Exploring the Impact of Lead and Wastewater Exposure on El Paso Communities Using Geospatial Heat Maps and the CEJST Tool

Francis Biney

September 9, 2022

Outline

Introduction

- Lead pollution has been shown to be harmful in low-income neighborhoods and communities of color, [(CDC, 2021)]
- Children who live in these communities are more likely to be exposed to lead based paint, dust, or soil than their higher income peers.
- These exposures affect growth and development of children's brains, and have been linked to behavioral issues such as attention deficit hyperactivity disorder ADHD [Needleman,1982], poor school performance[Kuang, 2020], poor memory[Arnvig, 1980], lower IQ scores[Needleman 1990], and reduced life expectancy in adults[Sandhya, 2016].

Motivation

- Paso del Norte community in El Paso, Texas is known to have a high concentration of lead in the air and soil[Darby, 2012].
- Due to heavy metal contamination caused by the extraction of lead, copper, and zinc from metal ore by the American Smelting and Refining Company (ASARCO) [Marcosson,1949] from 1901 to 1999, which was closed in 2009. [Darby, 2012].
- Mielke and Reagan [Mielke, 1998] showed that lead is particularly troubling due to its propensity to settle in the soil, where it can be inhaled or ingested by humans. Long-term lead exposure reduces cognitive functioning, which can influence educational outcomes and economic opportunities [Schell,1997].

Purpose of the study

- We explore the distribution, correlations and effect of lead and wastewater exposure in El Paso communities (census tracts) using geospatial heat maps and data obtained from the Climate and Economic Justice Screening Tool(CEJST) website.
- We also provided feedback on feature we thought were great, features that we would like to see, and roadblocks we encountered while implementing the Climate and Economic Justice Screening Tool (CEJST)in its beta phase from github.

The CEJST is a Biden-Harris Administration's project to help address inequity and inequality by assisting federal agencies in identifying disadvantaged communities that are marginalized, underserved, and overburdened by pollution CEJST 2022

