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Community Engagement Concerning Soil Lead Levels

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Abstract

By performing a sixteen-week study on soil lead concentration in Springfield, Ohio, I was able to develop my capabilities as a researcher; learning new research methods and applying important urban policy information to the environment. This study surveyed different redlining areas of Springfield in order to determine any discrepancies in soil lead levels, as well as aimed to locate any areas with unsafe soil lead levels. This study was done as a part of a collaboration between a number of universities in the Midwestern United States to measure soil lead levels in various cities. By assisting in this study, I have further enhanced my skills as a scientist, gained valuable knowledge for my personal future living in urban areas, and have learned of several factors that may be of interest to me as a social scientist.

Introduction

Over the course of sixteen weeks, my Environmental Research Methods class performed a study concerning the soil lead levels in Springfield, Ohio. This study was carried out primarily through sampling different areas of Springfield and measuring the soil lead levels present at each location's dripline, midyard, and near the street. With this information, it was possible to observe emerging patterns that arose due to HOLC, or Home Owner's Loan Company, redlining and make assumptions based on census data.

Describing the Case Study

The course began with a collaboration with the Springfield Promise Neighborhood. Every year, the Promise Neighborhood holds "PromiseFest" outside of Lincoln Elementary School. Before the event, we created instructions, as a class, as to how individuals living in the area could sample lead for us to test. We walked around passing them out to willing participants. These flyers directed individuals to sample from the top two to three inches of soil from three locations around the house: the dripline, or area right up against the house, the midyard, and the area nearest the street. These locations were chosen because, in any citizen-generated science, there will be some inconsistency in the sample pool, due to the subjective nature of interpretation (Filippelli *et al.*, 2018). By specifying where the sample should be taken, it limits the distance in which a sample can be taken and limits the differences between samples. We also emphasized

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that the samples should be collected in plastic bags, and direct contact with the soil should be avoided, especially as the top inch of soil will contain the highest concentration of lead (Zahran *et al.,* 2013). In the end, we only had three individuals who provided us with samples. This provided a valuable lesson about how difficult it is to have community engagement in these types of projects. While much of the neighborhood showed interest in lead level testing when we passed out flyers or simply seeing the booth at the "PromiseFest," that did not guarantee participation from the community, nor does it ensure that satisfactory data can be collected.

With this lesson in mind, we moved forward in our study. I educated myself on the effects lead has on people and how it can affect their futures if exposed as a child, as well as became familiar with different environmental risks that high soil lead levels expose populations to. By doing extensive research on the different effects lead can have on a community, I was able to better understand why our study was important, and it made the following steps much easier.

The bulk of our study revolved around redlining. Redlining is the denial of a service to an individual based on where they live, in the form of mortgages, insurance, access to transportation, or quality of schools and healthcare providers in the area. This creates a form of systematic inequality that disproportionately diminishes the quality of life of individuals living within these redlined areas. The Home Owner's Loan Company created four designations of redlining, that were created in the 1930s (Hillier, 2003). These designations are divided into Area A, Area B, Area C, and Area D, with A having the highest economic status of the designations and D having the lowest. Individuals in Area A have a better quality of life due to easier access to hospitals, medical centers, schools, grocery stores, and transportation than those living in B, who in turn has better access than C, and so forth onto D. I had never heard of redlining before this project, but I have since realized how much it had affected my life. I have lived in nearly all of these areas, and I can relate to individuals living in each area. I had never known while living in these areas that the advantages and disadvantages extend onto the environment past aesthetics. I realize now that for most of my formative years, I lived in areas that likely had very high lead levels. I had also never known that the different neighborhoods were actually designated areas created for financial purposes and not simply social creations. While redlining is no longer practiced as of 1975, the effects it had are very much still present today (Hillier 2003).

Most importantly, I realized how valuable these designations could be for research. In our case of lead, three teams sampled in different redlining areas. My team sampled in two D designations and one B designation. These areas looked so different from each other, and the data was tremendously different, despite only being a few streets away from each other. The discrepancy between areas provided evidence for environmental injustice, but more importantly provided

important sample areas for other future tests. For example, testing the water quality in the different redlining areas would also have interesting and varying results. In the future, no matter what the experiment, these areas would be important research sites.

Before we finished the project, we also sampled several of the public Springfield parks. Though not figured into the main study, the data was also helpful in displaying discrepancies between residential land and city owned land. The comparison also aided in my understanding of redlining, lead partitioning, and environmental injustice.

