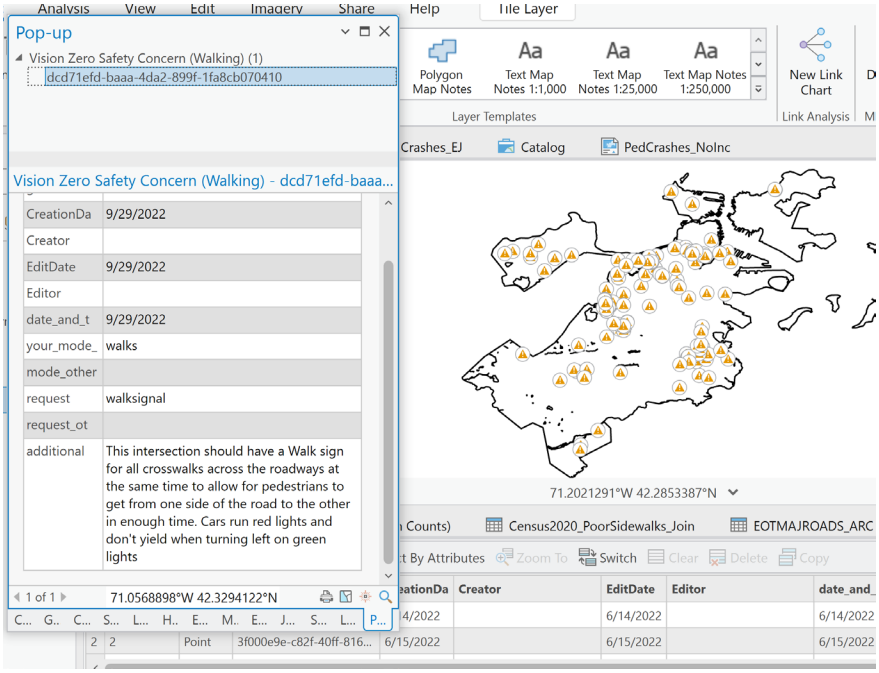


Figure 4: Example safety concern for pedestrians

Finally, I added the 2020 Environmental Justice Populations layer from MassGIS. This layer represents the 2020 Census Block groups across the state that meet certain criteria for low income, minority population, and lack of English proficiency (i.e. English isolation). I clipped this layer to show only the census blocks in Boston which meet the EJ criteria.