CEJST for El Paso County

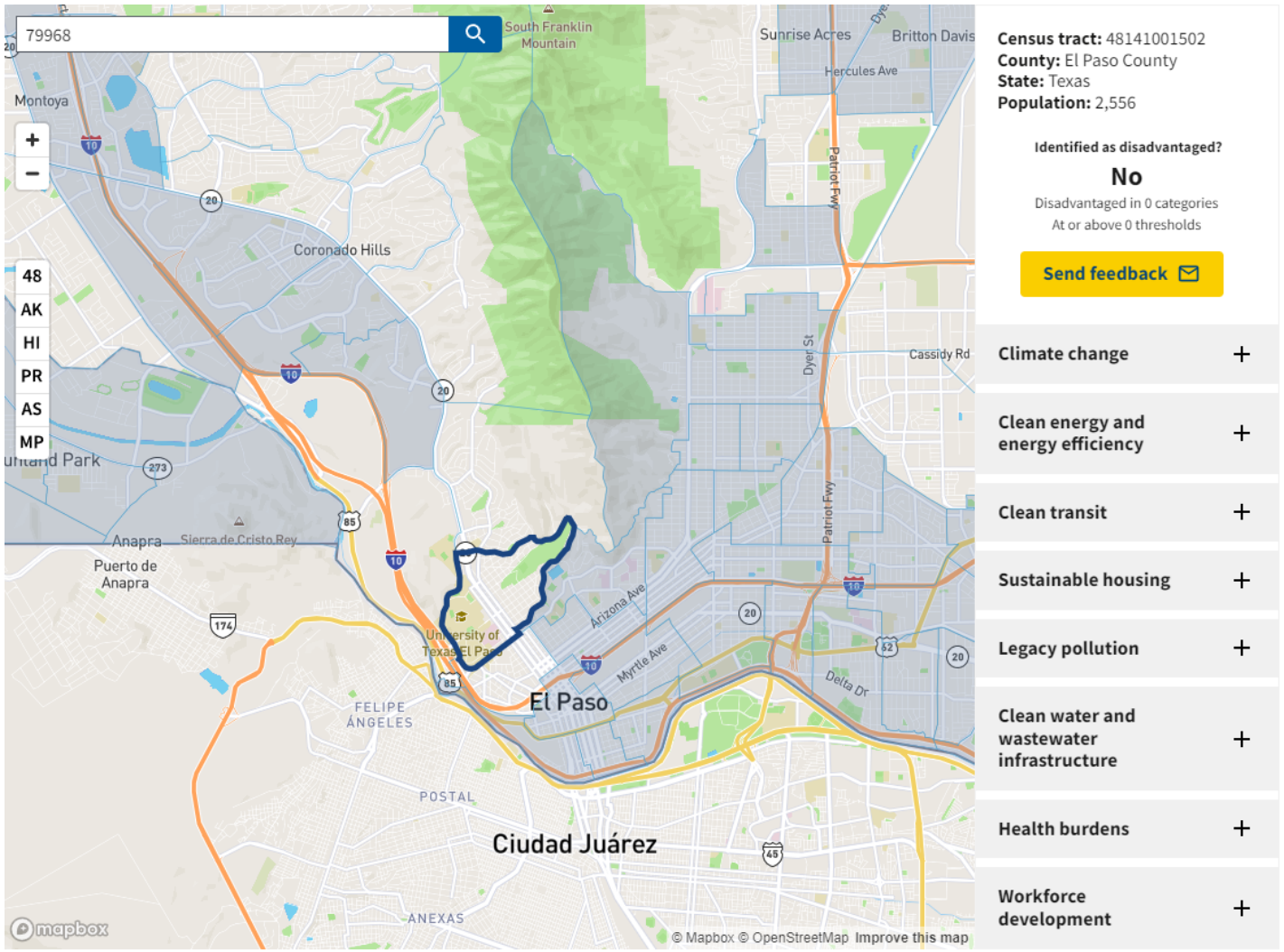


Figure: CEJST result for El Paso community with zip code 79968

Research Question (What we Did)

- Where in El Paso (census tract) has higher percentage of lead paint exposure.
- Where in El Paso (census tract) has higher percentage wastewater discharge. exposure
- What is the effect of high percentage of lead paint exposure on health of the El Paso community.
- What is the effect of high percentage of wastewater discharge exposure on health of El Paso community.

Implementation

Implementation of the Climate and Economic Justice Screening Tool (CEJST) in its beta stage from Github.

1. Install git on my windows computer
2. Clone (copy) the directory (folder) from Github to my local computer
3. Install docker on windows
   - Install/Set up WSL2 (windows subsystem for linux 2)
   - Install Ubuntu on Windows
   - Download and install docker

https://github.com/usds/justice40-tool

Method

We focused on exploring the distribution, correlation and association between water quality related measures such as exposure to lead paint, exposure to wast water discharged and basic demographic measures including education level, socio-economics status, and health related measures such as percent adult diagnose Diabetes

1. Geospatial heat maps
2. Box plot
3. Histograms
4. Conditional bar chart

Geospacial Data Source

1. Data use is available on the Climate and Economic Justice Screening Tool (CEJST)website under methodology and data page, published on March 30,2022.
2. The data contain 74131 observations(rows) and 83 variables(col.) with information on environmental, climate and socio-economic measures.
   - lead paint, Proximity to hazardous waste site
   - heart disease, asthma, diabetes
   - low income, Unemployment, Poverty rate and higher education enrollment rate.
3. The target variable: whether or not a community is disadvantage based on the criterior defined by CEJST team. A community qualifies as disadvantaged if the census tract :
   - is above the threshold for one or more environmental or climate indicators, and
   - is above the threshold for the socioeconomic indicators.
4. Additional goeospatial data was obtained from the *tigris* package in

Sample Data

First eight observations and columns

id	county	state	T_threshld	T_cat_exceded	is_disAdvan	total_population	LILpHE
01001020100	Autauga County	Alabama	0	0	FALSE	1923	FALSE
01001020200	Autauga County	Alabama	0	0	FALSE	2028	TRUE
01001020300	Autauga County	Alabama	0	0	FALSE	3476	FALSE
01001020400	Autauga County	Alabama	0	0	FALSE	3831	FALSE
01001020500	Autauga County	Alabama	0	0	FALSE	9883	FALSE
01001020600	Autauga County	Alabama	0	0	FALSE	3705	TRUE
01001020700	Autauga County	Alabama	0	0	FALSE	4029	TRUE
01001020801	Autauga County	Alabama	0	0	FALSE	2826	FALSE

