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Addressing Service Gaps in the EPA's Superfund Program Process: Arsenic & Lead Soil Concentrations External to the 35th Avenue Superfund Site

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2021

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a thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
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Abstract

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Introduction
The use of quantitative and technological methods to assess, classify and remediate Superfund Sites may propagate service gaps and perpetuate an elite technocracy that deprioritizes lay observations. The use of qualitative methods in the EPA's Superfund process has a well-documented history demonstrating its insufficiencies that have influenced mistrust from fenceline communities. These communities present their lived experiences of being victims of environmental injustice yet are not venerated or validated until technical agencies quantify their qualitative observations. When assessing Superfund Sites borne of pollution from industrial processes, community voices play a key role and have optimal potential to clearly define the extent of the contamination and the associated health outcomes. Previous research demonstrates that without those voices, the assessment and remediation process may exacerbate negative health outcomes associated with pollution.

The 35th Avenue Superfund Site is composed of three neighborhoods and has recently expanded. Interviews with residents in the North Birmingham neighborhood, which is adjacent to the Site boundary, demonstrate longstanding concerns about pollution events and adverse health outcomes. However, there is no documented evidence of an exploration of contamination in this neighborhood in response to community concerns.

Methods
This research looked to venerate lay observations of community members by assessing the association of soil concentrations of toxic heavy metals and metalloids (HMM) in this neighborhood in comparison to the 35th Avenue Superfund Site. A nonparametric Wilcoxon Rank Sum (WRS) test was used to assess this association.

Results & Discussion
Findings of the analysis demonstrate no difference in HMM concentrations, suggesting a likely contamination issue in the North Birmingham neighborhood. As such, it may be necessary to reassess soil concentrations in this neighborhood for possible inclusion in the existing site boundary in tandem with assessing lay observations of the contamination issue.

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This research is dedicated to victims of environmental injustice whose voices have been muted and whose lives have been taken for protesting for a healthier environment. This research is greatly inspired by my great grandmother who lived and died in the woes of environmentally racist practices.

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Part I: Introduction & Background

Creation & History of Superfund Sites

There are presently 1,894 legally recognized contaminated waste sites, or Superfund Sites, in the United States (US EPA, 2018b). Superfund Sites are governmentally recognized by the Environmental Protection Agency (EPA) under the Superfund Program and can be defined as polluted waste sites presenting danger to human health that require efforts to be cleaned or remediated to protect human health (US EPA, 2019b). A premier example of a Superfund Site is the Valley of the Drums in Kentucky which included over 20,000 containers of toxic chemicals that polluted water and soil sources (US EPA, 2013a). The Superfund Program is supported by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980 which exists in attempts to enforce financial liability onto environmental polluters (typically industrial companies) for cleanup of their hazardous waste. However, when no responsible party is brought forth, the EPA utilizes taxpayer dollars for remediation efforts (US EPA, 2018c; (US EPA, 2020).

Requiring a greater discourse than what can extensively be offered presently is the extractive colonial conditions that warrant the development of Superfund sites and who's mostly impacted--however, I will offer a brief polemic on this issue throughout this paper. Superfund sites develop from actions, or inaction such as dumping of toxic waste, negligence in production and disposal of toxic materials, oil spills, and disasters not directly caused by human action (Amin et al., 2017; US EPA, 2017). The Valley of Drums Superfund Site was a result of negligence with handling waste. It is predominately industrial practices and negligence concerning hazardous waste production and disposal that have influenced the presence of such hazardous waste sites and continue to impact the health of the public globally (Bullard, 1993; Fazzo et al., 2017; Stafford, 1981). The Valley of Drums was illegally operating on a field of 17 acres (about twice the area of the Lincoln Memorial Reflecting Pool) from 1967 to 1977, hauling toxic waste from affluent industries of Kentucky (Filiatreau & Hornblower, 1979). After a decade of negligent mismanagement of toxic waste with the potential to cause negative health outcomes such as birth defects and cancer, it was classified as a Superfund Site and took a little over a decade to be remediated (US EPA, 2013a).

Historical and modern research has continuously affirmed that hazardous waste sites are housed in predominantly Black and Brown communities (Bullard, 1993; Moreno Ramírez, 2020; U.S. General Accounting Office, 1983; United Church of Christ, 1987). Communities living near waste sites and other environmentally hazardous conditions are considered "fenceline communities" and are living in conditions manufactured by environmentally racist and capitalistic practices and policies that influence negative health outcomes, subjects its inhabitants to economic blackmail, and inequitable exposure to toxic (Bullard, 1993; Moreno, 2020). Indubitably, this happenstance is not a random occurrence of a consistently demonstrated action—Bullard (1993) explains that the co-habitation of environmentally toxic sites and Black and Hispanic communities arise from poor economic conditions toppled with political disempowerment.

Workers in and near Superfund sites are also exposed to toxics in their place of work. This is especially of concern in occupations exposed to material hazardous to human health. The destitute economic conditions that many low-income Black and Hispanic communities face encourage employment in hazardous conditions threatening their health but provides monetary rewards supporting the livelihood of themselves and their family as detailed by Dr. Bullard (1993). As a result, many are forced to maintain positions that harm, which is a form of economic blackmail (Bullard, 2011; Bullard, 1993). Plainly stated, disproportionate exposure to hazardous waste on historically oppressed groups is a modern display of environmental racism and environmental injustice. Even more perturbing is the process in which Superfund Site classification is established.

Classification Process of Superfund Sites

The U.S. EPA has a clearly defined a robust multi-phase process for Superfund Site classification, remediation and deletion and can be described in six steps; 1) Discovery and Assessment, 2) Risk Characterization, 3) Site Classification, 4) Remediation/Removal, 5) National Priority List (NPL) Deletion, and 6) Preparation for Reuse. Citizens, state or tribal agencies, and environmental organizations may report to the EPA about concerns about contamination (US EPA, 2015a). Oftentimes routine inspections by the EPA can lead to pollution discovery leading to site investigations (Wisconsin Department of Natural Resources, 2012). After notifications are received, the federal process places suspected sites or facilities on the Federal Agency Hazardous Waste Compliance Docket, allowing for a Preliminary Assessment (PA)/Site Inspection (SI). The PA includes an analysis on the history of the site or facility, its uses and the current condition followed by the SI which conducts environmental sampling of water, soil, and air to measure concentrations of contaminants to rule on the potentiality of negative impacts on human health. The EPA has the option to inform the community about the investigation. The PA/SI calculates a score under the Hazard Ranking System (HRS), sites with a score greater than 28.5 out of 100 qualify for a classification proposal onto the Superfund NPL (US EPA, 2015a). Proposal for NPL classification allocates sites to additional programs housed under the EPA for prioritized remediation. At this point in the process, lay community members may be presented with options to share input on the site. They may have the opportunity to share details about the site with the EPA during the PA/SI phase (US EPA, 2015a). Community involvement opportunities may also arise during the proposal phase; the community is notified about the proposal and has a period to submit comments on the proposal of the classification. The 60-day window for commentary and other stakeholders could sway the outcome of the classification (US EPA, 2015d). If classification is achieved, therein begins the remediation or removal phase with the intention to delete the site from the NPL and repurpose the use of the landscape or reinforce protective measures or regulations such as requiring updates to outdated technology (US EPA, 2011; US EPA, 2018c).

As previously mentioned, hazardous waste sites may be discovered by concerned residents, which precedes the PA. When assessing potential negative health impacts from identified toxic waste, this phase may utilize a mixed methods approach by deploying quantitative and qualitative methods. Qualitative methods include interviewing residents about the history of the site—though this method is optional for site coordinators to execute. This process presents a range of opportunities for the EPA to involve the community residents in its investigation by choosing to host community meetings, interviews, providing information about exposure and risks and sharing details with local media sources. A Community Involvement Coordinator (CIC) may also be appointed to a site during and throughout the entirety of the process to share information with the community (US EPA, n.d.-d). Officially classified Superfund NPL Sites require a Community Involvement Plan (CIP) to maintain an open pathway for sharing site developments with the community. While the optional and mandatory elements in the phases of a Superfund Site have high potential to utilize a shared community space and venerate community voices, it is not always executed effectively (Moreno Ramírez, 2020; Ramirez-Andreotta et al., 2014).

The EPA is the technical agency throughout the entire portion of Superfund work, and it rests a great deal on quantitative methods (numerically characterizing concentrations of contaminants at site, developing remediation and removal processes using technology) while the individuals in the community are the non-technical party carrying their lived experiences and observations. Predominately utilizing quantitative methods may unintentionally propagate service gaps during site discovery. This prioritization of technological uses to discover hazardous waste sites may also esteem the technical knowledge of agencies over the non-technical offerings of lay community members. This hierarchy may subsequently fail to regard community voices and ineffectively characterize and remediate Superfund sites (Moreno Ramírez, 2020).