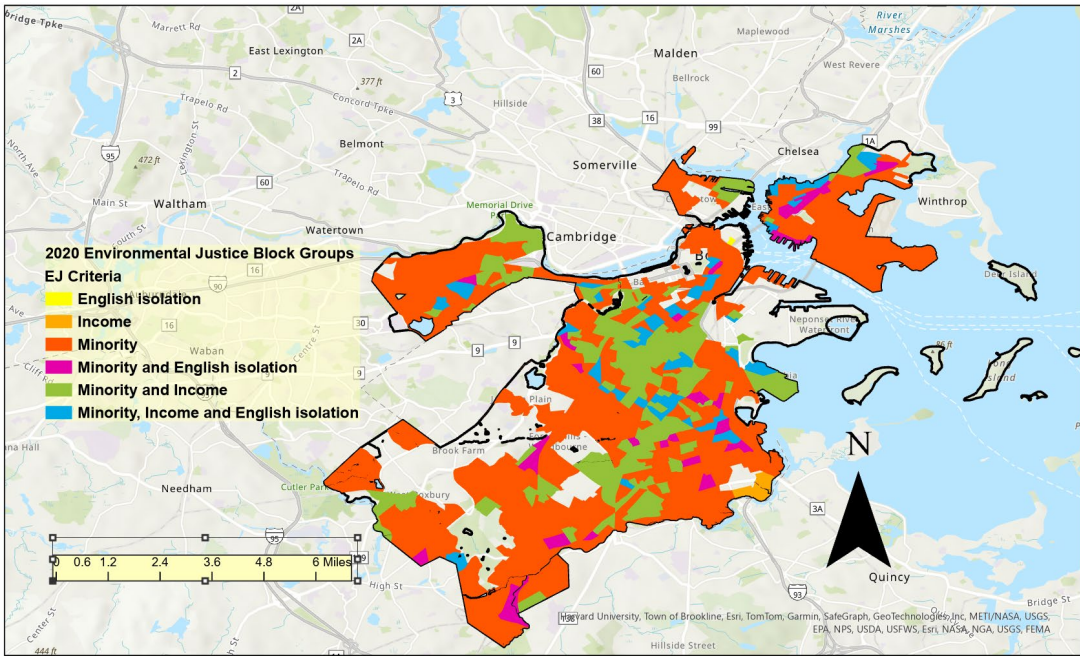


Figure 5: Environmental Justice Block Groups in Boston

Analysis

In my analysis, I aimed to find correlations between pedestrian crashes, sidewalk quality, number of reported safety concerns, and Environmental Justice (EJ) criteria. I used Spatial Joins on each layer with the EJ block groups layer to summarize the totals for each block group. My initial strategy was to label each block group according to the total number

of pedestrian crashes it contains, as shown in the figure below.