Data Summary and Exploration

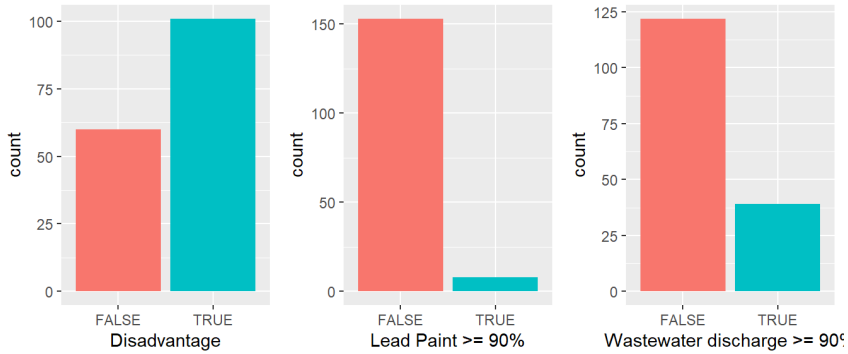


Figure: Distribution of disadv. communities in El Paso, exposure to lead Paint and wastewater.

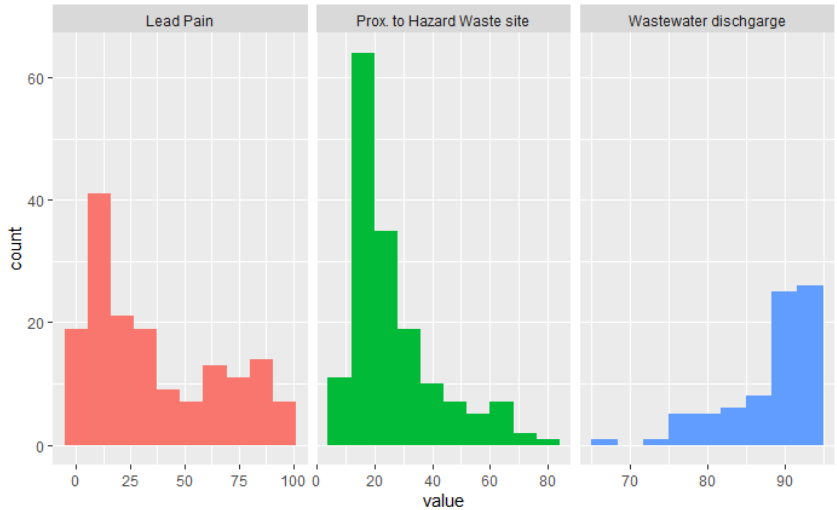


Figure: Distribution of the percentile of El Paso communities exposed to lead paint, Harzard waste and wastewater.

Data Summary and Exploration

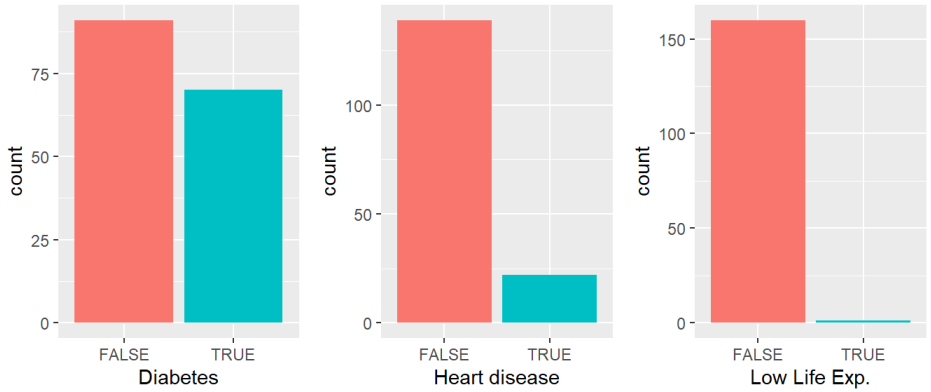


Figure: Distibution of Low, Life Expectancy, Diabetes and Heart disease in El Paso community