In the PA/SI stage there are only recommended, not required actions for the EPA to consult with the community members (US EPA, 2013c). After NPL classification is achieved, the use of a CIP lacks sufficient qualitative methods to understand the community and its history, it also lacks adept tactics for science communication, and rests a great deal of responsibility on community members to understand the political process involved in constructing a Community Advisory Group that uses community input to influence site outcomes (Moreno, 2020). Throughout the NPL process from investigation to cleanup, the EPA’s priority is to produce scientifically affirming results to influence decision to classify with the secondary priority being to include community input (Nagisetty et al., 2022).

There are gaps and flaws in the methods and pursuit of non-technical community involvement in the Superfund process. Previous research supports that these flaws can hinder the success of the EPA's efforts to utilize qualitative methods from Superfund Site investigation throughout remediation (Byrd et al., 2001; Moreno Ramírez, 2020; Nagisetty et al., 2022; Ramirez-Andreotta et al., 2014). This paper addresses the following gaps and flaws; deprioritizing lay observations, voluntary executing of community involvement in particular phases, and poor science communication. Such flaws perpetuate an elitist technocracy that has an unrealized potential to exacerbate health outcomes and perceptions of environmental health (Moreno, 2020).

Service Gaps & Negative Health Outcomes

Social determinants of health are indicators of health and quality of life that are composed of five domains; access to quality healthcare, economic stability, access to quality education, built environment, and context of social supports (Office of Disease Prevention and Health Promotion, 2022). Of these five indicators, living in close proximity to a Superfund Site may negatively influence each indicator of health and quality of life, and has demonstrated impact on reduction of number of years lived (Kiaghadi et al., 2021). This is especially the case due to the health outcomes associated with the pollutants from industrial practices that are responsible for the development of Superfund Sites which has been shown to increase mortality events, or death (Kiaghadi et al., 2021). There are a variety of toxics at Superfund Sites from centuries of industrial practices with more than 600 chemicals logged at Superfund Sites on the NPL. Heavy metals and metalloids are mostly present in Superfund Sites on the NPL, including lead (Pb) (43%), chromium (Cr) (35%) and arsenic (As) (28%) which have all been shown to influence adverse health outcomes such as various cancers, asthma, low birthweight, premature birth events, developmental, and neurological conditions (Fazzo et al., 2017; US EPA, 2015d; Watts & Teel, 2014).

Risk is calculated quantitatively by exploring the fate and transport of toxics in the environment and the likelihood of exposure to toxic chemicals leading to adverse health outcomes (Moreno, 2020). Fate and transport of chemicals simply describes the movement of chemicals throughout the environment.

By default, risk exploration of suspected hazardous waste sites does not prioritize perceptions of perceived vulnerability by individuals living in proximity to such environments, nor is it included in models used during the preliminary assessment. As a result, observations by lay individuals are not always accounted for and may influence perceptions of safety (Moreno, 2020). Stressors such as psychological stress, stress of socialization and stigmatization from living near contaminated landscapes, and other anxieties have been associated with individuals living near polluted landscapes, all of which affect physical and mental wellbeing (Senier et al., 2008). During the process of site discovery, assessment and remediation, individuals in fenceline communities have expressed a frustrating distrust of technical agencies such as the EPA, and other public health agencies when reporting on their experiences (Byrd et al., 2001). Additionally flawed in the quantitative process is the method used in the risk assessment calculation for cancer. This process uses an additive approach to represent risk of developing cancer from exposure to multiple toxics by adding their risk together. By assuming that interactions between various hazardous chemicals only add together to present a cancer risk is a recognized limitation by the agency (US EPA, 2009). The EPA recognizes that this assumption of additive risk has potential to under/overestimate risk for cancer. As such, this method is an example of how the prioritization of technological uses to develop quantitative characteristics of hazardous waste may dangerously esteem technical knowledge over non-technical offerings of lay community members. This exclusion of the non-technical voices of community members when attempting to address environmental contamination concerns is dangerous as it may lead to intensified adverse health outcomes (Brown and Mikkelsen, 1997).

Part II: Research Question

The 35th Avenue Superfund Site

Established in 2021, the 35th Avenue Superfund Site of north Birmingham, Alabama is composed of three neighborhoods out of a total of six neighborhoods (See Figure 1) including Collegeville, Fairmont, and Harriman Park and is not yet placed on the National Priorities List (NPL) though a proposal to do so has been made in recent years (US EPA, n.d.-c). The North Birmingham community has endured a great deal of environmental injustice that has led the community to being surrounded by an environment riddled with toxic waste and disproportionate health outcomes from decades of a heavy coal and steel industry producing materials that are known carcinogens (Allen et. al, 2019). After decades of concerns from residents, a 2011 EPA inspection found contaminants to be leaching from one of the many coke plants in North Birmingham that included benzo(a)pyrene (BaP), Pb, and As (US EPA, n.d.-c). The results of this inspection alerted the EPA to perform immediate removal of pollutants as they posed an acute risk to the health of individuals in the community. In addition to this finding, the EPA learned that slag, a solid industrial waste byproduct, was reportedly placed in the community for purposes of preventing flooding (US EPA, n.d.-c). Unfortunately, this solid material likely contained chemicals that have negative impacts on human health. Though there are more than ten industries in the North Birmingham community, the EPA has listed six Potentially Responsible Parties (PRP) while only one has held any degree of accountability for the pollution activity. Drummond Company, a global company operating in this Site, was found to have been involved in an illegal dispute that has prevented the 35th Avenue Superfund from being listed on the NPL which complicates expedition of its cleanup process. Without an NPL classification, Superfund sites are not entitled to the exclusive funding available for immediate remediation actions (US EPA, 2018c). Dr. Robert Bullard, the Father of Environmental Justice, defines environmental justice as a “dynamic social movement” in pursuit of the design and enforcement of environmental laws and regulations that protect the most vulnerable populations (Bullard, 1993). It is safe to say that residents of the North Birmingham community have endured decades of environmental injustice.

The 35th Avenue Superfund Site is being assessed and remediated through the Superfund Emergency Response Program which addresses and eliminates immediate environmental hazards that threaten human health (US EPA, 1994). With the main purpose of the Emergency Response Program being to address immediate threats, this type of response does not provide a thorough assessment of the area such as the analysis that is rendered in a non-emergency Superfund response (Wisconsin Department of Natural Resources, 2012). It is important to note that community involvement during the emergency response is primarily limited to the technical agency (i.e., EPA) having a responsibility to oversee community actions and keep citizens informed on the status of the emergency. While this is essential, further consideration suggests that the EPA takes on a paternalistic leadership style that does not venerate community wisdom.

In 2019, over five years after being established, the 35th Avenue Superfund Site was expanded in the Fairmont neighborhood after contamination was discovered beyond the initial boundary (US EPA, 2022), giving the notion that the boundary is likely not yet definitive, and the contamination issue likely has not been completely assessed. Alternatively, it is possible that contamination has physically spread throughout the landscape. A fourth neighborhood in the north Birmingham community is the twin-named neighborhood, *North Birmingham,* and is contiguously situated with neighborhoods in the Superfund Site. The North Birmingham neighborhood has not been included in the site boundary, neither has it been sampled and little evidence suggests that the voices of this neighborhood have been accounted for. To avoid confusion pertaining to the dual use of the North Birmingham name, the appropriate geographic container (community or neighborhood) will be denoted throughout this paper.

The North Birmingham community is less than 3 miles from at least one of the PRPs identified by the EPA and houses an access road where industrial materials are transported, which is also a source of environmental pollution. For decades, residents of the North Birmingham neighborhood had voiced concerns about the wellbeing of their environment. Group and individual interview with residents conducted by the researcher in 2021 found that there had been longstanding concerns about the soot or dusty pollution particles, that fell on their homes, the noxious fumes that interrupted their breathing, and concerns about diseases running rampant in their families including various cancers, asthma, and other illnesses (Bowen, 2021).

The health complaints of residents in the North Birmingham neighborhood mimic those found in interviews with residents within neighborhoods in the 35th Avenue Superfund Site (Allen et al., 2019).

This is indicative of a possibly unaddressed environmental issue. The purpose of this research is to address community concerns found in interviews from legacy residents and to address a possible service gap propagated by the insufficiencies of the Superfund assessment process including lack of qualitative measures to venerate community knowledge about the extent of contamination issues. As such, I will evaluate possible environmental risks in the North Birmingham neighborhood to estimate the similarities of As and Pb soil concentrations. My hypothesis posits that the soil concentrations of As and Pb will be similar to the concentrations found in neighborhoods in the 35th Avenue Superfund Site.

