Raw Sewage and Environmental Racism: Racial Disparities in Sewage Backup Risk In Syracuse, New York

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Abstract

Environmental racism places communities of color at higher risk of pollution in urban environments. Using data from public records in the highly segregated city of Syracuse, New York, we identify significant racial disparities related to reports of sewage backups. We use spatial analysis and multivariate regression to find evidence of greater risk of reported sewage backups in census tracts with higher proportions of minority, Black, and both Black residents and residents 65 years or older, distinct from poverty-related risks. Large hotspots of sewage backup risk exist in Syracuse's predominantly Black census tracts. The concentration of environmental risk, in this case sewage backups, occurs in residential areas where Blacks are segregated. Residents of predominantly Black census tracts, especially those with greater numbers of both Black residents and senior citizens, experience disproportionate harm from infrastructure due to legacies of racial segregation and city planning choices.

Introduction

Environmental racism is a physical manifestation of systemic racism in which "communities consisting primarily of people of color continue to bear a disproportionate burden of this nation's air, water, and waste problem" [1]. Communities of color face greater risk of exposure to a variety of toxins, including, in this case, risk of exposure to untreated sewage. In this study, we offer a spatial analysis of reported sewage backups in Syracuse, New York – a post-industrial city with extreme levels of racial segregation and racially concentrated poverty – to show how the legacy of residential segregation and decades of supposedly race-neutral engineering decisions have placed Syracuse's Black residents, especially senior Black residents, at a much high risk of sewage backups than their white counterparts. Urban infrastructure engineering and maintenance purports to rely on unbiased estimates of risk and cost to inform their decisions about vital urban infrastructure such as drainage and sewage systems, relying largely on conventional cost benefit analysis (CBA) to determine where infrastructure should be prioritized [2]. In practice, however, these seemingly neutral engineering approaches perpetuate and exacerbate existing racial disparities by prioritizing already advantaged communities with higher property values and greater resources [3]. This infrastructural inequality is an example of how race-blind policies may perpetuate and exacerbate structural racism and environmental racism in contemporary cities.

In 2017 and 2018, the City of Syracuse received over 4,000 reports each year of sewer backups into people's homes and businesses[4] (data.syr.gov). Each sewer backup is an upsetting and dangerous experience for residents, damaging their home and property and exposing them to untreated sewage that is heavy with fecal contaminants and other toxics [5–7]. During a sewage backup, residents and their properties are exposed to raw, untreated human waste which carries the risk of disease and can also expose people to toxic gasses that are released from the waste even if they avoid physical contact with the sewage itself [6]. Cleaning and repair after a sewage backup places individuals at high risk for a number of gastrointestinal and respiratory illnesses, and if not properly addressed a sewage backup can make a property unfit for habitation.

In this study, we analyze public records from the City of Syracuse to answer the questions: which census tracts are most at risk of sewage backups in Syracuse? Are Syracuse's most socially vulnerable residents, those with the fewest resources, at a higher risk of sewage backups? And is this predominantly a relationship with poverty, race and ethnicity, or both? By examining public records of sewage backups between 2017 and 2021 along with key socioeconomic characteristics of Syracuse census tracts, we find that Syracuse's Black residents, particularly residents who are both Black and age 65 or older, are at a much higher risk of exposure to sewage backup events than other residents.

A wide body of empirical studies have found significant evidence that points to inequality in the distribution of urban environmental hazards [8–13]. For instance, a number of studies have found that toxic waste and solid waste sites are disproportionately located in poor and minority communities [14–16] and that there are differential risks of exposure to a variety of kinds of pollution [17–20]. While environmental inequalities exist along class lines, scholars [1,21,22] agree that there is indisputable evidence of racial inequality regarding the siting of environmental hazards, with communities of color much more likely to be exposed to environmental risks than white communities regardless of social class.