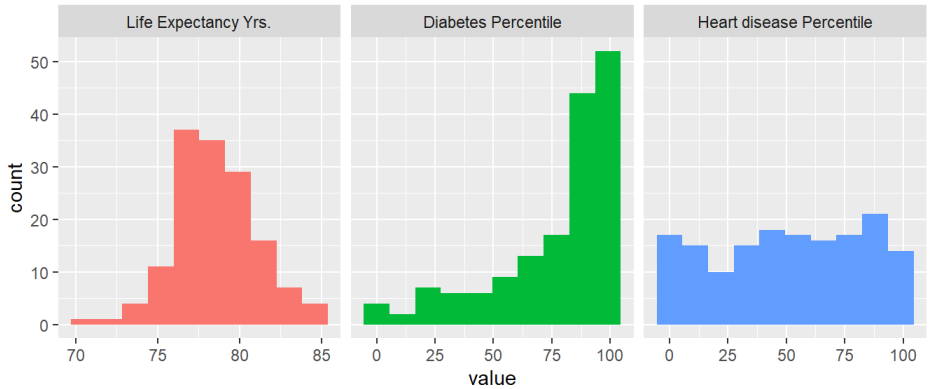
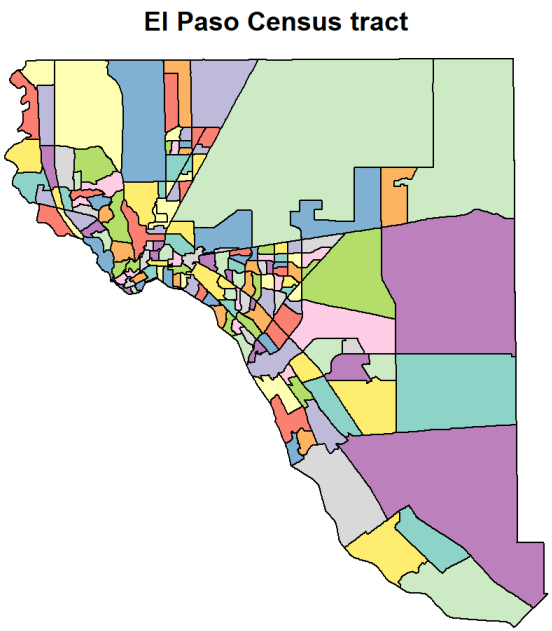
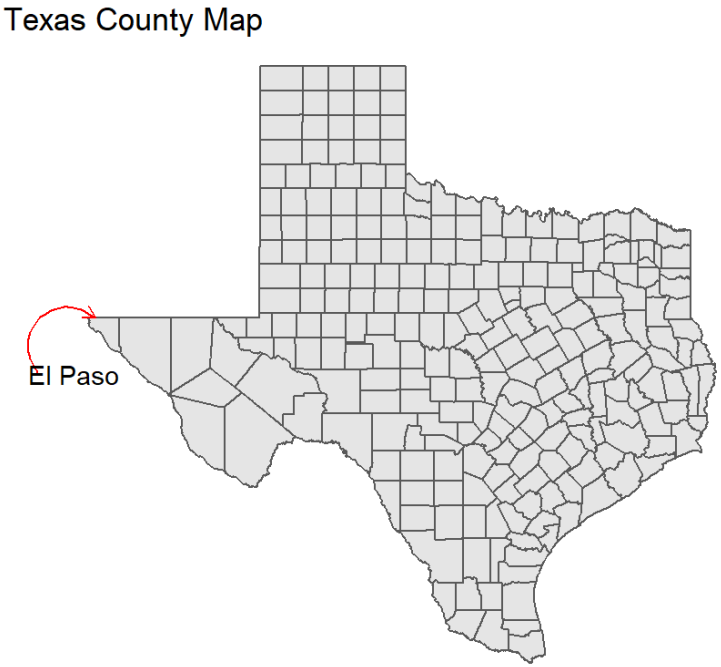


