Lead in the Water: The Effects of Blood Lead Levels on Incareration Rates

An Analysis

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Introduction

Could exposure to lead increase one's likelihood of going to prison? After our team's recent systematic review of studies, we have explored the potential effects of lead exposure on brain development in children and adults. Various studies highlight the detrimental effects of lead on different brain regions, noticeable in a decrease in executive control and cognitive control, thereby affecting memory, mood, behavior and comprehension skills. Such exposure to lead during the developmental years of children causes irreversible damage, the effects of which can be seen later on in life.

Studies in the past have shown a strong correlation between aggressive behavior, criminal tendencies and exposure to lead. Talayero et al. (2023)[1] highlights a strong association between lead exposure during childhood and criminal tendencies during adulthood. One can be exposed to lead through different means, including water, which is what we've chosen to investigate. Our research topic inquires about whether a relationship exists between a specified area's water lead levels and its incarceration rates, while also considering potential effects of other demographic factors.

This research topic has important societal implications, namely the complicated intersection of crime, environmental racism, and more. It's an ever relevant question today and we hope to come to meaningful conclusions by the end of our analysis. Our initial hypothesis is that there is a positive relationship between water lead levels and the rate of incarceration with the existence of other interaction effects from things such as race and income.

1. The association between lead exposure and crime: A systematic review

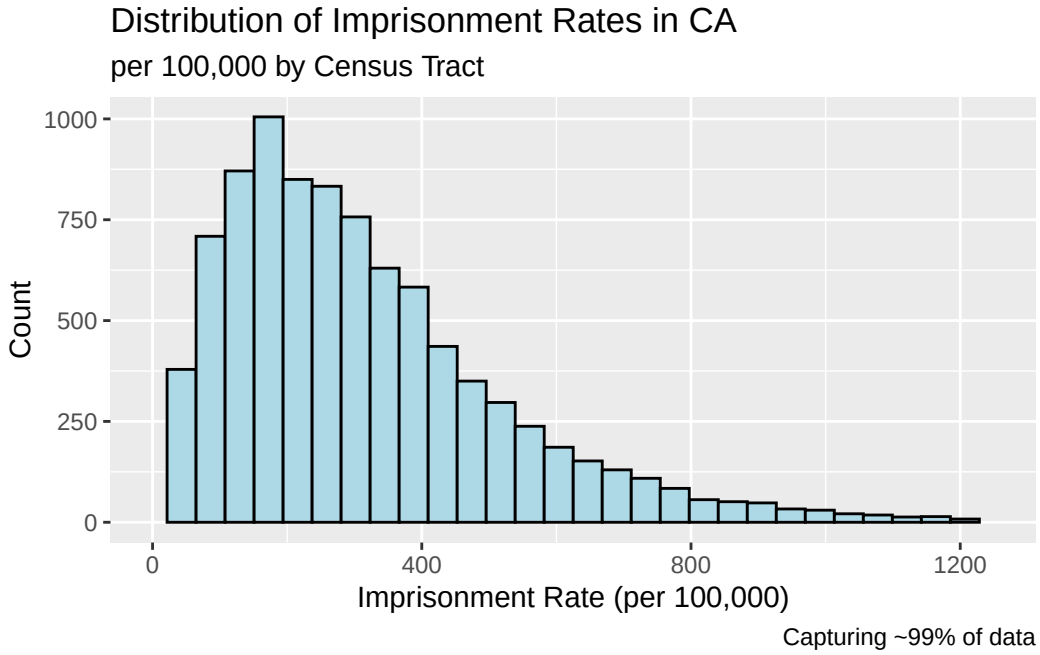
Exploratory Data Analysis

Our Data

We've chosen to create our dataframe from a variety of census data relating to California in 2020. Our data looks at different California census tracts and their respective statistics relating to blood lead levels, income, incarceration rates, and racial demographics. For our analysis, we are particularly focused on `perc_bll_indicator`, `med_income`, our age and race variables and how well they can predict `imprisonment_rt`.