Conventional urban engineering approaches contribute to infrastructural inequality by neglecting social and economic inequality. For urban drainage systems, the design and management of infrastructure relies heavily on conventional Cost Benefit Analysis (CBA). Because of the higher valuation assigned to already-advantaged areas, risk becomes further concentrated in areas with lower incomes, lower property values, and higher proportions of racial and ethnic minorities [23,24]. Together, these conventional engineering approaches intensify inequality and concentrate risk in vulnerable communities.

These purportedly race neutral policies can perpetuate and even exacerbate existing and historical disparities. Grigsby [25] reminds us that "in planning there is no such thing as a 'race neutral' policy" because urban populations are heavily racially segregated. Therefore, urban planning and infrastructure policies that do not explicitly consider race or their impacts of racial disparities almost always advantage already privileged white populations while deprioritizing or even harming populations of color [26,27].

Syracuse is a post-industrial city in the center of New York State (NYS) with a population of approximately 660,000 people in the metropolitan area [28]. Syracuse has a very high level of concentrated poverty, with 40% of census tracts in the city having poverty rates between 41 and 82% [29], median household income for white-headed households is 40% higher than that for Black-headed households [29], and 15 census tracts in the City of Syracuse that are defined as having "racially concentrated poverty", with over 50% non-white residents and a poverty rate of over 40% [29].

In addition to this extreme poverty and racial inequity, Syracuse also faces the challenges of a Combined Sewer System (CSS) and increasingly dramatic precipitation events due to climate change. In CSSs, stormwater, sewage, and industrial wastewater are all collected and processed in the same infrastructure [30]. During heavy rain events, CSSs experience overflow of untreated sewage and industrial wastewater into properties and waterways and wastewater treatment plants can be inundated beyond capacity. This combination of factors sets the stage for the significant environmental racism we find in Syracuse's risk of sewage backups.

Results

Bivariate Results

Bivariate analyses show that Syracuse census tracts that are majority Black have significantly more sewage backups reported that census tracts that are not majority Black. For each 1 percentage point increase in percent Black population, the number of reported sewage events goes up 2.3 events ($p = 0.015$). On average, census tracts that are majority Black have 123 (64%) ($p = 0.0078$) more reported sewage backups than those that are not majority Black, averaging 0.13 sewage backups per person in majority Black census tracts versus 0.07 sewage backups per person in those that are not majority Black.

Table 1: Bivariate Relationships Between Census Tract Characteristics and Number of Reported Sewage Backups

<insert table 1 here>

Bivariate analyses also show a significant relationship between the percentage of a census tract that is 65 years or older and the number of reported sewage events. For each 1 percentage point increase in percent age 65 or older, the number of reported sewage events goes up 148 events ($p = 0.028$). On average, census tracts that have more than 20% of their population 65 years or older have 69 (40%) more reported sewage backups than those that have less than 20% of their population 65 years or older.

Given the significant relationships between both percentage of Black residents and percentage of residents 65 years or older and the number of reported sewage backups, we then tested the potential interaction between both percent Black and percent over 65 years. Bivariate analyses show a significant relationship between the percent of a census tract that is both Black and percent 65 years or older. For each 1 percentage point increase in the percent of Blacks, conditional on percent 65 and older, the number of reported sewage backups goes up 21 events ($p < 0.0001$). On average, census tracts that have more than 5% of their population that is both Black and over 65 years of age have 131 (73%) more reported sewage backups than those that do not.

Multivariate Results

Multivariate results confirm that an increased risk of exposure to sewage backups is strongly correlated with a census tract's percentage Black population, even when controlling for other variables, and also finds a significant positive effect for the percentage that is a racial or ethnic minority. However, the relationship with the percent of the population age 65 or older is no longer significant and instead we find a significant relationship with the interaction between percent 65 or older and percent Black population, specifically.

Table 2: Multivariate Linear Regression for Reported Sewage Events by Census Tract Characteristics

<table 2 here>

First, Model 1 finds that census tracts with a higher percentage of their population that is racial and ethnic minorities have a higher number of reported sewage events ($p = 0.011$). Second, Model 2 finds that census tracts with a higher percentage of their population that is Black have a higher number of reported sewage events ($p = 0.008$), with the effect size being very similar to the effect size of the percent minority in Model 1.

