

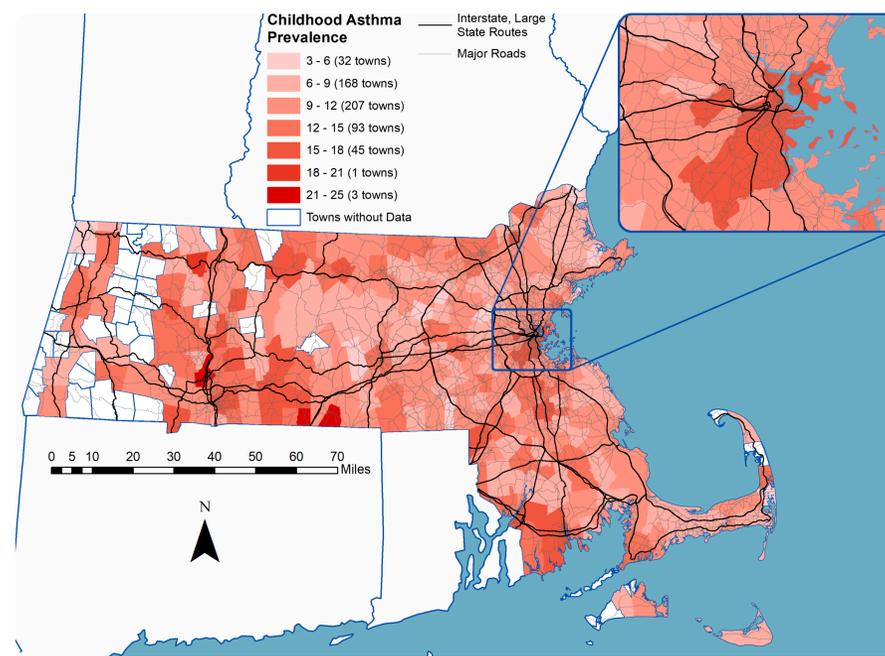
Air Pollution and Income: Mapping Asthma in Massachusetts

Introduction

Asthma, particularly childhood asthma, is a common and serious problem in Massachusetts, where it impacts the lives of 10.2% of adults and 12.9% of children compared to the national average of 8.2% in 2015. Two-thirds of Massachusetts children with asthma had “poorly” or “not well” controlled symptoms, resulting in hospitalizations which cost \$104 million dollars in 2013.

Asthma prevalence (percent of schoolchildren diagnosed) and related hospitalizations (hospital visits per 10,000 people aged 5 to 14) have been linked to both roadway air pollution exposure and household income. Understanding the relationship between asthma, income, and traffic exposure is critical to implementing effective interventions to reduce town asthma rates and hospitalizations in the future. The ratio of asthma hospitalizations to asthma diagnoses is referred to as “asthma severity,” while the “relative roadway exposure” refers to the kernel density traffic-weighted value of distance to roadways.