Part III: Literature Review

Popular Epidemiology

Individuals living in or near contaminated landscapes are usually the first to recognize the contamination issue long before technical agencies, such as the EPA, enter and perform quantitative assessments to affirm what the community has long suspected (Moreno, 2021). However, such non-technical observations are not earnestly regarded, and this may be the case considering that technical agencies tend to prioritize processes while non-technical, or lay community members are concerned with lived experiences, (Brown and Mikkelsen, 1997; Brown, 1992). Brown (1992) describes a form of science that focalizes lived experiences and observations to include lay participation in discovering and responding to environmental contamination and refers to it as popular epidemiology. In this untraditional science, individuals of the community are positioned to gather pertinent information and are in a power position with the knowledge that they possess about their community and its history. The stages of popular epidemiology in action includes lay members of the community being first to observe the issue and forming a hypothesis on the connection between the issue and health outcomes. Continuing to retain their power over their knowledge, the community gathers to develop a common perspective with one another to begin sharing their findings with technical or governmental agencies. What may precede is a technical investigation to further investigate the community's findings which may lead to legal disputes should the community feel their needs are not being met (Brown, 1992). This form of scientific inquiry has the power to amend disproportionate power dynamics present in the technical versus non-technical power dynamic. Unfortunately, as displayed in this present paper and in other studies, community voices do not take priority over technical processes when investigating toxic environmental contamination (Moreno, 2020; Ackerlund, 2011).

During the Superfund Site assessment and remediation process, there presents multiple opportunities for the EPA to include lay observations by individuals living in the community. For example, oral observations provide a rich knowledge about the history of the landscape, historical exposures, pollution activities, health outcomes or concerns, and what the interaction with the landscape looks like (Moreno, 2020). This qualitative data allows the technical agency an opportunity to better understand the site they are assessing and the best methods to use when developing remediation plans. Though this in-depth inquiry with communities is rarely sought after when technical agencies enter the community. As mentioned previously, individuals in the community have the option of contacting state and federal agencies (i.e., EPA, Department of Health) with concerns about contamination. Yet, it has been demonstrated that the anticipated outcomes are not always the case. Scholarly findings have demonstrated that once requesting assistance, residents have been displeased with response which result in distrust and anger with responsible agencies, and distrusting or unsure with the actuality of what they have observed and even relinquishing their power to solely defer to information provided by technical agencies (Senier et al., 2008).

The act of powerful agencies deprioritizing lay observations in support of their technical and quantitative methodology is a display of an elitist technocracy. Coined by Philosopher John Dewey, elitist technocracy refers to the structure of a society that places scientific methodology in position to rule over the non-technical players of society (Moreno, 2020). Moreno (2020) also supports that these ruling class agencies are typically governmental, and that by being in an elite position to rule, the status of expert is rendered to this group while the non-expert status is placed on the non-technical group. This dynamic allows technical agencies to control information and opinions as means of retaining power. This can be exemplified in the language that the EPA uses on their website when discussing community involvement during emergency responses; supporting the notion that it is the agency's responsibility to be the forerunner of information and an access point for the non-technical individuals of the community. The language used asserts that the agency is the party with full responsibility for decision making during the response (US EPA, 2013c). A primary purpose of the EPA's Superfund Program is to reduce threats to human health, however, without completely grasping contamination issues due to a lack of holistic inclusion of lay observations, this is a difficult task to achieve and may even exacerbate health issues (Nagisetty et al., 2022; Ramirez-Andreotta et al., 2014).

History of Injustices

Poor science communication has been a major issue in environmental remediation work and has fostered inadequate risk information communication and tainted the public's perception of environmental agencies (Nagisetty et al., 2022). Scholarly findings support the notion that environmental agencies ineffectively conveying environmental risks are a result of the context and origins of communication by technical agencies and differences in risk perception between agency and the public (Byrd et al., 2001). Research findings by Byrd et al. (2021) also uphold the concept that agency focus on quantitative outcomes creates a barrier to communication information pertinent to the perception that the community is more concerned with, which are the quantitative outcomes. Additionally supported is that the gaps in communication stem from a history of distrust between agencies in power and lay fenceline communities (Byrd et al., 2001).

Research by Ramirez-Andreotta (2014) shows that communication in the earth sciences (i.e., chemistry, geology, etc.) have not been geared towards communicating with lay communities and that actors in this science have not been trained with the skills to do so until relatively recent years (Ramirez-Andreotta et al., 2014). Without such skills, ineffective communication may result in the inability to build relationships with lay communities and other stakeholders. Further suggested is that such issues originating from technical spaces (I.e., EPA, contracted environmental agencies, etc.) can hinder environmental remediation efforts leading to distrust from individuals of the community.

The industrial revolution waged a type of colonialism by the name of extractive colonialism (Lawrence, 2015; Monarrez et al., 2021). This type of colonialism refers to the pursuit of retrieving natural resources from the Earth for means of modernization and an industrialized way of living which includes extracting fossil fuels for crude oil to produce gas for international travel, and metals for building materials. This extraction is damaging as it does not nonrenewable or restore natural sources to the Earth and influences pollution from the pursuit of material to the use of the extracted and produced material (Monarrez et al., 2021). Not only is extraction from the Earth leading to anthropogenic climate change and establishment of hazardous waste sites, it also presents adverse health outcomes to workers involved with extraction and manipulation of these materials. Let us recall that the colonization and forced removal of Indigenous peoples of this land was followed by the extractive economy that has fostered communities surrounded by hazardous waste. The industrialization has targeted and historically oppressed Indigenous, Black and Brown communities for the means of production.

What has been demonstrated is that poor science communication and venerating the use of technical assessment over lay observations has impacted outcomes of environmental remediation. Additionally, an extraction-based economy responsible for the oppression of Black, Brown and Indigenous communities has led to practices that produce toxic environments and Superfund Sites. I would reasonably suggest that by not supporting the environmental observations of oppressed communities is a form of environmental racism that sustains a history of distrust with governmental and technical agencies.

Environmental Racism

The history of environmental racism against Black, Brown, and Indigenous communities are longstanding, multifaceted and can be defined as the practice and enforcement of harmful environmental policies and regulations that disproportionately target and harm oppressed groups (Holifield, 2001). This also includes increasingly exposing Black, Brown, and Indigenous people to pollution that harms their health and reduces quality of life. Though there are many studies that have reproduced the legitimacy of this phenomenon, a relevant example is a grassroots case study of nine communities throughout the United States that examined the environmental threats in each community and its relation to race (Bullard, 1990). One objective of this study that Dr. Bullard (1990) details included examining how communities disputed environmental conflicts. The methods of data exploration included in-depth interviews with organizers and snowballing to influential community leaders involved in resolving disputes to understand tactics to organizing and disputes. A summary of the nine communities involved in the study demonstrated that each community was dealing with disputes related to existing or proposed sites of solid waste landfills (N=2), lead smelters (N=2), petrochemical refineries (N= 1), as well as solid (N= 1) and hazardous waste incinerators (N= 3). Out of the 9 sites in the case study, most were communities of mostly Black and Brown individuals while one slated for a solid waste landfill was Indigenous. This fact of environmental racism has been supported in historical landmark studies as well as modern studies that maintain the fact that race is the leading variable when identifying locations of hazardous waste sites (Mascarenhas et al., 2021; U.S. General Accounting Office, 1983; United Church of Christ, 1987).

Deserving further examination is the living conditions of people living in Superfund sites, or toxic waste sites including working conditions, interactions with political structures and the associated health outcomes. Dr. Robert Bullard (2011) describes how the South became a hub for industrial development and who bore the brunt of its development. Migrating from chattel enslavement of Africans and through the Civil Rights Movement, the southeastern region of the United States became the “New South” in the 1970’s, priming itself for economic growth by influencing new industries to migrate and make a home of the south for the purpose of profit. To achieve this, southern policy makers relaxed environmental laws and regulations, thereby permitting increased pollution-related activity with little regard for the voices of community residents. As mentioned previously, most of these industries were housed in Black communities and consequently used the labor of unemployed and economically depressed Blacks. Accompanying dangerous environmental regulation that permitted pollution was poor compensation for laborers who also worked and lived in unfavorable conditions. Bullard also explains that this unfair treatment, though a true lived reality, was met with push-back when laborers and other residents complained. It is important to note that pollution from extraction operations date back as early as the 1880s (Moreno, 2020). Predominate countering arguments were about a trade-off that residents and laborers had; there's economic gain in an economically depressed space, never mind the hazards presented. He coins this concept as economic blackmail. These trade-offs suggested that economic gain far outweighed the squalid working conditions and health outcomes laborers, and their families were facing from the hazardous pollution. Not only was there monetary gain, Environmental Sociologist Dr. Dorceta Taylor (2014) also highlights Bullard's finding that industrial exploitation accompanies other benefits such as investments in education and community amenities.