Data Exploration

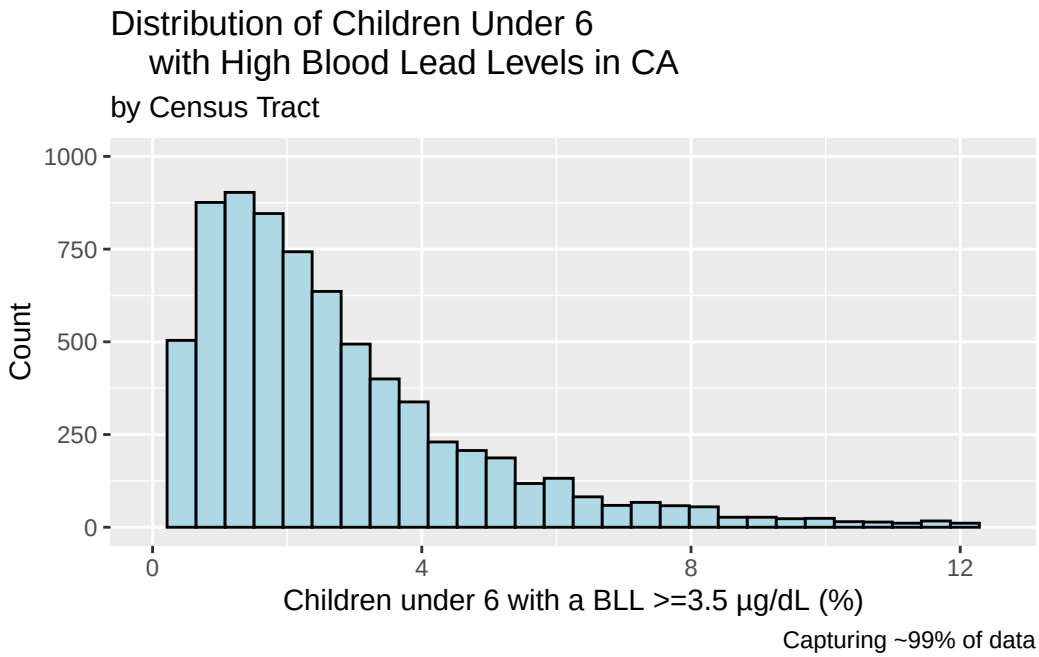
Incarceration Rate



The shape of the imprisonment rate distribution is unimodal that is skewed to the right with a median incarceration rate of 267 out of 100,000. This doesn't appear surprising - there are fewer census tracts with particularly high imprisonment rates.