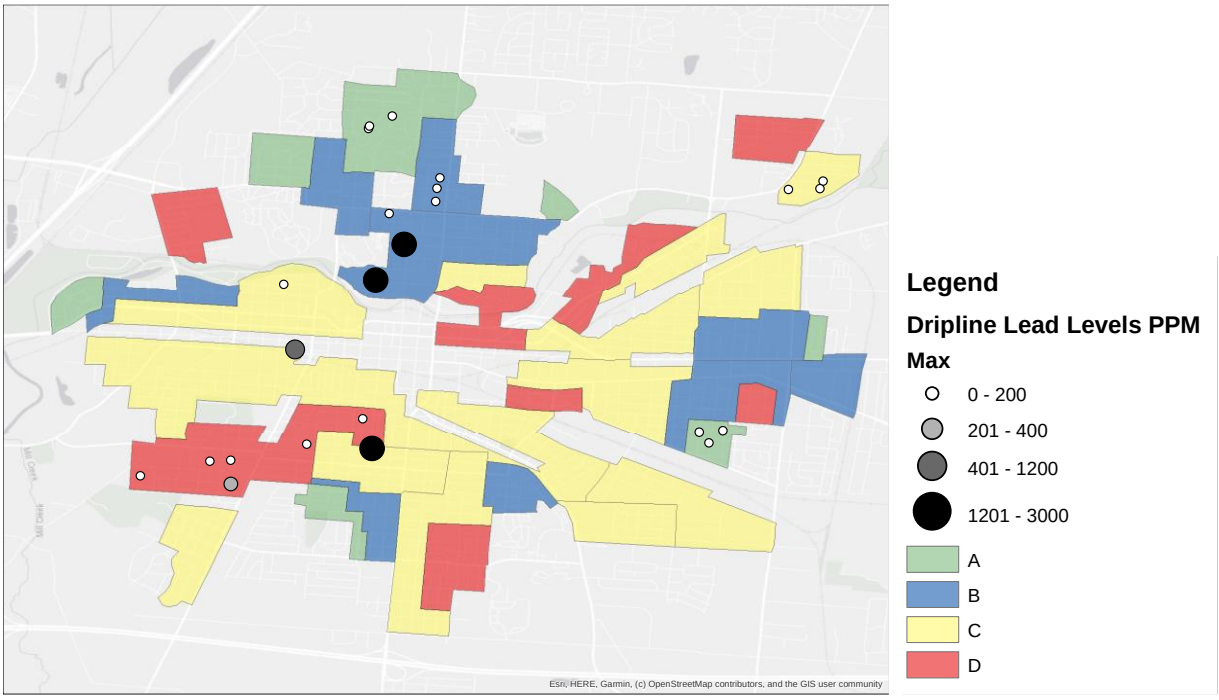
Analysis

The lead levels among different redlining areas showed that the lower designations had higher lead levels, which did not change depending on where in the yard the sample came from. We met with residents within these designations to obtain informed consent on sampling at occupied houses, as well as sampled some vacant housing. At each location, we sampled near the street, in the midyard, and near the dripline of the home. Once collected, the soil was dried overnight and measured using an XRF machine. Nine grams from each location were combined and sent to the larger scale study for analysis.