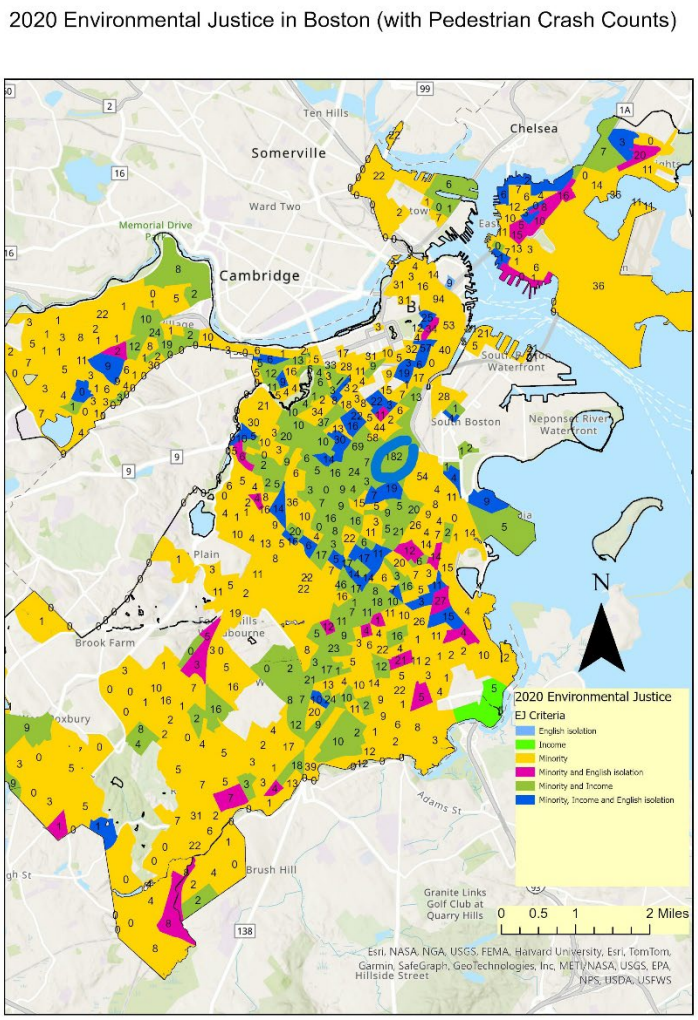


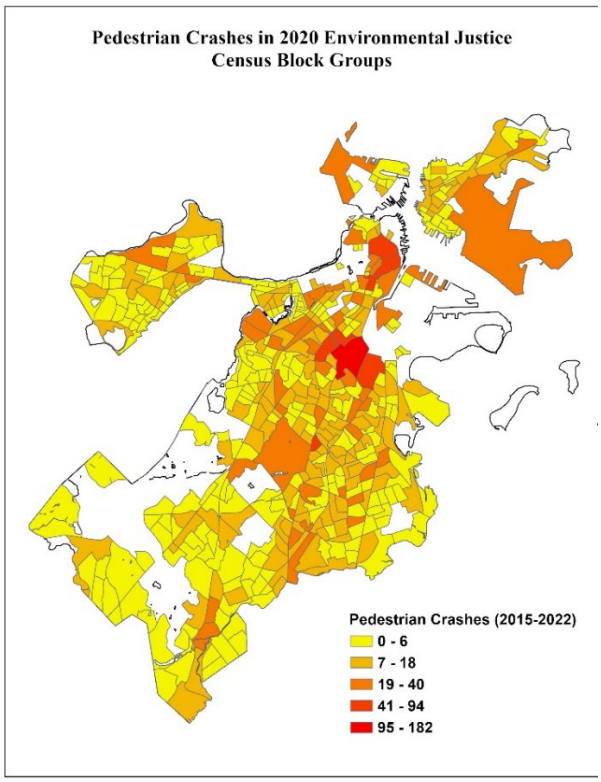
Figure 6: Pedestrian Crash Counts

The highest crash count is 182, and this is in the block group shown with a blue circle in Figure 6. This block group meets the minority and low-income EJ criteria.

I produced similar maps with the totals of poor-quality sidewalks and reported pedestrian safety concerns because I wanted to maintain the colors of the EJ criteria. However, this produced maps that were clunky and hard to read. I then tried using

graduated colors instead of labels to symbolize the total counts, and this resulted in cleaner maps.

The maps below are a result of joining point layer data spatially with the EJ block groups, then symbolizing the totals with graduated colors.



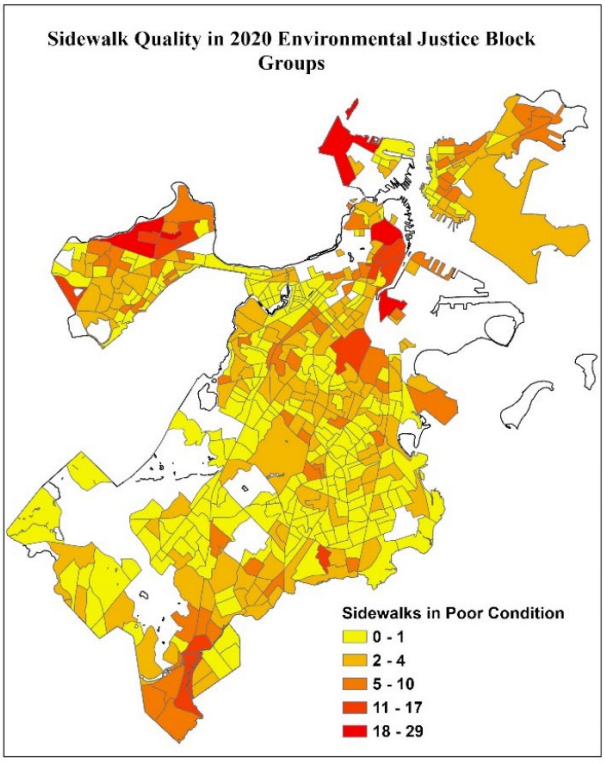


Figure 7: Pedestrian crash counts for Environmental Justice block groups

Figure 8: Sidewalk quality in Environmental Justice block groups

Figure 7 displays the pedestrian crash counts in each block group, and Figure 8 displays the total number of poor-quality sidewalks. Many of the highest totals are in similar locations on these maps, particularly in the downtown core, parts of Roxbury (south of downtown) and parts of Allston-Brighton (west). This suggests a moderate negative correlation between crashes and the quality of pedestrian infrastructure.

Similarly, I joined the pedestrian safety concerns data with the EJ block groups to create the map shown in Figure 9, displayed alongside the map of crashes from Figure 7.