Blood Lead Levels

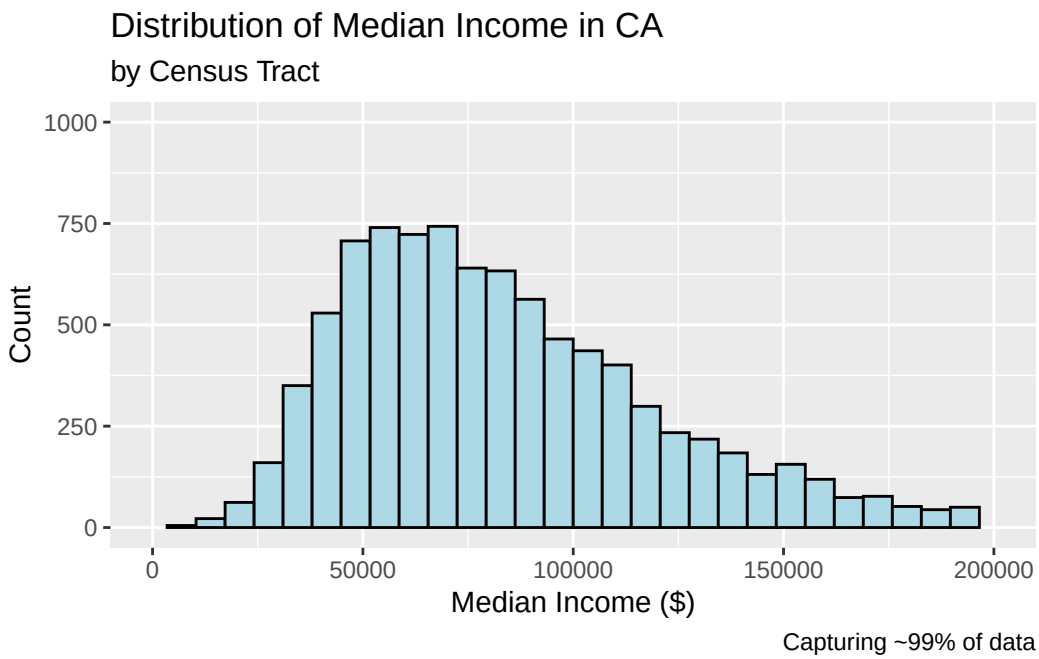
```
     99%
12.57605
```



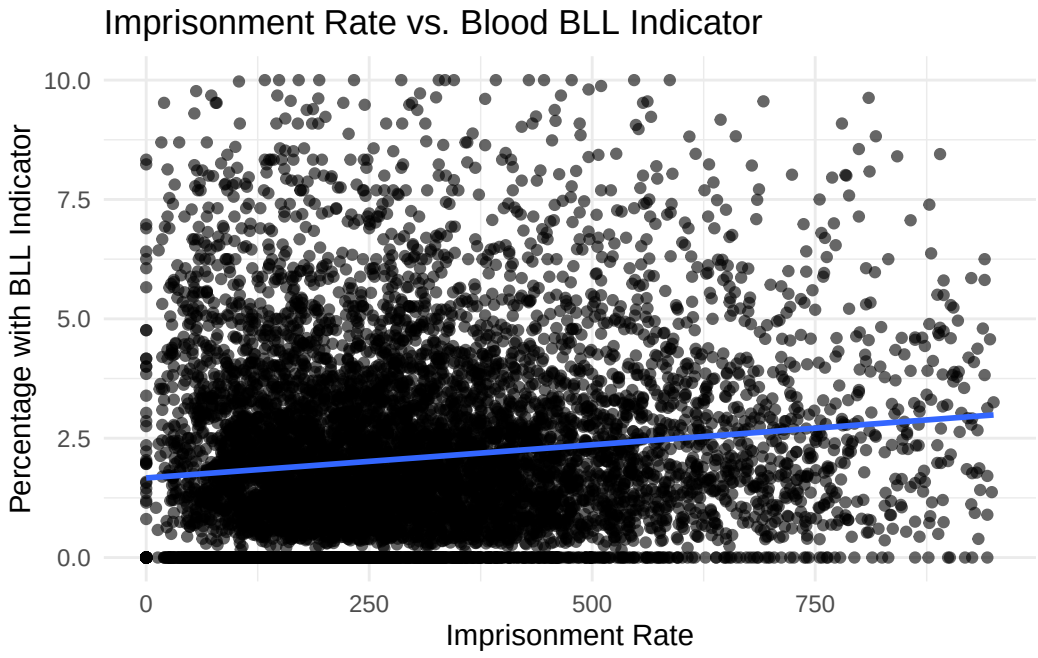
Similar to our imprisonment rate distrubution, the shape of the BLL distribution is unimodal that is skewed to the right with a median rate of 1.6891892. This doesn't appear surprising - there are fewer census tracts with particularly high BLL rates among children.