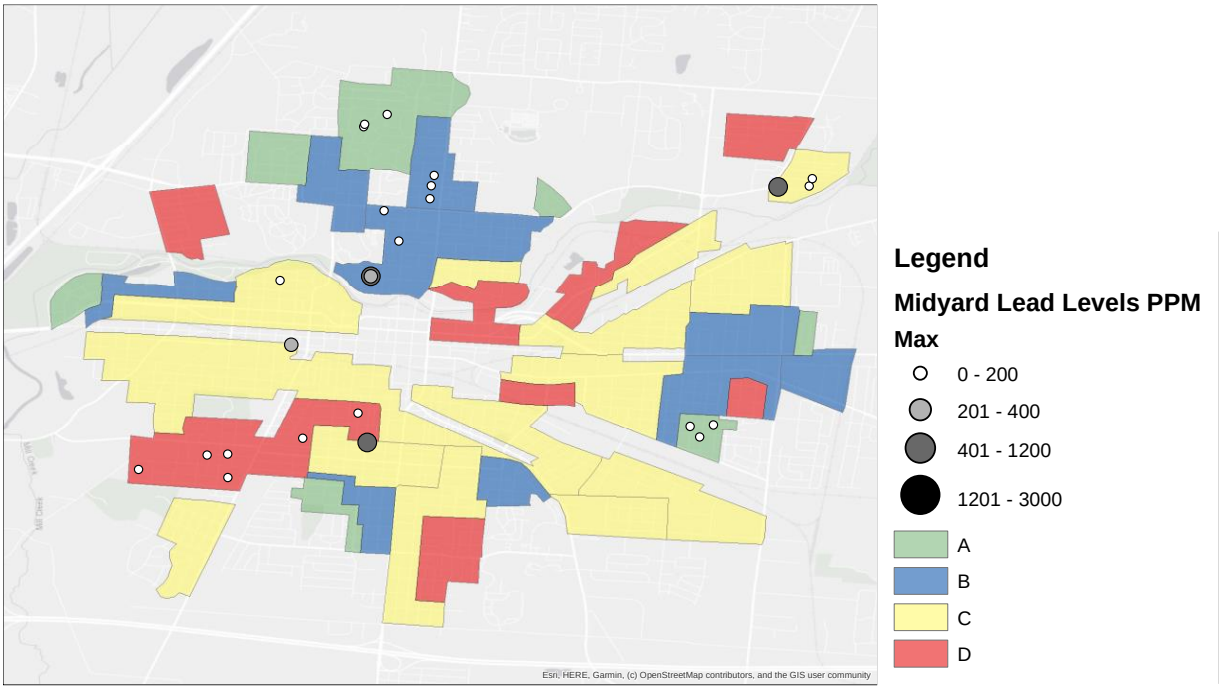
There are different safety thresholds that apply to soil lead concentration. It used to be that any lead concentration below 600 parts per million (ppm) was considered safe (Madhavan *et al.*, 1989). Now, various peer-reviewed literature articles and the EPA have placed safety thresholds as concentrations below 200 ppm being a safe range for the any type of activity, below 400 ppm being safe for gardening, and anything above being an increasing risk. These safety thresholds correlate with higher blood lead levels, which could also hinder development. That being said, soil lead levels of 1,000 ppm can actually be safe- if, and only if, the individual does not spend time outside and does not live in a smoking household (Schilling and Bain, 1988).

In Springfield, the dripline had the highest concentration, as well as the most frequent concentration over 200 ppm (Figure 1). Nevertheless, there are still a decent number of sample areas where the lead concentration fell below the safety threshold. This helps me localize any future experiments, as well as informs me in my personal life. For example, if the dripline has the highest concentration, any future gardening, outdoor projects, or child's playsets I may want in my yard I know I will have to place them further away from my home.

1A.


Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
Legend
Dripline Lead Levels PPM
Max
0 - 200
201 - 400
401 - 1200
1201 - 3000
A
B
C
D

1B.


Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
Legend
Midyard Lead Levels PPM
Max
0 - 200
201 - 400
401 - 1200
1201 - 3000
A
B
C
D

1C.