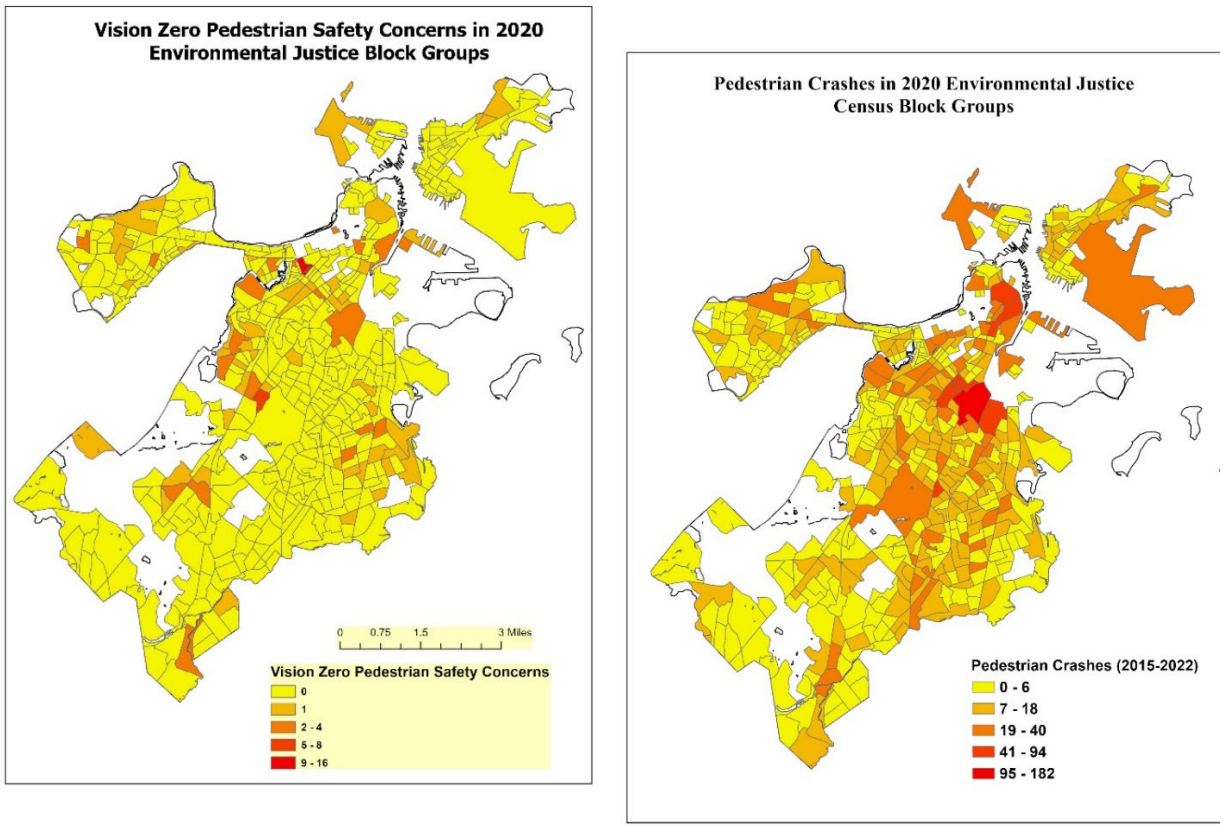
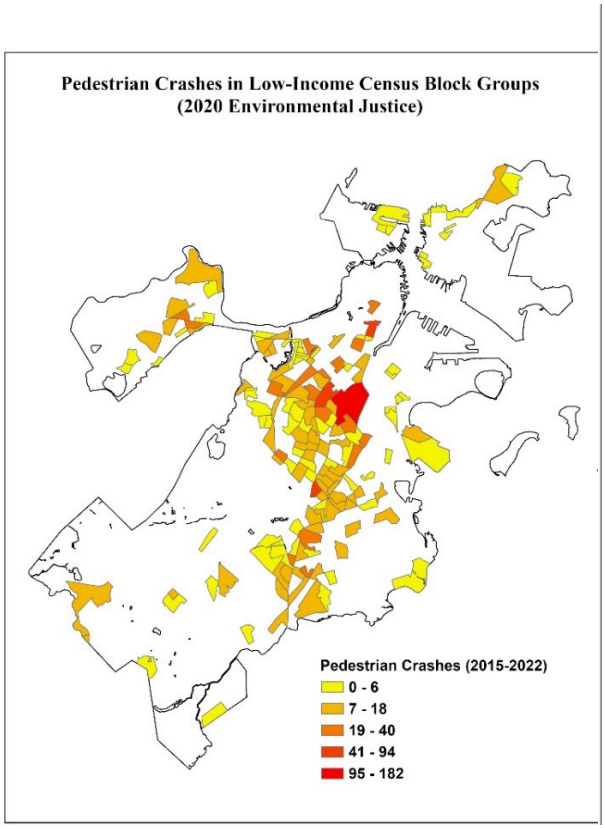