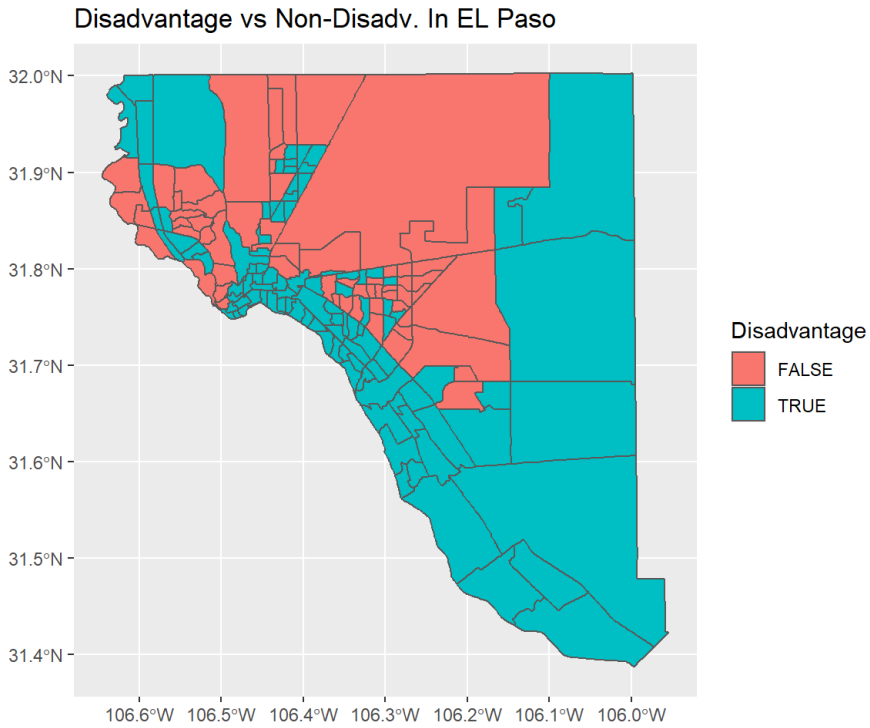
Figure: Distribtion of the percentile of El Paso communities for Life Expectancy, Diabetes and Heart disease