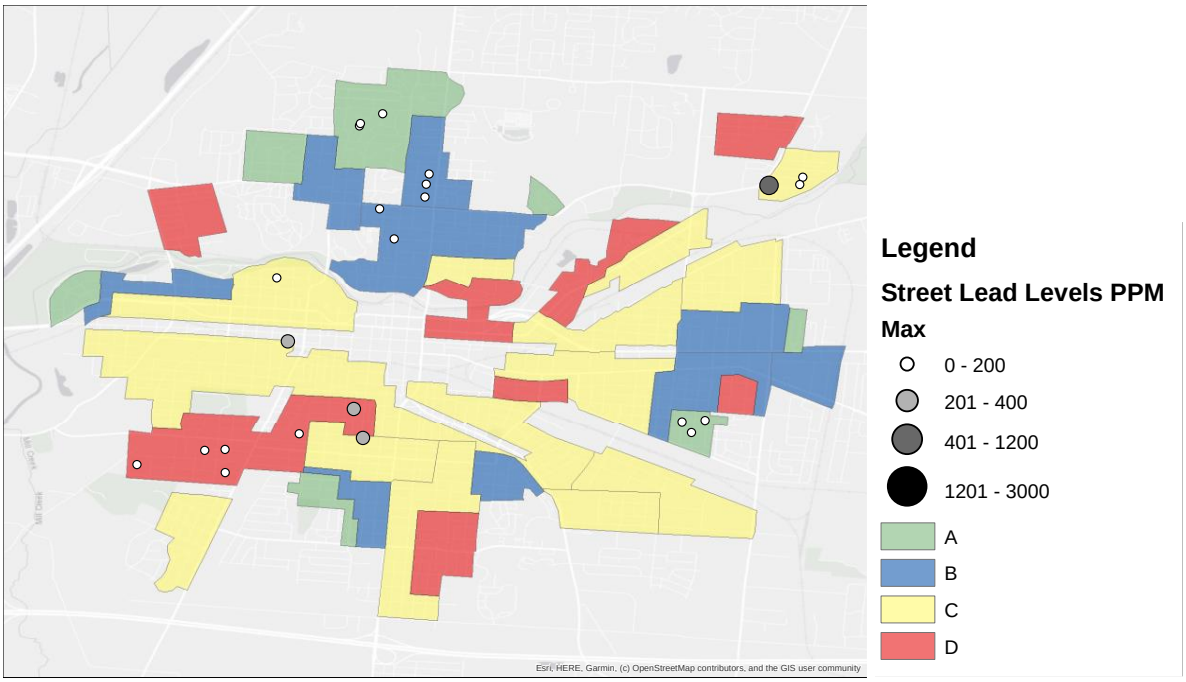


Figure 1. Lead Concentration by HOLC Designation In all three sample locations, Area C had the highest lead levels of all four areas, many of which were unsafe. (A) Lead levels on the dripline were highest in areas B and C. (B) Lead levels in the midyard were worst in C, but were also high in B and on the edge of D. (C) Lead levels in the street were highest in C, but were also high in D.

Additionally, I feel as though I have a greater understanding of how cities prioritize. The public parks maintained by the city had very low and very safe lead levels (Figure 2). Each park measured was geolocated to determine the nearest redlining areas. Then, the maximum ppm possible at the park and the average of the maximum ppm of the three samples taken per park were calculated in order to determine if any lead safety thresholds were met. Nearly all the parks were under the 200 ppm safety threshold, and even the one that surpassed it- Veteran's Park Memorial- did not pose an extraordinarily high risk to individuals who may visit. Luckily, even if it had, the memorial is not a play area for children, but simply a monument on display. Overall, the city is making an effort to prevent lead exposure in public parks. They are not, however, taking an active enough approach in residential areas, as shown by the current residential lead levels.

Figure 2. Max Lead Levels Per Park After the sampled were collected and analyzed, it was determined that Veteran's Park had the highest maximum ppm and the highest average ppm. Old Reid Park had the lowest maximum ppm and lowest average ppm.

Park	Redlining Area	Max PPM	Average Max PPM
Layne Addition Park	B	74.8	55.5
Selma Road Park	D	93.2	62.6
Standpipe Park	D	75.8	64.2
Virgil Mabra Park	D	56.0	41.4
Davey Moore Park	B	103.3	95.2
Veteran's Park	B	336.8	184.4
Veteran's Park Memorial	B	328.7	310.2
Snyder Park	C	76.2	52.5
Buck Creek Nature Park	C	70.5	64.2
Old Reid Park	C	48.5	37.2

Childhood exposure to concentrations of lead also plays a large role in how well the child develops and functions as an adult. Studies have shown that high childhood lead exposure predisposes individuals to antisocial behavior (Wright *et al.,* 2008). By following children who exhibit these behaviors, they discovered that individuals who were exposed to high soil lead concentrations as children were associated with higher rates of arrest, especially for violent crimes (Wright *et al.,* 2008). A different study not only linked high soil and blood lead levels with violent crime, but also linked it to lower IQ and cognitive function, increased likelihood of unwanted pregnancies, and overwhelmingly more aggressive and delinquent behavior (Nevin, 2000; Stretesky and Lynch, 2004). Our sample data also supports these claims. Redlining areas A through C have an increasing number of crimes, with C being the highest, before dropping back down in D (Figure 3). As shown previously, C had the highest lead level concentrations, before dropping again in D. The high number of crimes committed correlates, just as it does with the other redlining areas (Figure 4).

Figure 3. Crime by Redlining Area Listed are the total number of crimes committed n 2013 per redlining area, using 2013 census data. HOLC Area C had the highest number of crimes committed, and Area A had the least.