The interactions between political actors and community members have added to the canonical knowledge of mistrust between communities and agencies that are tasked with protecting their health. Dr. Taylor (2014) highlights research that shows people in powerful decision-making positions often sided with corporate interest than they have sided with individuals in the community. Such is the case Dr. Bullard (2011) expressed in his study with lawmakers creating environmental laws that brought detrimental impacts.

The 35th Avenue Superfund Site

A 1979 news article seen in Figure 2 reporting on a health department study of residents in the North Birmingham community found that residents were living in socioeconomically depressed conditions with 60% living below the poverty level. The racial demographics from this study were 90% non-white residences who had poor access to healthcare (David, 1979).

The 35th Avenue Superfund Site in the North Birmingham community has a rich history of its development starting from residential segregation that primed the community for placement of heavy toxic industry. This community was mostly inhabited by employees of the local industrial companies, most of whom were Black following the 1970's New South embarkment (Lewis, 2008). This Superfund Site expands through 3 zip codes; 35207, 35217, and 35234 and includes neighborhoods both within and outside of the Site's boundary. As of the 2021 U.S. Census, the overall racial makeup of residents within the three zip codes are 76% Black, 18.6 % White, and 3.6% Other. Roughly 80% of the community have a high school education or higher while about 28% are below the federal poverty line. This data is stratified by zip code in Table 1.

The North Birmingham community is a major hub for the iron and steel industry that has long polluted the environmental landscape and the people living there (Blau, 2022). Fueling this production included the use of convict labor, a varied form of enslavement that included forced labor (Lewis, 2008; William, 2005). Spanning from 1875 through the 1920's, convict laborers largely consisted of Black males convicted of petty crimes such as not being employed, and other systemically racist reasons. Included in the history of Birmingham is repeated violation of pollution emissions and residential concerns of pollution activity. Air pollution as early as the 1940's was visible and a major concern that led to a proposal for more structured enforcement, especially considering that workers were dying from diseases (Blau, 2022). One instance of visible air pollution, or smog was captured in 1972 (LeRoy, 1972). Throughout the years, multiple industries were fined and sued for exceeding emissions of toxic waste that posed threats to human health, some exceeding emission standards for over a decade (Blau, 2022; Department of Justice, 2010; Driscoll, 2021; Spencer, 2010). After the Clean Air Act was passed, industries prevalent in north Birmingham (i.e., coke production) have over twenty years to fully comply with the mandate. Even after the EPA communicated concerns about pollution in north Birmingham, the Jefferson County department made very little changes (Blau, 2022).

Later, in 2009, Walter Coke, a popular industrial company in north Birmingham was prompted to complete soil sampling in homes and school nearby which led to the discovery or toxic amounts of As and polycyclic aromatic hydrocarbons (PAHs), carcinogenic chemicals. (Allen et al., 2019; ATSDR, 2021; US EPA, n.d.-b). A great turning point was an EPA inspection of coke company, ABC Coke, a subsidiary of Drummond Company in 2011. The subsidiary was found to have violated the National Emission Standards for Hazardous Air Pollutants (NESHAPs) and reportedly emitting illegal amounts of toxic byproducts at its daughter company, ABC Coke (US EPA, 2019a; US EPA, 2021). ABC coke produces coke, a product used to manufacture iron and steel. This finding prompted the EPA to enact its Superfund Emergency Response and Removal program to protect the health of residents. During the PA/SI Phase, a HRS score is produced to suggest placement on the NPL. The 35th Avenue Superfund Site scored a HRS of 50, and though scores at or above 28.5 are placed on the NPL, this site is not yet placed on the NPL to expedite long-term solutions. The Superfund classification was rendered in 2012 and cleanup in residential lots has commenced.

Still, five years later, a 2017 report found that the 32 industrial facilities in north Birmingham released a total of 1.9 million pounds of toxic waste reported to the Toxic Release Inventory (TRI), a repository managed by the Environmental Protection Agency (Allen et al., 2019; Benbrook & Saraiva, 2021; US EPA, 2013b). The TRI is a management tool tracking release of toxic substances into the environment (land, air, water) by manufacturing, metal-related, power generating, chemical, and treatment plants--not all industries are responsible for reporting to the TRI though it is a mandatory program for participating industries. The purpose of the TRI is to respond to public concerns about contact with toxic chemicals and statistical tracking of polluting waste. The TRI was largely inspired by the unplanned release of methyl isocyanate, a deadly chemical, in a chemical plant in India that killed thousands of people and disable many others (US EPA, 2013b). The TRI supported findings from an additional study that found industries in north Birmingham were in the top four industries releasing toxic waste (Allen et al., 2019; Benbrook & Saraiva, 2021). Today, the EPA's TRI for this area reflects that only twelve industries were reporting on release of waste into the environment (US EPA, n.d.-e).

The NPL classification, as of 2023, has not yet been attained for multiple reasons including illegal activity between state actors and miscommunication to residents (Allen et al., 2019; Mufson, 2019). Drummond Company, a global company that has repeatedly violated workers' rights, was listed as a PRP for site remediation efforts with a hefty fine for polluting activities. Drummond Company has been on trial for war crimes in Colombia for using a Colombian paramilitary force to murder a union leader protesting for safe working conditions (Gates, 2007). In the case of opposing an NPL classification and being monetarily responsible for remediation, Drummond Co.'s officials bribed the Black state legislator to convince community residents to oppose the NPL classification. Reasons cited to residents were imprudent, suggesting that EPA activity would complicate property values. Their tactics were successful and explains why the site is not on the NPL.

The development of the 35th Avenue Superfund Site is riddled with a frightening history and could serve as *the* posterchild of environmental injustice. The history supports the multifaceted causes and outcomes of environmental injustice which include the following; increased industrialization of neighborhoods in the North Birmingham community, squalid working conditions that lead to ultimatums deprioritizing health for economic gain, living in polluted landscapes that impacts health and the consequences of voicing concerns about pollution which often go unattended until technical measures confirmed suspicions, and eventually arriving at violent interactions with trusted legislators that find themselves deeply aligned with corporate interest and personal gain.

In 2014, the Agency for Toxic Substances and Disease Registry (ATSDR) was contracted by the EPA to conduct a Public Health Consultation (PHC) for exposure to toxic soil in the Superfund boundary. The PHC assessed for arsenic, lead, PAHs on residential properties and found harmful exposure sources with some risk including carcinogenic sources especially in cases of long-term exposures (ATSDR, 2017). Health outcomes associated with the arsenic and lead in the 35th Avenue Superfund Site are detrimental, especially to developing children. As is a Class A human carcinogen, and varying levels of exposure to arsenic can potentially have short-term and long-term effects (Conversation Alabama Foundation, 2008). Short-term exposure has impacts that include gastrointestinal issues, and nervous system disorders. Long-term exposure includes outcomes such as cancer, anemic disorders, skin issues, and organ damage. Pb has great impacts on developing children and pregnant people. Impacts on children include poor cognitive functions, mood disorders, learning deficits, and poor sensory functioning (ATSDR, 2007). The. ATSDR Toxicological Profile for lead also suggests reproductive, heart, and immune disorders in both children and adults (ATSDR, 2007). It is important to note that exposure to a chemical does not automatically equate to experience of adverse effects, especially considering the varying metabolic processes of the human body with specific chemicals. The detrimental health risks posed by chemicals present at this Superfund Site further urge the importance of a thorough assessment and inclusion of voiced concerns to properly assess the potential risks to human health.

Soil Sampling

Soil contamination is often the result of industrial practices related to the release of toxic products during the production process as well as dumping or emission of waste into the environmental landscape (Moya & Phillips, 2014). As such, soil sampling is optimum for estimating exposure to toxic chemicals in risk assessments and can be useful when determining measures for site remediation (Moya and Phillips). The exposure route of contaminated soil is simple; contaminants contact soil via direct and indirect discharge into the environment, contact made with contaminated soil outdoors is tracked into the home in a fine particle size and becomes a source of dust indoors. Contact with contaminated soil that has been tracked indoors can be through dermal absorption, inhalation, or oral ingestion. Describing this process, Moya and Phillips (2014) explain that children are especially susceptible to exposure to contaminated soil due to activities such as pica and increased interaction with soil especially during play. When assessing for As and Pb concentrations in residential soil, EPA's Regional Screening Level (RSL) standards are used to identify concentrations that may pose a threat to human health. RSL deem levels exceeding 35 parts per million (ppm) for As and 400 ppm for Pb as hazardous for human health (US EPA, 2015b). Though, there is no safe level of lead exposure (Centers for Disease Control and Prevention, 2020).