Finally, Model 3 finds a significant relationship for the interaction between the percent of a census tract's population that is both Black and percent 65 or older, with a higher number of reported sewage events ($p < 0.0001$) and a much larger effect size that the percentage minority in Model 1 or the percentage Black in Model 2.

All three multivariate regression models explain at least 53% of the variation in the number of reported sewage events (adjusted r-squared values), even with this very limited number of explanatory variables and a model that does not include any geophysical variables such as ground cover, slope, or soil type. Together, this indicates the significant relationship between socio-economic characteristics and sewage backups, rather than sewage backups being determined primarily by geophysical features of neighborhoods.

Spatial Results

Spatial analysis strongly confirms the higher risk of sewage backups for Syracuse's Black residents. The heat map displays the density of reported sewage backups (see Figure 2), not constrained by formal census tract boundaries. Four key hotspots are visible in the heat map. The most substantial hotspot is on the South side of Syracuse, spanning census tracts 59, 58, 54, and 61.01, all with greater than 49% of their population Black. The second most dense hotspot is on the West side of Syracuse, spanning census tracts 38 and 39, with 30% and 49% of their population

Black, respectively. A large but less dense hotspot on the North side of Syracuse spans census tracts 6, 7, 14, and 15, with 36%, 16%, 32%, and 14% of their population Black, respectively. Finally, a smaller and less dense hotspot on the East side of Syracuse spans census tracts 36.01 and 36.02, with 45% and 51% of their population Black, respectively.

<figure 2 here>

Figure 2: Heatmap of reported sewage backups, 2017-2019+2021, census tracts labeled

Optimized hotspot analysis identifies statistically significant hot and cold spots that confirm the areas previously identified in the heatmap. A large and statistically significant hotspot is identified on the South side of Syracuse, spanning census tracts 51, 52, 53, 54, 55, 57, 58, 59, 60, and 61.01 (99% confidence)[1]. A second statistically significant hotspot is identified on the North side of Syracuse, spanning census tracts 2, 3, 4, 5.01, 6, 7, 8, 14, and 15 (99% confidence). A third, much smaller, statistically significant hotspot is identified on the Northeast side of Syracuse in census tract 36.01 (90% confidence).

We then examine the relationship of location of hotspots with census tract characteristics previously identified as significant in bivariate and multivariate analysis (see Figure 3). The large hotspot on the South side of Syracuse spans the census tracts with the highest percentage Black population in the city. These South side census tracts also contain high percentages of population age 65 or older and high percentages that are both Black and age 65 or older.

<figure 3 here>

Figure 3: Optimized Hotspot Analysis of Reported Sewage Backups and Census Tract Percent Black; Percent Black and Percent 65 or Older

Discussion

We find significant evidence for environmental racism in the distribution of risk of sewage backups in Syracuse, NY. Residents of majority Black census tracts are exposed to, on average, twice as many sewage backups per person as residents of census tracts that are not majority Black. Residents of census tracts with higher percentages of Black residents and higher percentage aged 65 or older are also at a much higher risk of exposure to sewage backups than other Syracuse residents. Multivariate regression results find evidence of greater risk of sewage backups in census tracts with higher percentages of racial minorities and Black residents, distinct from risk faced due to poverty.

A spatial lens allows us to see a broader picture of this environmental racism. Spatial analysis finds large hotspots of sewage backup risk in both Syracuse's predominantly Black Southside and Northside areas. There is a strong colocation of Black population with a higher risk of sewage backups. Our findings suggest that the legacy of Syracuse's extreme racial segregation [31] is the concentration of environmental risk – the risk of sewage backups – in areas where Blacks are segregated.