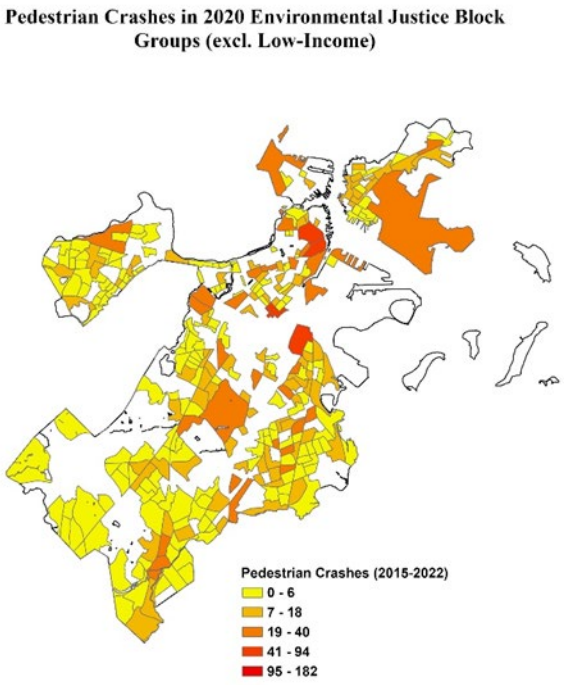
Figure 9: Pedestrian safety concerns in Environmental Justice block groups

` The correlation between pedestrian crashes and Vision Zero report locations appears to be less significant than that between crashes and sidewalk quality. The block group that contained the most crashes (from Figure 6) does have a significant number of safety concerns (between two and four), but there does not appear to be many other similarities. The fact that the safety concerns are user-reported is a limitation of that dataset, as the accuracy and consistency of the data is more prone to vary.

In addition, I aimed to find correlations between pedestrian crashes and some of the EJ criteria. In particular, I wanted to compare low-income EJ block groups with those

that did not meet the low-income criteria. (According to the state's Executive Office of Energy and Environmental Affairs, to meet the criteria, the annual median household income must not exceed 65 percent of the statewide annual median household income.[4]) To do this, I selected by the EJ criteria attribute and created the symbolized maps below.





Ultimately, it was hard to draw conclusions from this, but the pedestrian crash counts do not appear to be correlated with the low-income block groups any more than they are correlated with block groups that are not low-income. If I had more time or were to do this report differently, I would try to build comparison maps to see multiple patterns within a single map.

[4] https://www.mass.gov/info-details/massgis-data-2020-environmental-justice-populations#overview-

Conclusion

Based on my results, I would recommend that the city try to improve the condition of its sidewalks in Environmental Justice communities. This might mean repairing the concrete, widening sidewalks where feasible, or adding dedicated pedestrian facilities such as footpaths, bridges, and ramps. To address safety concerns, the city could implement traffic calming measures, such as speed humps and pedestrian refuge islands. Other recommendations include talking to people in the community about their needs, conducting traffic studies, and observing driver and pedestrian behavior in these communities.

If I were to do this report differently, I would incorporate more data into my analysis, because more data and variables would help better explain pedestrian crash counts. In my search, I found layers of roads, which included major routes, and I would like to figure out how to analyze spatial relationships between crashes and traffic volumes. I would also like to spatially relate crash clusters with MBTA stations, because walking is an essential part of using public transit. An analysis of the transit stations that are most in need of better pedestrian infrastructure would be very insightful. Furthermore, other data related to traffic would help further my understanding of pedestrian safety in the city, as well as data related to car ownership at the neighborhood level (though I was not successful in finding any GIS layers for this). Another idea is to analyze the school zones that are most at-risk regarding pedestrian safety.