Childhood Asthma and Major Roads

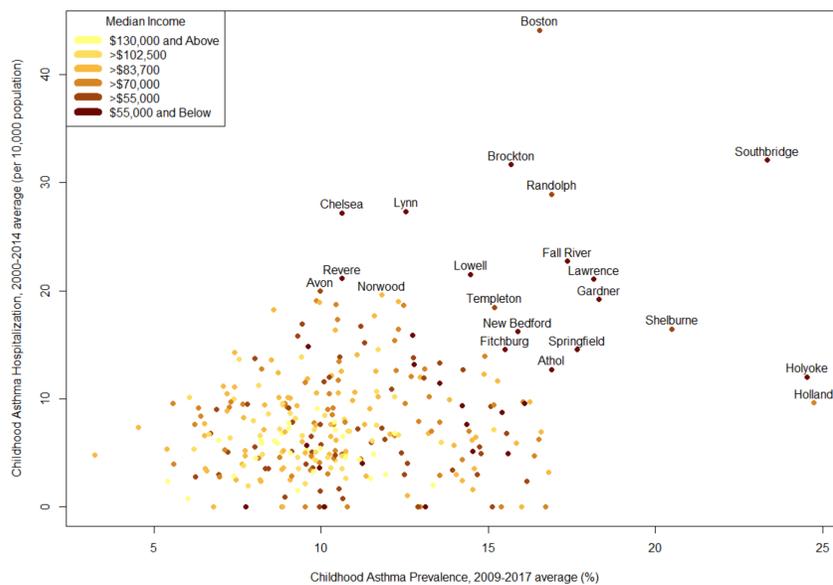


Results and Conclusions

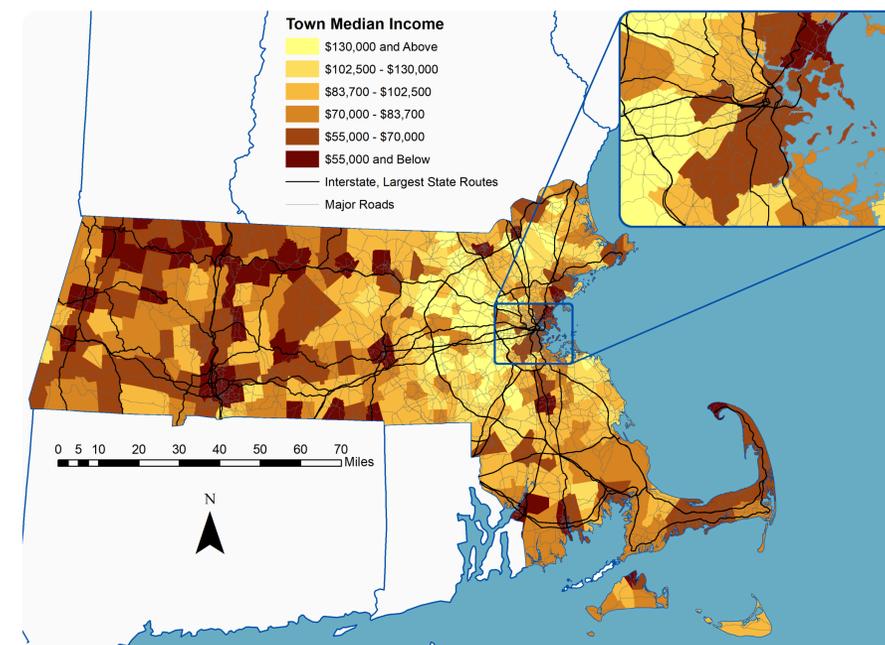
The maps show two spatial patterns consistent with the literature: dense, urban communities located at the confluences of large roads have high asthma rates, and communities split by large roads also have lower median incomes. The literature review indicated that the relationship between traffic and asthma rates is strongest at the neighborhood level, so the low resolution of this data at the level of towns or cities was a major limitation in this study.

Not all low-income communities have high rates of asthma or hospitalization, but all of the communities that have the highest combined prevalence and hospitalization rates are in the bottom three income brackets. The comparison of roadway exposure and asthma prevalence is dominated by the pattern of towns clustered at a relative roadway exposure of “1” which indicates low traffic local roads and missing data. A notable trend is that many lower income towns have a higher ratio of asthma to roadway exposure, which may be indicative of increased sensitivity or indicative of a confounding exposure such as household mold or poor nutrition.

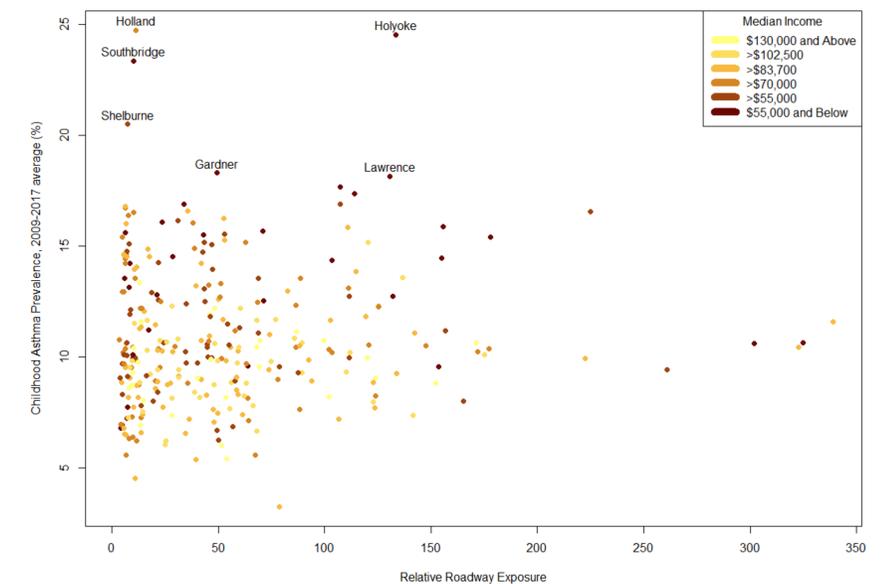
Asthma Severity by Income



Median Income and Major Roads



Traffic-related Asthma by Income



Scatterplot Methods

Childhood asthma prevalence and hospitalization data were downloaded from the state Office of Environmental Health and joined in R to 2010 census data of household incomes. The purpose of the graph above is to show how income impacts asthma prevalence and the ratio of hospitalization to cases of asthma. Childhood asthma prevalence is related to relative traffic exposure in the graph on the right. The roadway exposure measures distance to roads weighted by average daily traffic; e.g. interstates and highways were weighted 100 times the weight of local roads to reflect 100,000 vs. 1,000 vehicles daily.

Map Methods

Asthma and income data were joined in ESRI ArcMap to a shapefile of Massachusetts towns from MassGIS. Many communities in the western half of the state did not collect asthma data from 2009-2014 or did not collect enough data for it to be aggregated for patient privacy. Roads labelled minor or local in the dataset are not shown at the statewide scale, although they were included in the traffic exposure scores, because they are too numerous in urban areas to view the asthma or income data.

References

I would like to thank Kyle Monahan for troubleshooting R and ArcMap with me and answering many questions.

Cartographer: Logan Brill, Fall 2018

Course: Environmental Data Visualization

Program: Tufts CEE: Environmental Health Track

Data Sources: MassGIS, MassEPHT, MassDOT, Census 2010