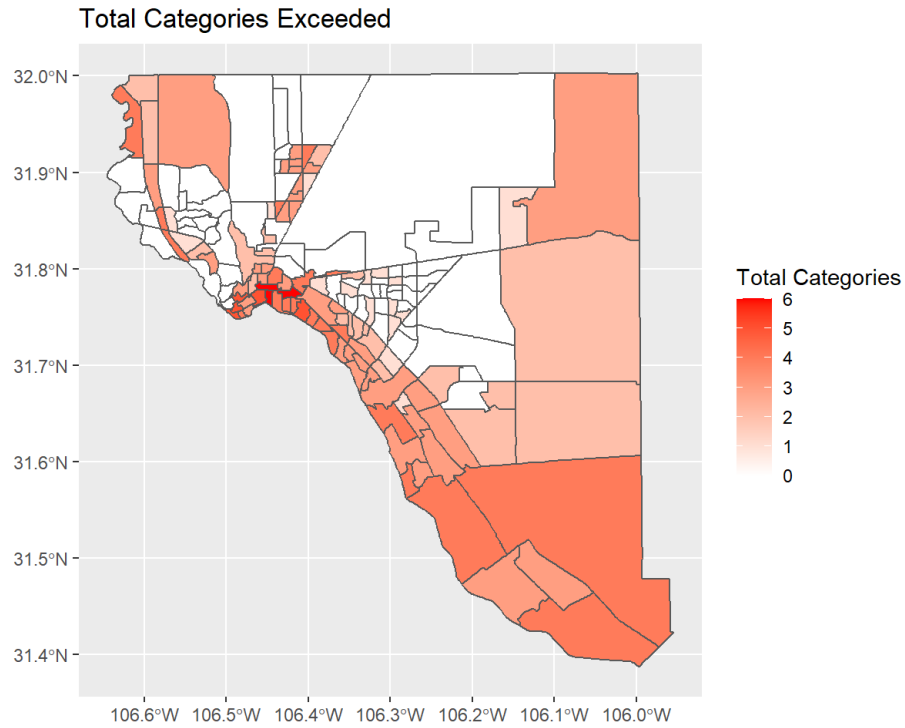
Texas County and El Paso census Tract



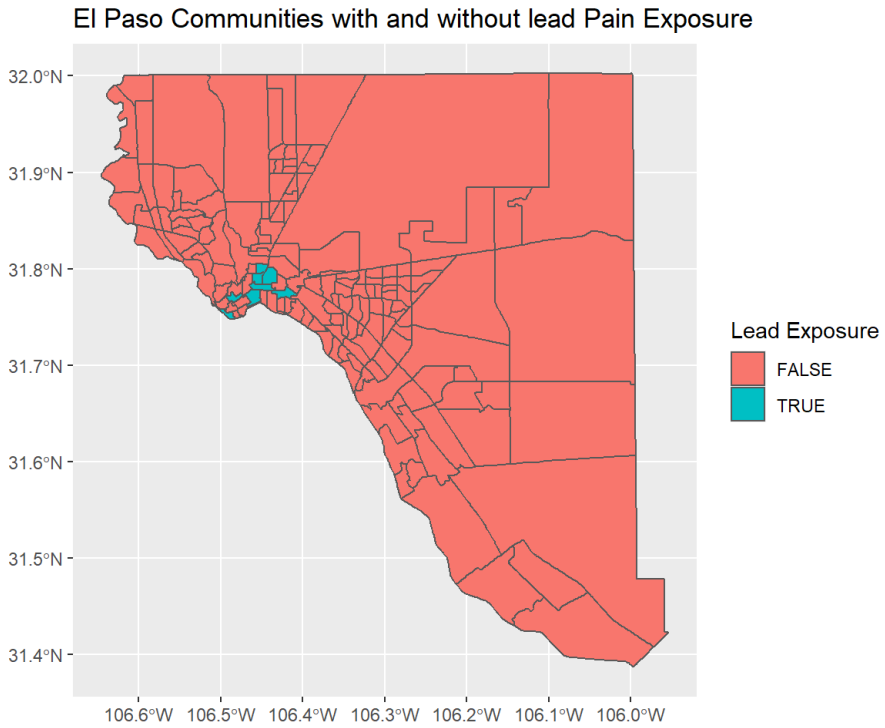


El Paso Disadvantage Community by CEJST criterion





