Investigating the Relationship Between Asthma and Pollution Burden in California to Understand the Importance of Race and Economic Status as Social Determinants of Health

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March 2, 2020

# Introduction

Air pollution has become an increasingly important topic of research in the past half-century, mainly because of the multitude of health risks that have been shown to accompany exposure to air pollution such as respiratory disease, cardiovascular disease, and even neurological dysfunction(Brunekreef and Holgate 2002, Rajagopalan et al. 2018, Schikowski and Altug 2020). Air pollution consists of a multitude of substances from a multitude of sources. Air pollution arises from fuel burning for energy and transportation, and as a product of other industrial processes. Pollution from mobile sources such as motor traffic has been cited as one of the most prevalent sources of harmful air pollution, especially in cities, where a vast population uses cars to commute into and out of dense urban areas daily(Mayer 1999).

Asthma is a respiratory disease that has been linked to air pollution in numerous studies worldwide(Koenig 1999, Raji et al. 2020). There are studies that look specifically at air pollution from mobile sources on the development and worsening of asthma (Gasana et al. 2012, Ristovski et al. 2012). These studies investigate a number of different components of motor traffic pollution which contribute to asthma including particulate matter. Particulate matter less than 2.5 micrometers in diameter, known as fine particulate matter, can have a hazardous effect because it is small enough to be inhaled into small airways and alveoli (small air sacs) in the lung(Guarnieri and Balmes 2014). These fine particles consist of transition metals and other substances that can cause the symptoms associated with asthma attacks(Guarnieri and Balmes 2014). These pollutants, which emerge from cars on major roadways in dangerous concentrations, can have these effects up to 500 meters away(Guarnieri and Balmes 2014). For reference, that is the distance covered by five and a half football fields. In North American cities, 30-45% of people live within this distance of a major roadway(Guarnieri and Balmes 2014).

Air pollution from motor traffic has a particularly pronounced impact in the state of California. In the American Lung Association’s State of the Air Report for 2019, 6 out of 10 of the countries most polluted cities for year round particle pollution were California cities. California relies heavily on car commuting because of the development of cities and surrounding infrastructure in a way that prioritized travel by motor vehicles(Cervero 2003). The problem is currently worsening because rapidly growing urban areas in Southern California and the Bay Area promise new jobs, but no affordable housing opportunities(Cervero 2003).Because of the disparity between job opportunities and affordable housing, Californians are forced to drive long distances to work and thereby increase the mobile source pollution in these metropolitan areas. This may contribute to the placement of the Los Angeles and San Jose/San Francisco metropolitan areas on the top ten list for most particle polluted cities. Much of this research has been focused on Southern California, with comparatively little research focused on the Bay Area(Houston et al. 2004, 2014, Perez et al. 2009).

The problem of air pollution and asthma does not impact all Californians equally. Differences in race and socioeconomic status has been shown to relate to how much particle pollution from motor traffic one is exposed to(Houston et al. 2004, 2014). Race and socioeconomic status, as they relate to potential health impacts, have come to be known as social determinants of health(Marmot 2005). These social determinants of health reflect how racism and class-ism extend beyond individual viewpoints, into the fabric of our society.

In this study, I aimed to investigate this relationship between asthma and traffic pollution in California Counties using asthma emergency department visit rates and other factors considered by the California Enviroscreen. Then, I questioned the relationship between poverty, race and Asthma in San Francisco. I identified a strong relationship between asthma and poverty in the San Francisco region, and a striking relationship between race and asthma state wide.

# Methods

## Data Analysis and Statistics

Data was taken from online databases and processed using R Studio. Statistical analysis utilized regression tests.

Results from the California Enviroscreen were used in the analysis. The California Enviroscreen is a comprehensive dataset collecting average amounts of pollution in California Cesnsus tracts along with various other social and medical indicators, such as the average age adusted rates of emergency department visits due to asthma. Emergency department visit rates were plotted against the county averages of the pollution burden score given to the various census tracts. The pollution burden score was determined by taking the average percentiles of the seven “exposures indicators” (ozone concentration, PM 2.5 concentration, diesel PM emissions, drinking water contaminants)