Environmental racism is both a result of and a cause of systemic racial inequality. Racial discrimination and a white supremacist racial hierarchy places communities of color, particularly Black Americans, at a greater risk for exposure to environmental toxics, wastes, and other environmental harms [1,9,32]. These environmental damages, then, degrade the financial valuation of communities of color and their assets, exacerbating racial disparities. Ultimately, environmental racism can be understood as a mechanism of structural and institutional racism.

What we find in our examination of sewage backups in the City of Syracuse is a dramatic case of environmental racism, the legacy of residential segregation, and the impact of supposedly "race neutral" infrastructure and engineering policies. Clearly, Black residents of Syracuse are "differentially affect{ed} or disadvantage{d}" [1] by sewage backups. As Bullard [1] reminds us, environmental racism does not require intentional actions to be present. Indeed, many, if not most, cases of environmental racism may be the result of policies that are ostensibly "race neutral" and fail to consider existing forms of racial disparity and stratification. In the case of sewage and water infrastructure, local governments and urban planners rely predominantly on conventional CBA when making decisions about urban infrastructure such as drainage and sewage systems [2,3,33,34]. Marginalized communities are less likely to access local political leaders and city bureaucrats to advocate for themselves and their communities [3,35,36]. Both of these systems place already disadvantaged communities of color at further risk. Together, this puts the most vulnerable residents of a community at the highest risk of an environmental hazard like sewage backups, the very residents who have least access to the resources and tools needed for resilience and rebuilding [37].

Our findings are further evidence that the supposedly race-neutral policies of urban planning, specifically CBA and sewage engineering in our case, may ultimately exacerbate racial inequities [1,25,26]. Sewage backups are disgusting, unsafe, and can cause lasting damage to properties and communities [6,7]. But the risk of these backups is not shared evenly by the residents of Syracuse. Instead, residents of predominantly Black census tracts and particularly census tracts with high proportions of Black residents and senior citizens face a much higher risk than their counterparts. This differential risk of sewage backups is an example of environmental racism and the environmental and social consequences of decades of residential segregation intersecting with ostensibly race neutral urban infrastructure decisions to intensify racial inequality.

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Footnotes

1. The same hotspot extends to census tracts 38, 39, 40, 50, and 29.01 at a lower rate of confidence (90% confidence).

Tables

Table 1: Bivariate Relationships Between Census Tract Characteristics and Number of Reported Sewage Backups

	Mean Reported Sewage Backups	Independent samples t-test		Bivariate Reg. Coeff.
Majority Black	192	-2.50**	% Black	2.32*
Not majority Black	315			
>=20% 65 and over	173	-1.83*	% 65 and over	147.77*
<20% 65 and over	242			
>=5% Black and 65 or over	179	-3.24**	% Black and 65 or over	21.41***
<5% Black and 65 or over	310			

Table 2: Multivariate Linear Regression for Reported Sewage Events by Census Tract Characteristics

	Model 1	Model 2	Model 3
Percent minority	0.09*	-------	-------
Percent Black	-------	0.09**	-------
Percent Black & >=65	-------	-------	0.64***
Percent non-English	-0.10	-0.01	-0.02
Percent disability	0.10	0.08	0.07
Percent >=65	0.14	0.13	-------
Percent 150% poverty	-0.07	-0.05	-0.04
Percent multi-unit	-0.12***	-0.12***	-0.12***
Constant	11.74***	12.76***	14.62***
Adj. R-squared	0.5295***	0.5351***	0.5714***