Redlining Area	Total Crimes Committed in 2013
A	962
B	7,419
C	17,987
D	4,364

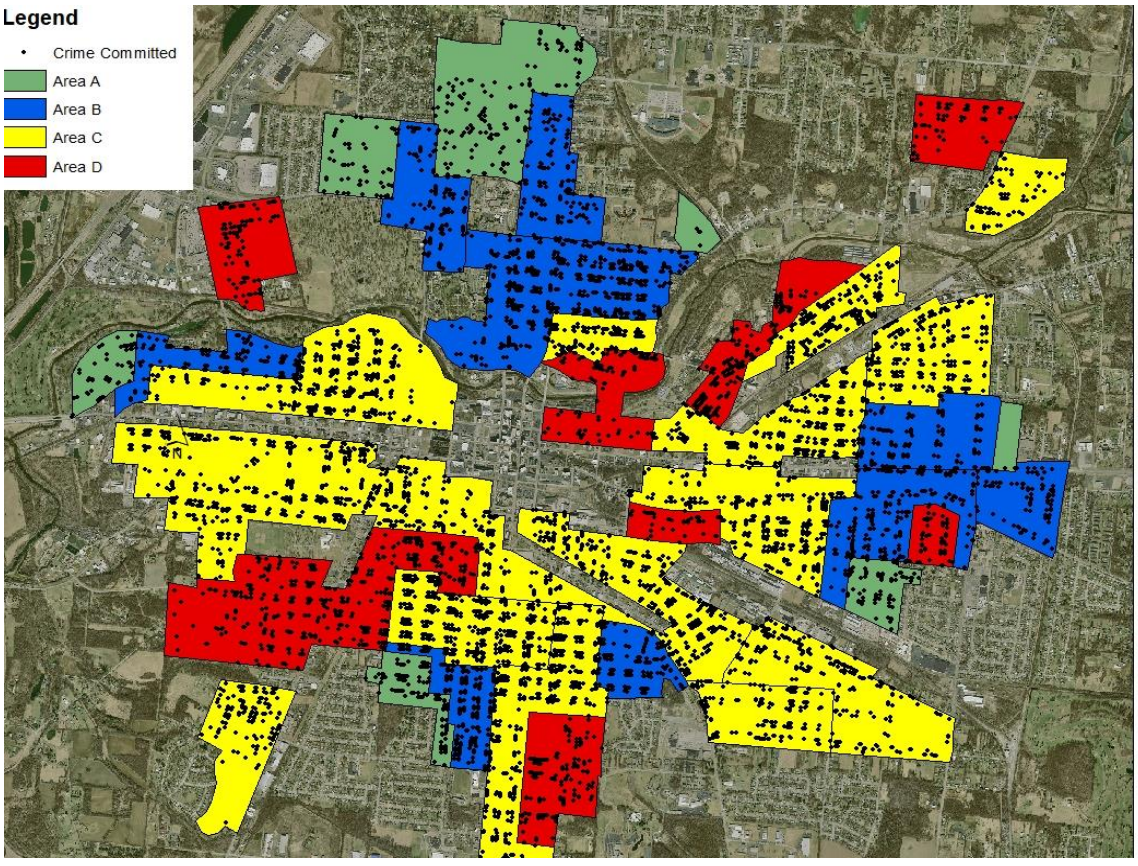


Figure 4. Crime According to Redlining Area All crime committed in 2013 was mapped based on redlining areas. Area C had the highest number of crimes committed, with B being a close second.

Finally, and most important to me, is how this study has affected me as a social scientist. As I graduate from Wittenberg, I plan to earn my Ph.D. in Criminal Justice and study the causative factors of crime. The research done on the correlation between childhood lead levels and crime was extremely interesting to me, but was not very well developed. Often the research did not acknowledge the societal variables, such as poverty in the lower socioeconomic areas or single parent households, and only focuses on lead. Only a few articles tie together the correlation properly. I would be most interested in studying the discrepancy between Area D having less lead than Area C, as well as lower crime rates. Specifically, I want to know if this difference could be attributed to an increase in the number of vacant homes in and clearing of unused lots in Area D. If Area C has more individuals, there will be more crime. Moreover, if there are more houses in C, there will be more lead paint to pollute the soil than in D. Using the methods I've learned through this class, I can enhance my professional endeavors by utilizing both my sociological education and my environmental education to form a more comprehensive and accurate study.

Synthesis/Discussion

The next step in this study would be to share our data and work with advocates to make policy changes to assuage these issues. This data should be given to the city, spread to other urban policy planners, and compared with other similarly sized cities. The data sent to the larger scale study should also be reviewed in order to see if there are any patterns among different cities to explore. By sharing this data, others can learn more about how the environment is affected by political decisions as well as determine what areas of a city need the most attention. Furthermore, this study should be done annually, in order to track if the problem is being properly addressed. By solving one problem, it is possible for city officials to solve many problems at once. By alleviating lead problems, there is the potential to improve the future quality of life of the children living in high lead concentration areas, lower city crime rates, and improve cognitive test scores. This sampling, between intense research and community engagement, allowed me the opportunity to grow as a scientist as well as influenced my future decisions as a citizen.

Acknowledgements

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