PART IV: Methods & Analysis

The North Birmingham neighborhood is within 1 to 3 miles from 2 of the EPA identified responsible parties. Despite its proximity to the major polluters, it is not included in the original risk assessment and thus excluded from the Superfund boundary. Additionally, members of this community have raised concerns about adverse health outcomes during a previous in-depth interview (Bowen, 2021).

This pilot study seeks to address the voiced concerns of this community that have not been addressed by agencies otherwise. This research is specifically exploring the similarities between As and Pb soil concentrations of the non-Superfund neighborhood, North Birmingham, in comparison to neighborhoods within the 35th Avenue Superfund Site to suggest a possible inclusion of North Birmingham into the Superfund boundary.

Data Collection

Field Sampling

The primary data collection consisted of soil sampling throughout the North Birmingham, Alabama neighborhood to include residential and non-residential lots. Field sampling was completed in a single day in cloudy conditions and consisted of a grab sampling method of surface soil. Random sampling points were generated using ArcMap, a geospatial software. If sampling point was inaccessible, samples were collected less than 0.5 miles from plotted points. All primary data was collected by the researcher.

For comparative means, secondary data originated from the Environmental Protection Agency. To obtain the data, a Freedom of Information Act (FOIA) request was made for soil analysis of heavy metals of neighborhoods in the 35th Avenue Superfund Site. To reduce bias, the request emphasized specification on randomization of site data—thereby avoiding gathering information about the most or least polluted sites. The method of soil sampling used by the EPA differs from methods used in primary data collection of the North Birmingham neighborhood. The EPA utilized a composite retrieval method in addition to grab methods (US EPA, 2023).

Emory's IRB approval was not sought as this research design did not include human subjects.

Quality Control

To reduce bias in sampling collection, random sampling points were plotted using ArcMap. Prior to storing samples, an x-ray fluorescent (XRF) analysis was performed on the batch of plastic bags to prevent any confounding, as studies have shown that heavy metals have been found to leach into the bags (Alam et al., 2019). XRF is an x-ray device that provides elemental analysis of heavy metals and metalloids (HMM) in geological samples (Ask A Scientist Staff, 2020). Once the sampling was complete, samples were transported to an environmental sciences lab in Atlanta, GA and stored in a chemical fume hood until analyzed using XRF.

Data Assembly & Analysis

Soil samples from North Birmingham were dried using a laboratory oven at 250° Celsius in aluminum pans and analyzed for As and Pb levels using XRF (N=15). Solid materials in samples were removed prior to analysis. Secondary samples from the EPA were also analyzed using an XRF device (N=16). Data from both sources were assembled into a single dataset and divided into two groups; Superfund and Non-Superfund. The Superfund group consisted of the three neighborhoods in the 35th Avenue Superfund Site (Collegeville, Fairmont, and Harriman Park) while the non-Superfund group is the North Birmingham neighborhood.

Part V: Analysis & Results

Data Analysis

To assess the associations between As and Pb concentrations between the two groups, data was analyzed using SAS, a statistical analysis software (SAS, 2019). Descriptive statistics were produced for each variable group. This analysis followed a nonparametric test, namely the Wilcoxon Rank Sum test (WRS). This test was chosen due to the non-normal distribution of the data and tests for a two-sided hypothesis (Purdue University, 2010; US EPA, 2007). This nonparametric test is also recognized as an equivalent to a parametric t-test. The null hypothesis under this test is that there’s no difference between As and Pb between the two groups.

Results

Initially descriptive statistics were produced to explore the data and assess the distribution before using a statistical hypothesis test. Sixteen samples in the Superfund group had a media As concentration of 22.37 ppm, and 217.80 ppm for Pb, while the North Birmingham neighborhood had a median As concentration of 20.63 ppm and 159.53 ppm for Pb. Within the Superfund group, 31% of samples exceeded the regional screening level (RSL) for As and 18% for Pb. 27% of samples from the North Birmingham neighborhood exceeded the RSL for As while 20% exceeded RSLs for Pb. The distribution of the HMMs in the sample presented with a right skew. Descriptive information is visible in Figures 3,-7.

After descriptive statistics were produced, a WRS test was run to determine associations of each element in relation to the group. The p-value for As concentration between the groups was 0.92 (alpha=0.05), suggesting a failure to reject the null hypothesis of no difference. In other words, there does not appear to be a difference between soil concentrations of As between communities within the Superfund Site and North Birmingham. For associations of soil Pb concentrations between the groups, there appears to be no statistically significant difference either (p=0.77, alpha=0.05). SAS output for the WRS test is visible in Figure 8 and 9.

Part VI: Discussion, Limitations, & Recommendations

Discussion

Though there were multiple contaminants present in the 35th Avenue Superfund Site, this study examined HMM concentrations of As and Pb only. As such, the findings presented in the study do not tell the complete story of the extent of contamination at the 35th Avenue Superfund Site. This study finds no statistically significant difference in the As and Pb levels between the two groups. The findings in this pilot support the importance of prioritizing lay observations when assessing contamination in environmental landscapes.

This pilot study assessed similarities of HMM content of As and lead between neighborhoods in the 35th Avenue Superfund Sites and the North Birmingham neighborhood to suggest a possible inclusion of the North Birmingham neighborhood into the existing Superfund boundary. This exploration was prompted by unaddressed community concerns. These findings support the hypothesis that the continued expansion of the 35th Avenue Superfund should be reassessed with consideration for the neighboring North Birmingham neighborhood.

Implications

This research has contributed to the veneration of lay observations of environmental landscapes that have been unvoiced or ignored by technical agencies. Primarily addressing decades of concerns and observations by residents of the North Birmingham neighborhood. By doing so, this study reaffirms existing knowledge emphasizing the importance of prioritizing community wisdom and other qualitative methods when discovering and remediating toxic waste sites.

Limitations

There are multiple limitations and concerns of this study. The limitations associated with the methodology include observer bias associated when collecting soil samples in the North Birmingham neighborhood. Furthermore, all samples originating from the EPA were soil collections in residential lots and likely have greater accuracy when assessing more immediate risks to human health. The design and results of this study do not present a robust approach to completely estimate the possible contamination issue of the sample site. This is due to factors such as sample size, sampling location, and additional variables needed to completely assess environmental contamination including the method of analysis using XRF. More robust methods to assess the presence of metals in soil are available such as inductively couples spectrometric methods (ICP-SM) (Nyika et al., 2019).

Part VII: Conclusion

Further research is required to completely assess environmental contamination in the North Birmingham neighborhood to determine inclusion into the 35th Avenue Superfund Site. Soil sampling should be completed with more robust methods such as (ISM). Considering that many environmental risk assessments primarily consider quantitative data, future research should continue to employ qualitative methods such is the case with further analysis of the North Birmingham neighborhood. More specific to this study site, a health study of is suggested with a primary focus on the health outcomes of residents with familial history of employment in local industry that have been listed as responsible parties in this Superfund Site. Supplementary oral interviews are urged. The data found in this study will be entrusted to appropriate members in the North Birmingham neighborhood to prompt further research and inquiry into the possible soil contamination issue. In a grander context of site discovery, assessment, and remediation, the modus operandi should be altered to prioritize lay observations.