# Results

## Pollution Burden and Asthma Emergency Department Visit Rates by County

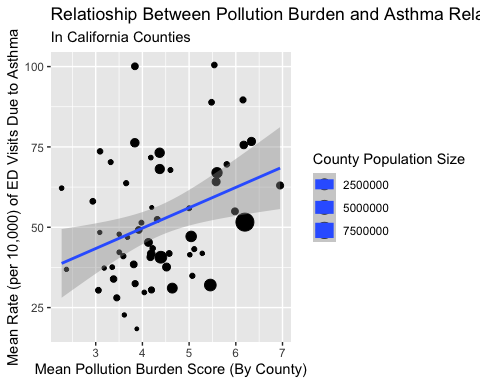
## Subsections are ok in the results section too

Add a number of code chunks in the Results section. These should read in, subset and plot the data as needed (no need to save any figures to pdf, since they will be put into the rendered document when you click ‘knit’), and, for any hypotheses that you want to test, an appropriate statistical test.

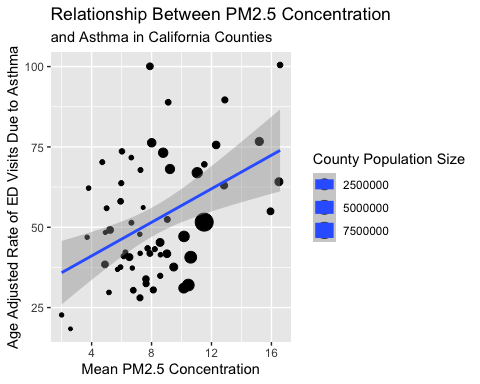
# Discussion

# Figures

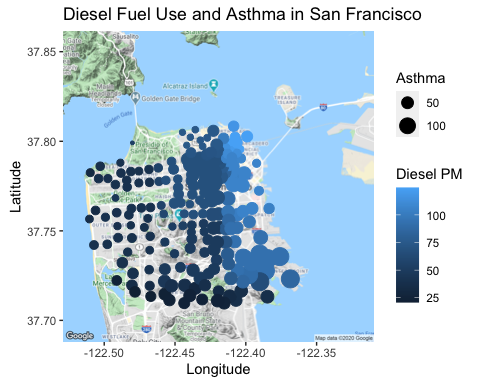
## Figure 1



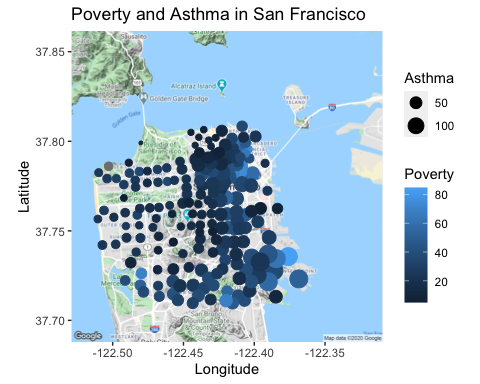
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| term | estimate | std.error | statistic | p.value |
| (Intercept) | 24.355 | 10.255 | 2.375 | 0.021 |
| mean\_pollution | 6.341 | 2.288 | 2.772 | 0.008 |



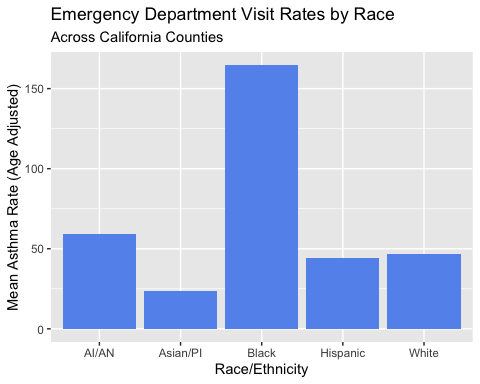
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| term | estimate | std.error | statistic | p.value |
| (Intercept) | 30.642 | 6.236 | 4.914 | 0.000 |
| mean\_pm25 | 2.611 | 0.710 | 3.677 | 0.001 |



|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| term | estimate | std.error | statistic | p.value |
| (Intercept) | 50.6698 | 3.3577 | 15.0904 | 0 |
| Asthma | 0.3173 | 0.0631 | 5.0302 | 0 |



|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| term | estimate | std.error | statistic | p.value |
| (Intercept) | 14.241 | 1.878 | 7.583 | 0 |
| Asthma | 0.301 | 0.035 | 8.562 | 0 |



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