El Paso Communities with water quatlity problem



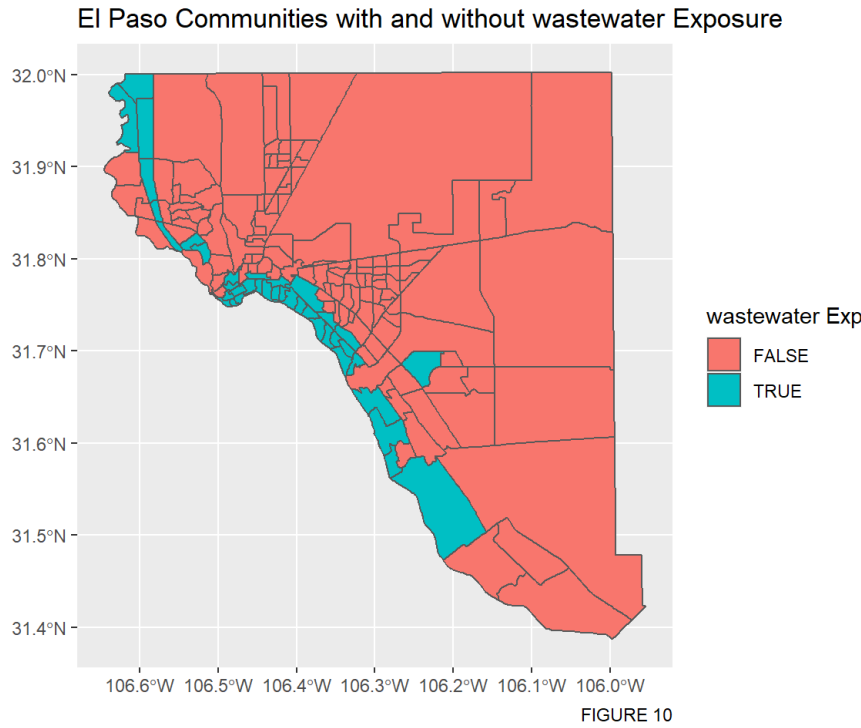
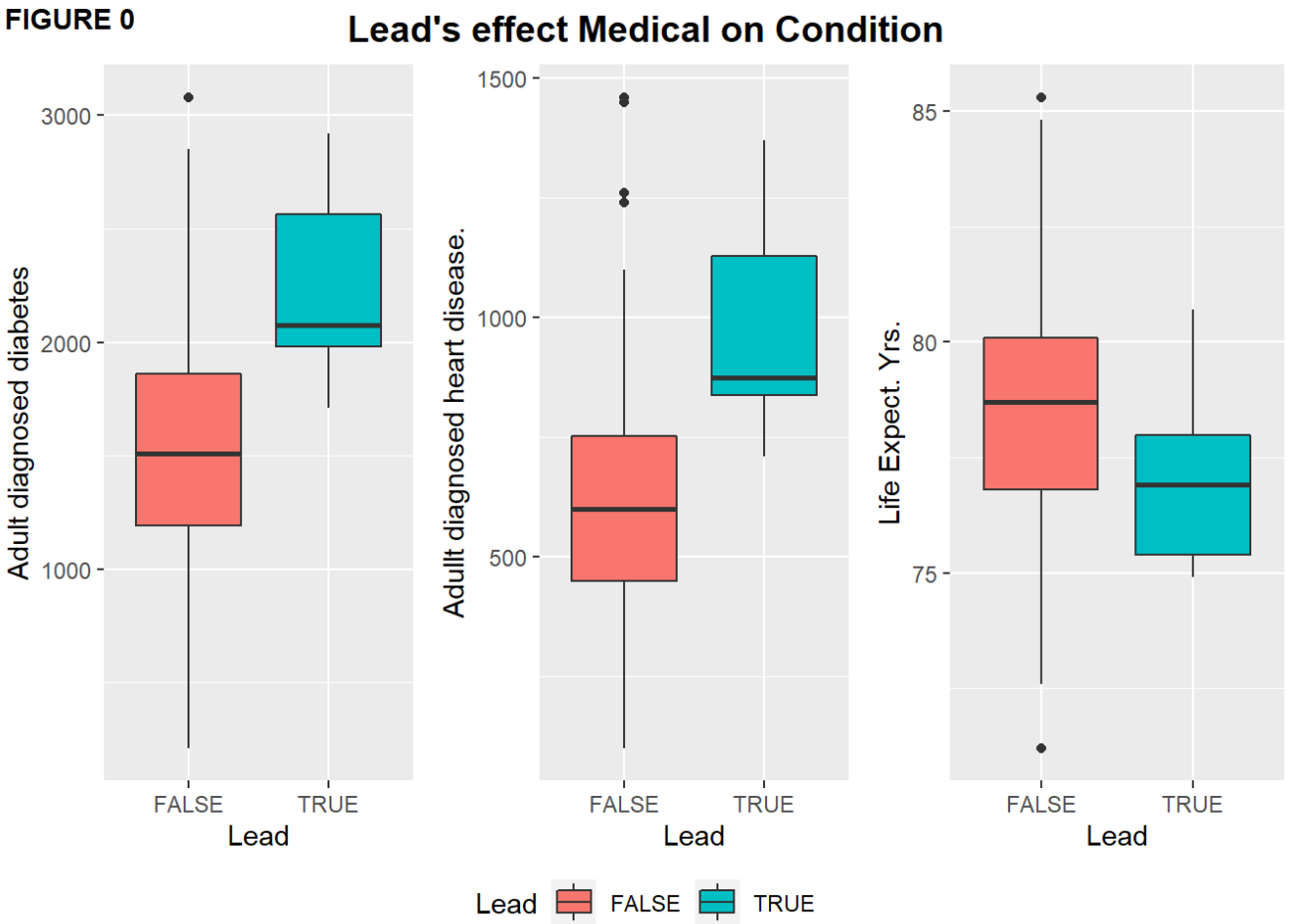
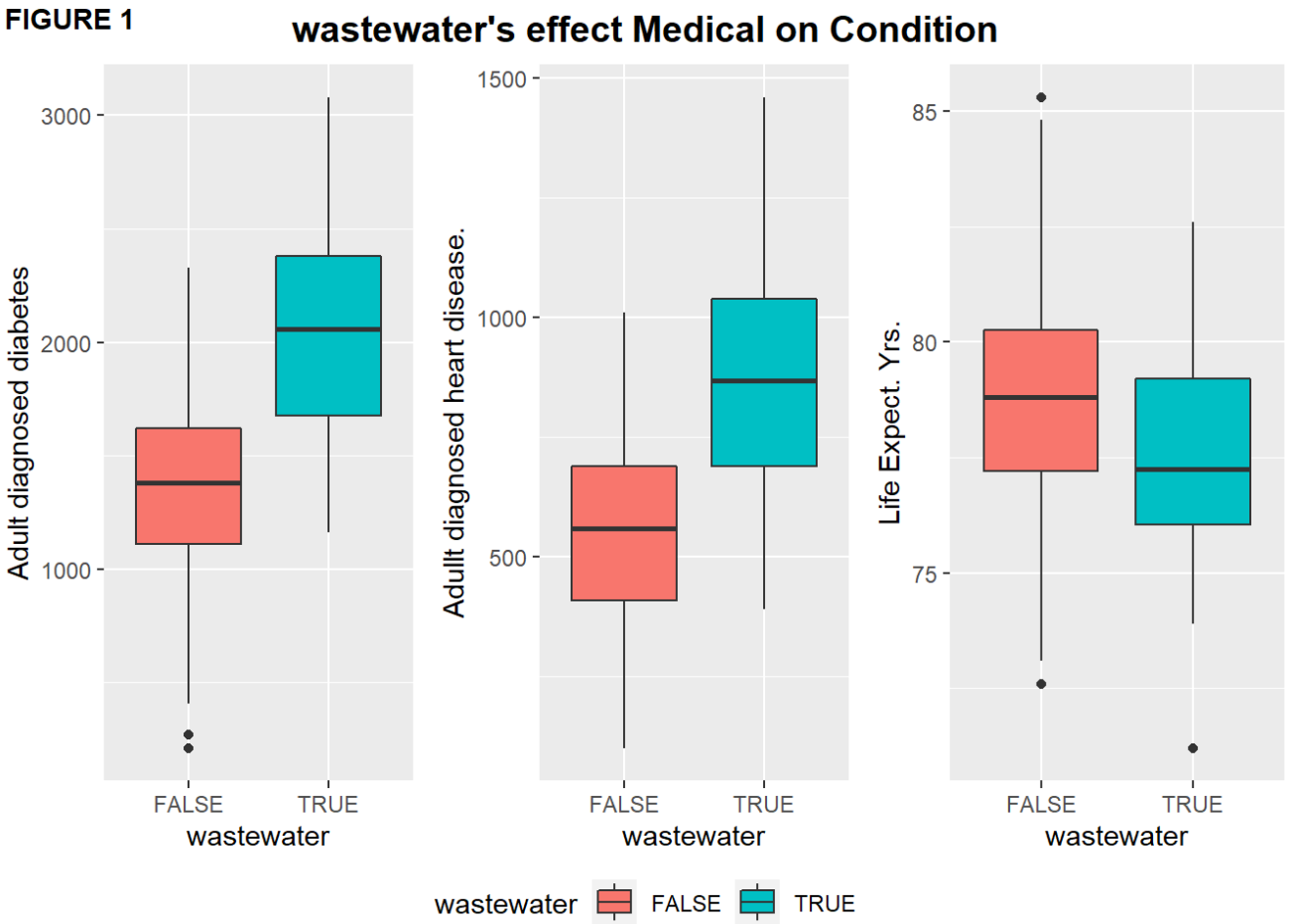