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Tables & Figures

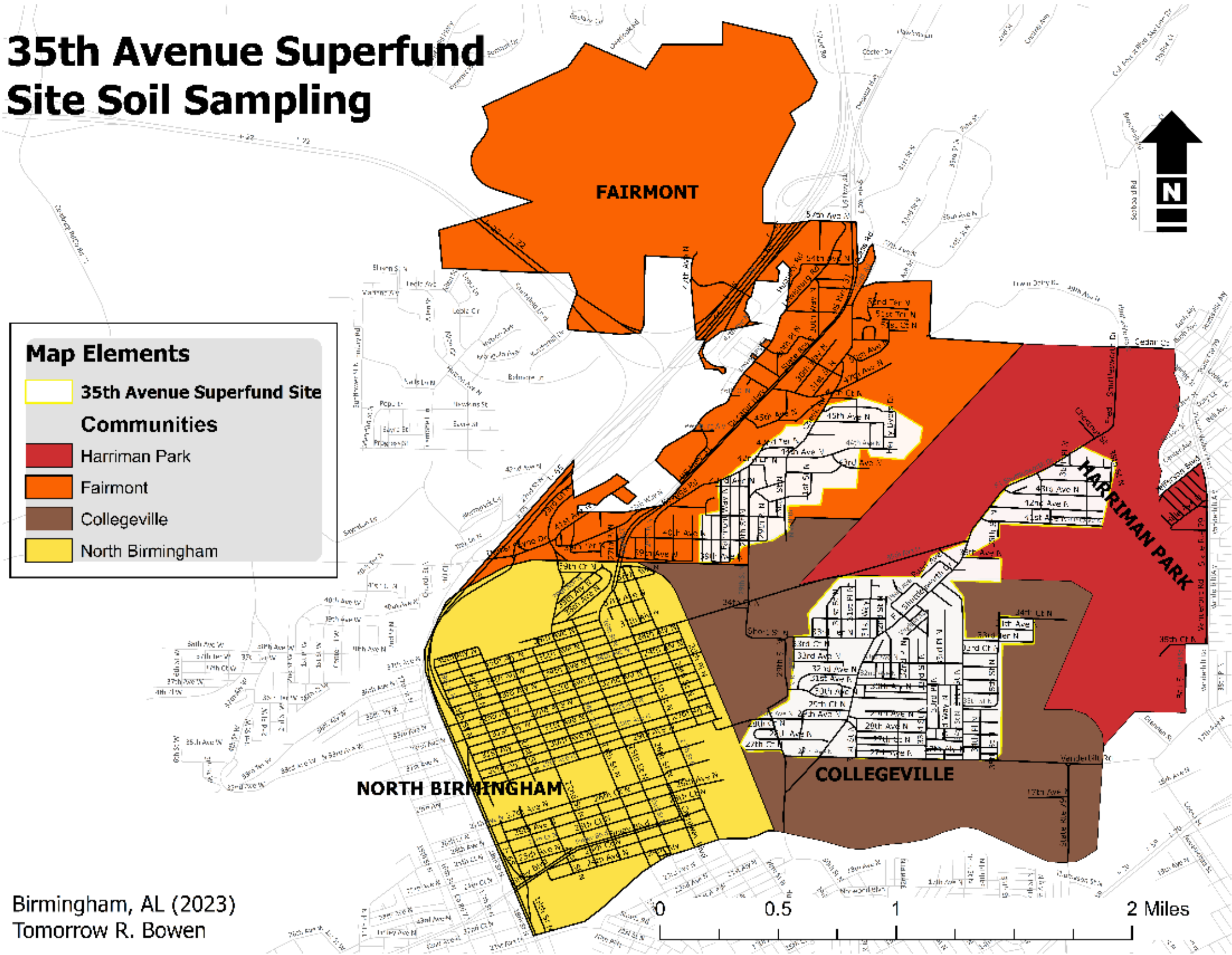
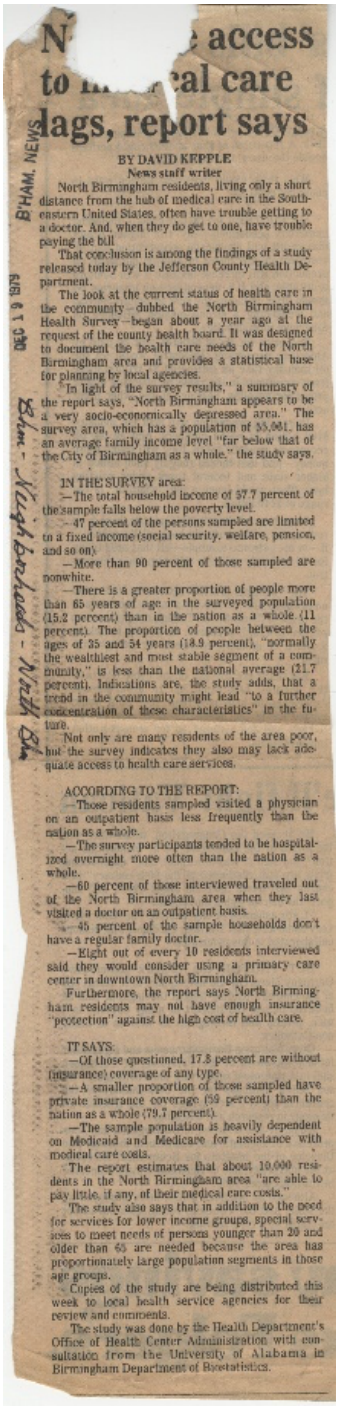


Figure 1: 35th Avenue Superfund Site



B'HAM. NEWS
DEC 1 9 1979
Bhm - Neighborhoods - North Bhm

N[illegible] access to [illegible]cal care lags, report says

BY DAVID KEPPLE
News staff writer

North Birmingham residents, living only a short distance from the hub of medical care in the Southeastern United States, often have trouble getting to a doctor. And, when they do get to one, have trouble paying the bill

That conclusion is among the findings of a study released today by the Jefferson County Health Department.

The look at the current status of health care in the community—dubbed the North Birmingham Health Survey—began about a year ago at the request of the county health board. It was designed to document the health care needs of the North Birmingham area and provides a statistical base for planning by local agencies.

"In light of the survey results," a summary of the report says, "North Birmingham appears to be a very socio-economically depressed area." The survey area, which has a population of 55,081, has an average family income level "far below that of the City of Birmingham as a whole," the study says.

IN THE SURVEY area:

—The total household income of 57.7 percent of the sample falls below the poverty level.

—47 percent of the persons sampled are limited to a fixed income (social security, welfare, pension, and so on).

—More than 90 percent of those sampled are nonwhite.

—There is a greater proportion of people more than 65 years of age in the surveyed population (15.2 percent) than in the nation as a whole (11 percent). The proportion of people between the ages of 35 and 54 years (18.9 percent), "normally the wealthiest and most stable segment of a community," is less than the national average (21.7 percent). Indications are, the study adds, that a trend in the community might lead "to a further concentration of these characteristics" in the future.

Not only are many residents of the area poor, but the survey indicates they also may lack adequate access to health care services.

ACCORDING TO THE REPORT:

—Those residents sampled visited a physician on an outpatient basis less frequently than the nation as a whole.

—The survey participants tended to be hospitalized overnight more often than the nation as a whole.

—60 percent of those interviewed traveled out of the North Birmingham area when they last visited a doctor on an outpatient basis.

—45 percent of the sample households don't have a regular family doctor.

—Eight out of every 10 residents interviewed said they would consider using a primary care center in downtown North Birmingham.

Furthermore, the report says North Birmingham residents may not have enough insurance "protection" against the high cost of health care.

IT SAYS:

—Of those questioned, 17.8 percent are without (insurance) coverage of any type.

—A smaller proportion of those sampled have private insurance coverage (59 percent) than the nation as a whole (79.7 percent).

—The sample population is heavily dependent on Medicaid and Medicare for assistance with medical care costs.

The report estimates that about 10,000 residents in the North Birmingham area "are able to pay little, if any, of their medical care costs."

The study also says that in addition to the need for services for lower income groups, special services to meet needs of persons younger than 20 and older than 65 are needed because the area has proportionately large population segments in those age groups.

Copies of the study are being distributed this week to local health service agencies for their review and comments.

The study was done by the Health Department's Office of Health Center Administration with consultation from the University of Alabama in Birmingham Department of Biostatistics.