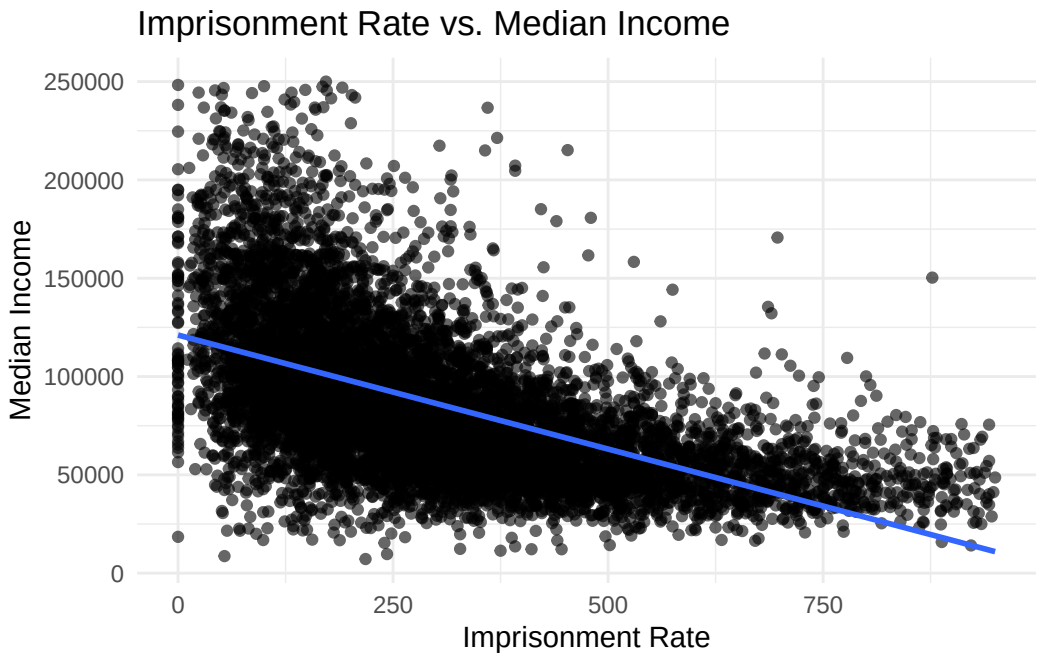
Income

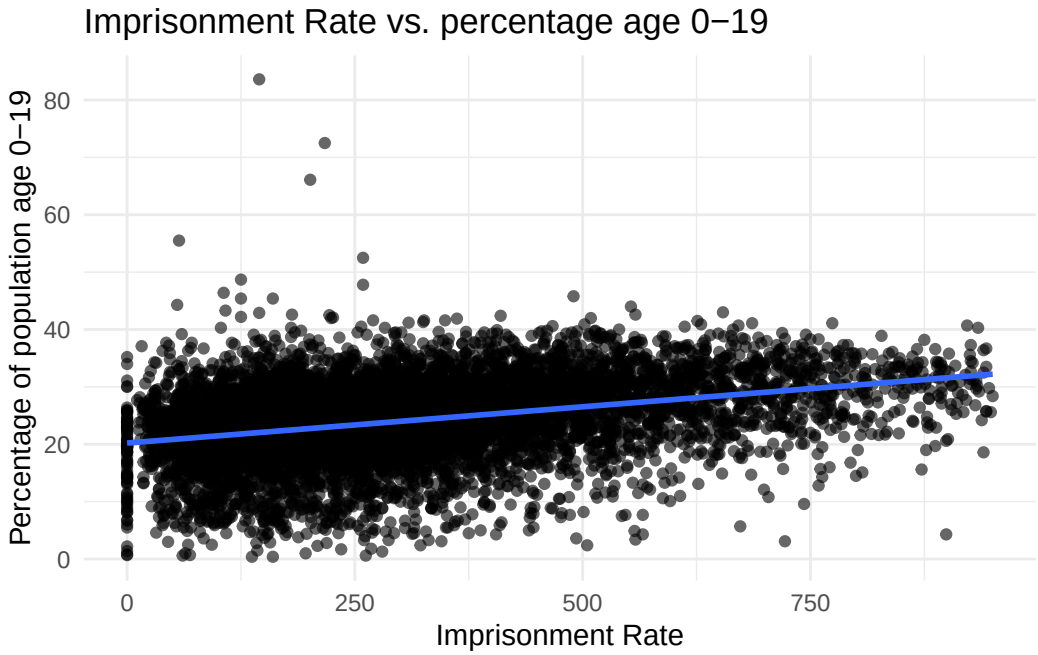
```
     99%
208825.1
```



The shape of the income distribution is also unimodal with a less extreme right skew and a median value of 7.7225×10^4. This doesn't appear surprising - more median incomes are concentrated towards the left.

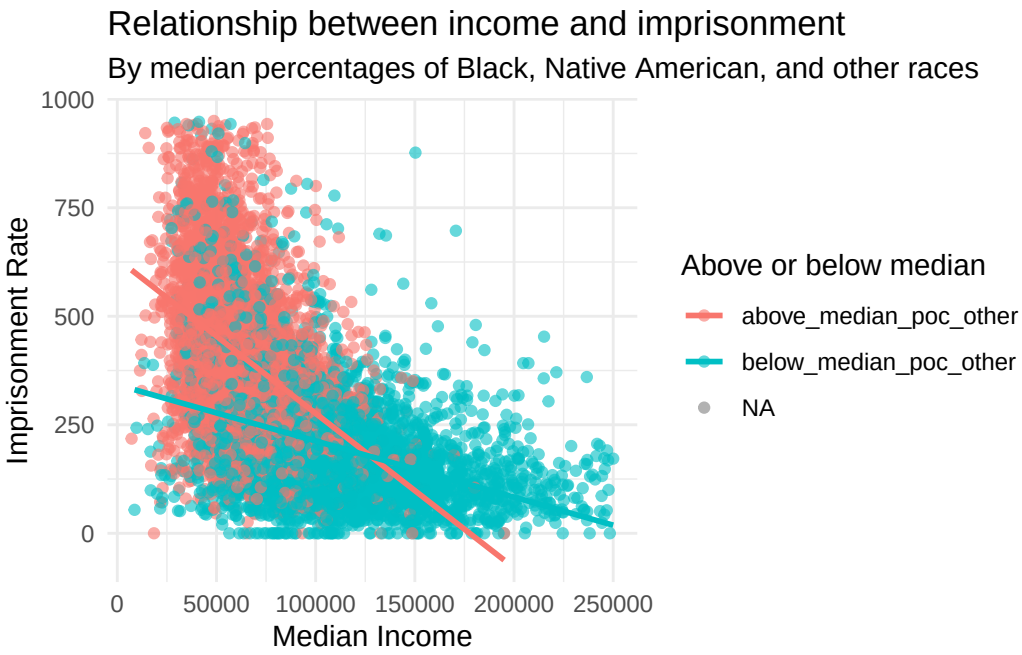






Imprisonment rate and percentage of census tract with a high blood lead level has a generally positive correlation. Imprisonment rate and median income has a generally negative correlation. Imprisonment rate and percentage of population aged 0-19 in the census tract has a generally positive correlation.

Potential Interactions



When comparing the relationship between median income and imprisonment rate, it appears that generally they have a negative correlation. This graph suggests there could be an interaction effect between race and income, as the relationship between median income and imprisonment rate differs by race. We created a categorical variable for the percentage of the census tract population that is black, native american, or "other race" that is categorically above or below the median in the data. The relationship between imprisonment rate and median income appears more negatively correlated when categorically above the median census tract population percentage of black, native american, and other_race. This supports that there could be an interaction effect between race and income.