Figures

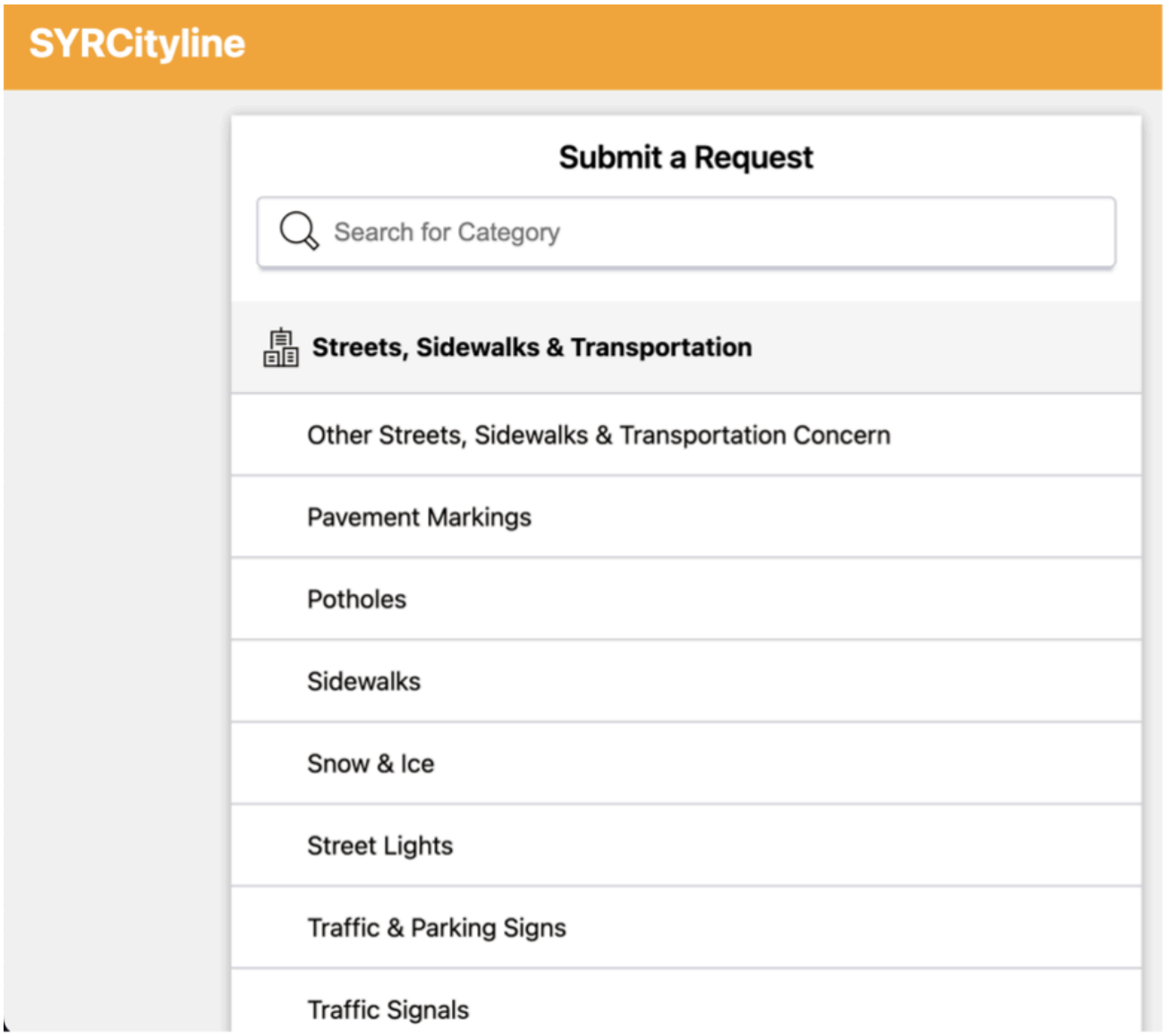

Figure 1

Online Request Form, City of Syracuse

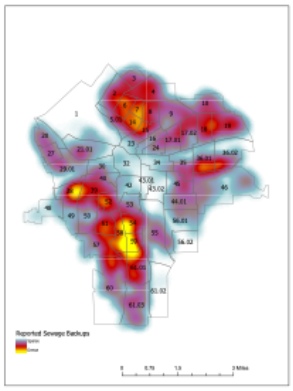

Figure 2

Heatmap of reported sewage backups, 2017-2019+2021, census tracts labeled