Figure 2: 1979 North Birmingham Health Study

Socioeconomic Indicators	**35207**	**35217**	**35234**
Race			
Black	94.7%	60.4%	86.7%
White	4.0%	30.6%	12.3%
Other Race	1%	6.5%	1%
Education Level			
High School or Higher	79.9%	80.5%	77.3%
Income			
Below Federal Poverty Level	33.3%	21.7%	34.6%

Table 1. Demographics Table (Source: US Census Bureau)

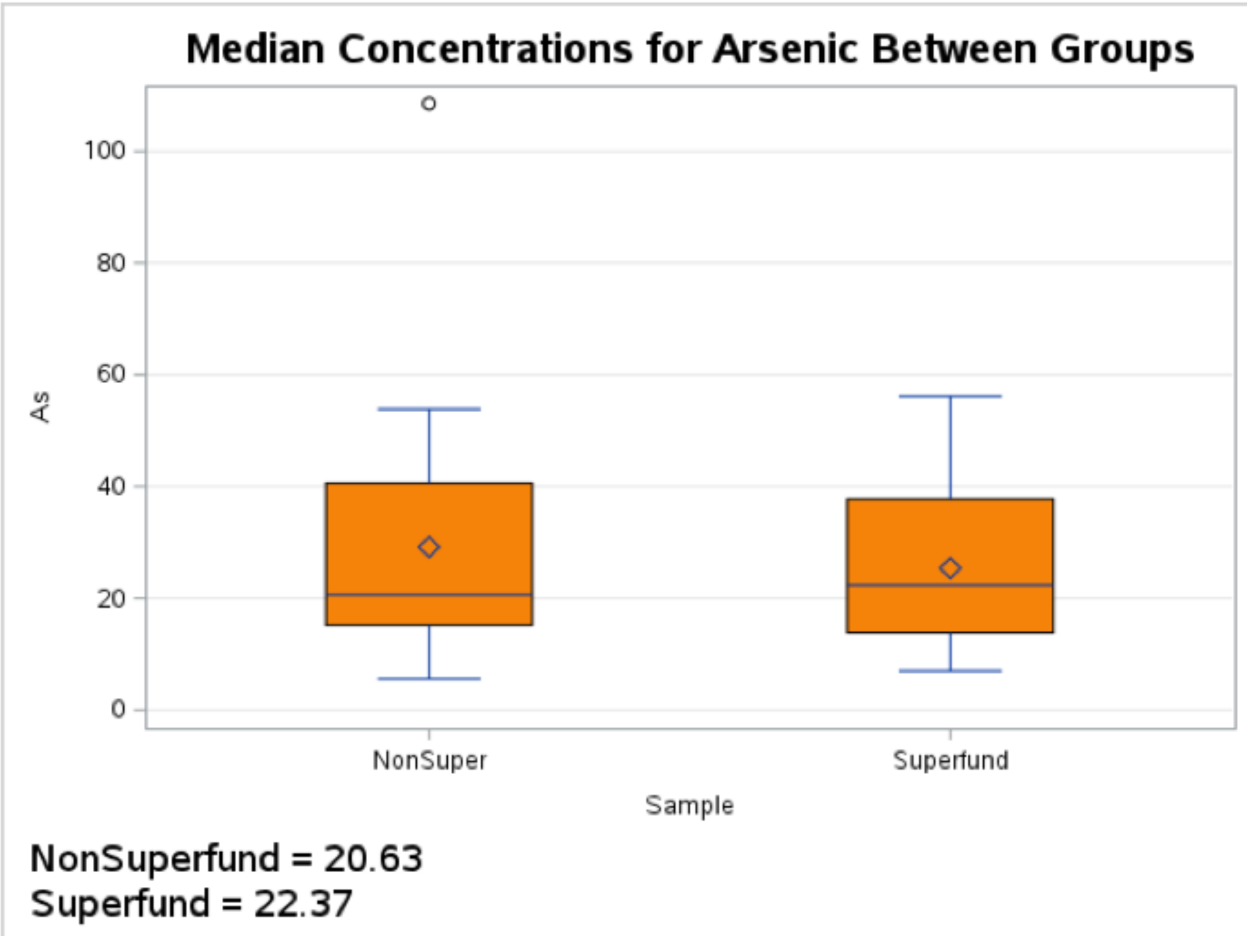


Figure 3: Median Arsenic Concentrations

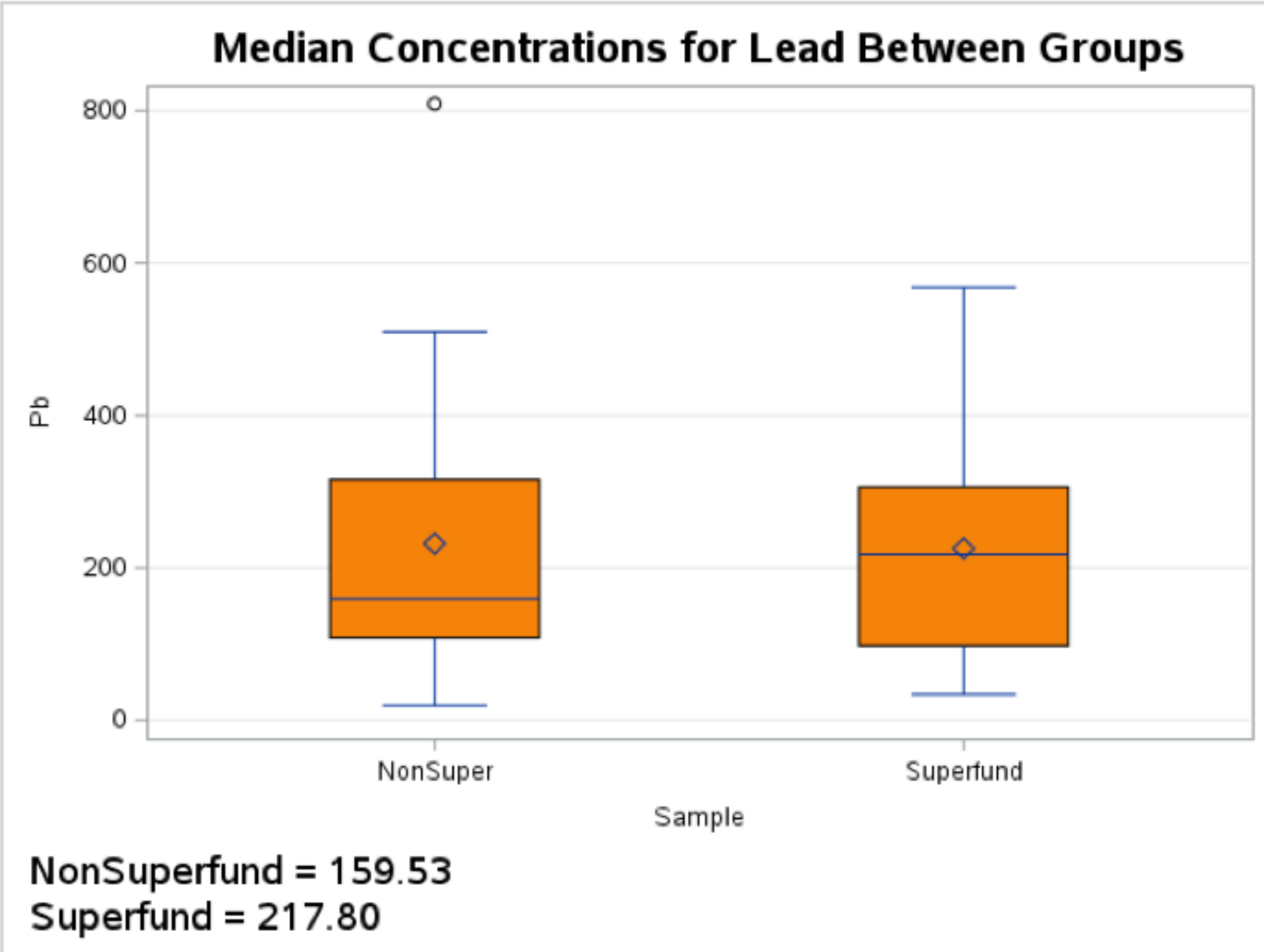


Figure 5: Median Lead Concentrations

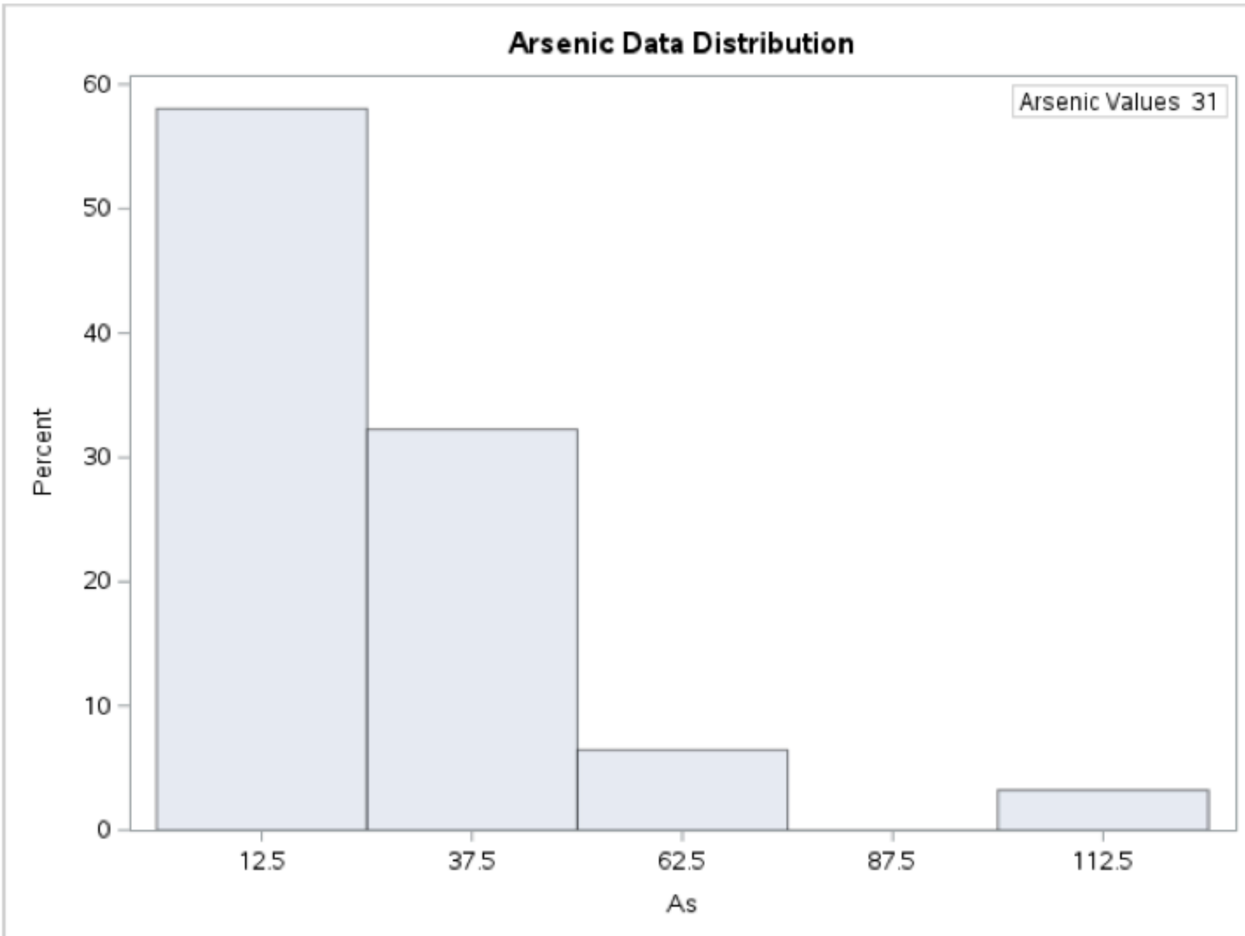


Figure 5: Arsenic Distribution

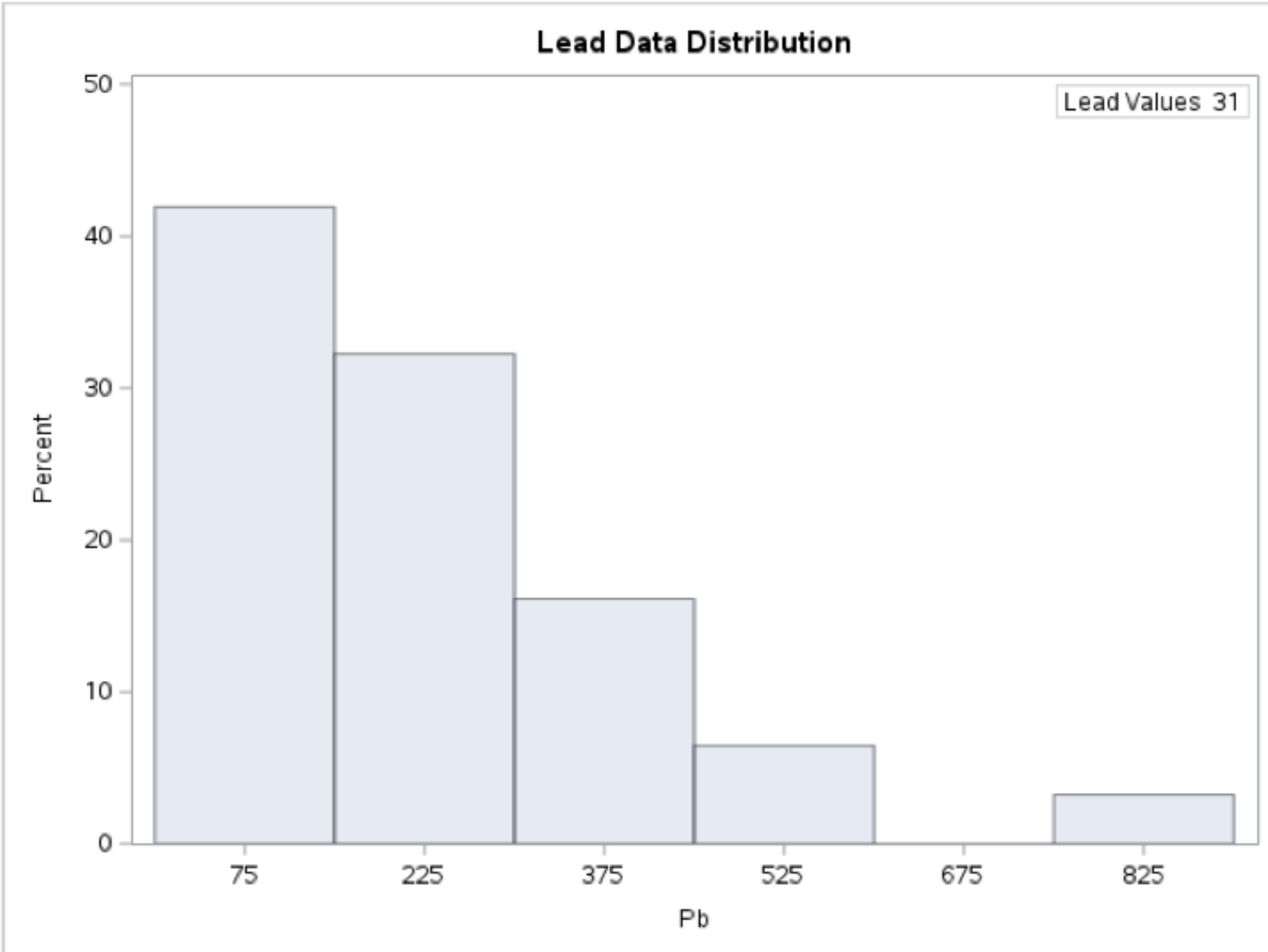


Figure 6: Lead Distribution

Exceeding EPA RSL for Arsenic

The MEANS Procedure

Analysis Variable : As						
Sample	N Obs	N	Mean	Std Dev	Minimum	Maximum
NonSuper	4	4	61.3075000	32.0241673	40.6200000	108.5200000
Superfund	5	5	42.9980000	7.6561034	37.2200000	56.1800000

Exceeding EPA RSL for Lead

The MEANS Procedure

Analysis Variable : Pb						
Sample	N Obs	N	Mean	Std Dev	Minimum	Maximum
NonSuper	3	3	585.9900000	196.5137379	438.8100000	809.1500000
Superfund	3	3	462.2700000	92.0347592	403.0400000	568.3000000

Figure 7: Samples Exceeding EPA RSL