FIGURE 10

Effect of high lead Piant Exposure, on life Expectancy, Diabetes and Heart Disease



Effect of high wastewater discharge on life Expectancy, Diabetes and Heart Disease



Conclusion

- In our exploration and analysis, we observed that communities with high exposure to lead and wastewater tend to have a higher number of people diagnosed with diabetes and heart disease.
- These communities also have low life expectancies relative to unexposed communities. We also observed that most communities with high lead exposure also have high wastewater exposure.
- Overall: The experience gained by making use of Data and Techincal frame work s.a
  - using GiT and WSL
  - running Docker

Suggestion

The analysis will be more informative if communities with lead pipes are included in the data. Other suggestions include

- Statistical Analysis to justify whether a significant difference exists between the groups compared.
- Model the above.90th.percentile.PM2.5 using binomial logit model with other columns as predictors.
- Model the above.90th.percentile.lead.paint.exposure using binomial logit model with other columns as predictors.
- Find features that are top predictors of disadvantageous communities.
- Model the Total.categories.exceeded using the proportional odds model.

References

1. Alvarez, Juan M. 2015. Comparison of Blood Lead Levels Between Children in an Urban Setting and Children in a Rural Setting. The University of Texas at El Paso.
2. Arnvig, Eva, Philippe Grandjean, and Jorn Beckmann. 1980. Neurotoxic Effects of Heavy Lead Exposure Determined with Psychological Tests. Toxicology Letters 5 (6): 399–404.
3. Darby, Kate J. 2012. Lead Astray: Scale, Environmental Justice and the El Paso Smelter. Local Environment 17 (8): 797–814.
4. Marcosson, Isaac Frederick. 1949. Metal Magic: The Story of the American Smelting and Refining Company. New York: Farrar, Straus.
5. Marcosson, Isaac Frederick. 1949. Metal Magic: The Story of the American Smelting and Refining Company. New York: Farrar, Straus.
6. Needleman, Herbert L, and Constantine A Gatsonis. 1990. Low-Level Lead Exposure and the IQ of Children: A Meta-Analysis of Modern Studies. Jama 263 (5): 673–78.

Thank you!