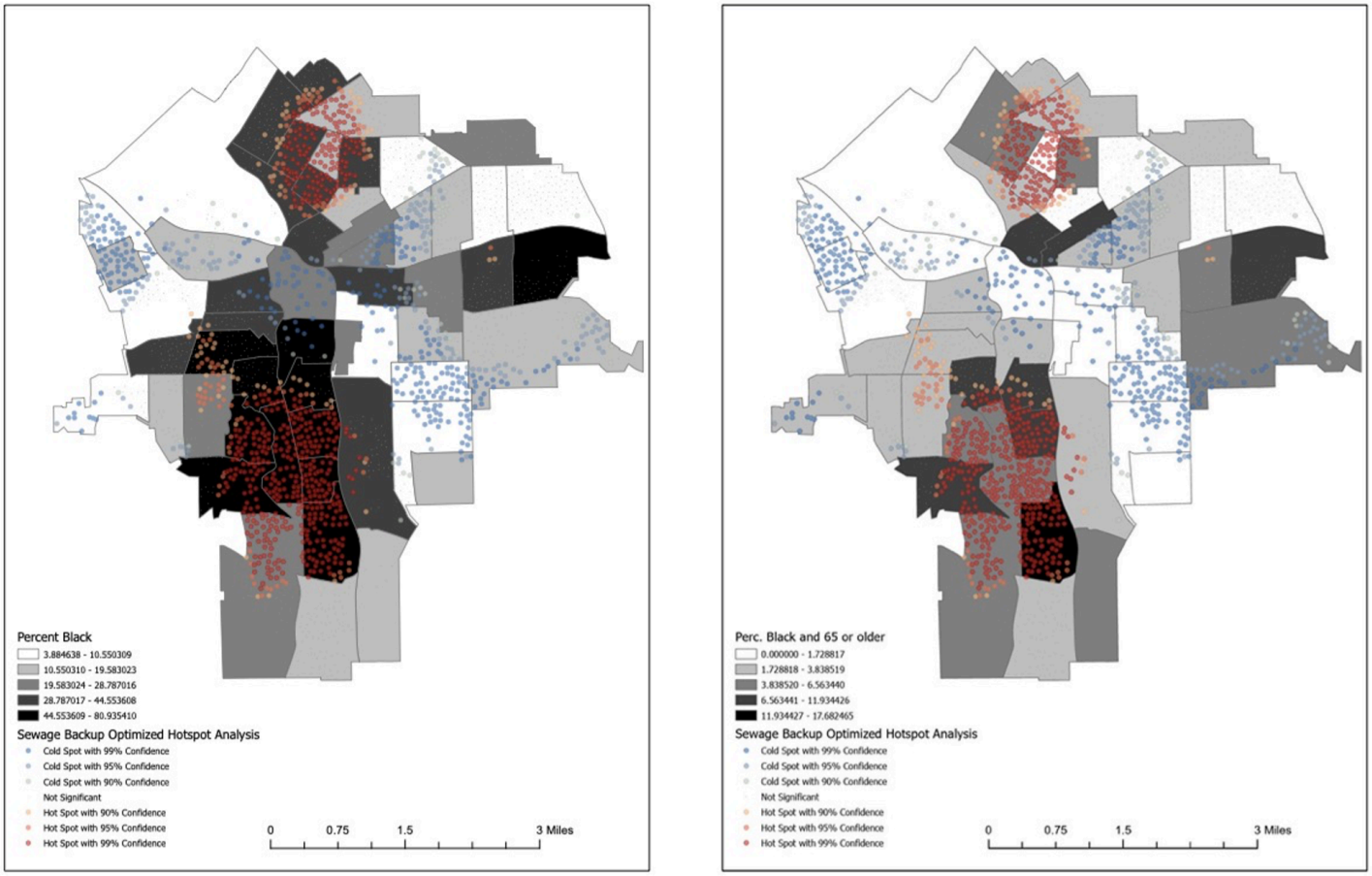

Figure 3

Optimized Hotspot Analysis of Reported Sewage Backups and Census Tract Percent Black; Percent Black and Percent 65 or Older

Supplementary Files

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