Nonparametric Wilcoxon Rank Sum Test to Compare Arsenic Concentrations

The NPAR1WAY Procedure

Wilcoxon Scores (Rank Sums) for Variable As Classified by Variable Sample					
Sample	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
Superfund	16	259.0	256.0	25.298221	16.18750
NonSuper	15	237.0	240.0	25.298221	15.80000

Wilcoxon Two-Sample Test					
				t Approximation	
Statistic	Z	Pr < Z	Pr > |Z|	Pr < Z	Pr > |Z|
237.0000	-0.0988	0.4606	0.9213	0.4610	0.9219
Z includes a continuity correction of 0.5.					

Kruskal-Wallis Test		
Chi-Square	DF	Pr > ChiSq
0.0141	1	0.9056

Figure 8: WRS Output for Arsenic

Nonparametric Wilcoxon Rank Sum Test to Compare Lead Concentrations

The NPAR1WAY Procedure

Wilcoxon Scores (Rank Sums) for Variable Pb Classified by Variable Sample					
Sample	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
Superfund	16	264.0	256.0	25.298221	16.500000
NonSuper	15	232.0	240.0	25.298221	15.466667

Wilcoxon Two-Sample Test					
				t Approximation	
Statistic	Z	Pr < Z	Pr > |Z|	Pr < Z	Pr > |Z|
232.0000	-0.2965	0.3834	0.7669	0.3845	0.7689
Z includes a continuity correction of 0.5.					

Kruskal-Wallis Test		
Chi-Square	DF	Pr > ChiSq
0.1000	1	0.7518

Figure 9: WRS Output for Lead