DSAN 5100

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Living In Risk:

Public Health and Socioeconomic Indicators in NYC Housing Insecurity

Motivation

What does it mean when "affordable housing" in New York City costs over $3,000 per month? For many, it means making impossible trade-offs: foregoing basic necessities like food, healthcare, and other essentials just to keep a roof over their heads. Currently, 38.9% of NYC renters are considered rent-burdened, spending over 30% of their income on housing costs (New York City Housing Authority). This is not merely an individual struggle but a systemic crisis. Housing insecurity entrenches individuals in cycles of public health disparities, educational barriers, and community instability, perpetuating intergenerational inequality.

This problem is not confined to New York City. As a global metropolitan hub, NYC serves as a microcosm of broader global trends—economic inequality, housing insecurity, and their ripple effects are evident in cities worldwide. The challenges faced here provide invaluable insights into the forces driving housing markets globally and highlight the urgency of addressing housing instability on a larger scale.

Beyond statistics, this issue is deeply human. Each number represents individuals and families navigating a flawed system that often neglects their needs. Exploring these stories fosters empathy and underscores the universal right to secure, affordable housing—a fundamental need that transcends geographic and economic boundaries. By analyzing and understanding housing inequality, we contribute to research, inform equitable policy creation, and equip ourselves with the knowledge to advocate for meaningful, data-driven solutions—both locally and globally.

Research Question

This research aims to answer the following question: What are the key factors that contribute to high housing risk across boroughs, and how do public health and socioeconomic indicators correlate with these risks?

Objectives

The primary objectives of our research are to:

- Identify and analyze the factors driving housing risks in NYC boroughs.
- Examine the relationships between housing risks, public health outcomes, and socioeconomic conditions.
- Provide insights that can inform policy solutions aimed at reducing housing insecurity in NYC and beyond.

Introduction

New York City's housing landscape has long been shaped by systemic inequities and discriminatory policies. Practices such as redlining in the 1930s, urban renewal projects from the 1940s to the 1970s, and the privatization of public housing in the 1970s have consistently displaced low-income communities, entrenching cycles of poverty and exclusion. While programs like rent stabilization and affordable housing initiatives (e.g., Projects 8 and 9) were introduced to mitigate these disparities, they have failed to meet the escalating demand for truly affordable housing.

Today, the term "affordable housing" in NYC often refers to units costing upwards of $3,000 per month—a price accessible only to the top 1% of earners. This stark reality reflects a growing class divide, where even college-educated individuals entering the workforce find housing costs unattainable. The result is a city where economic inequality not only persists but deepens, leaving middle- and low-income families to face increasingly precarious living conditions.

The COVID-19 pandemic has amplified these challenges, intensifying unemployment, evictions, and housing insecurity. Displacement not only disrupts lives but also fragments long-standing cultural communities, such as those in Harlem and Chinatown, further widening gaps in equity and opportunity. For marginalized communities, these disruptions compound pre-existing vulnerabilities, perpetuating systemic inequities across generations.

In response to the rising number of unhoused individuals, public spaces have adopted exclusionary measures that criminalize or deter their presence. For instance, NYC's Strand Bookstore infamously installed sprinklers to drench people seeking shelter under its iconic awning. Similarly, in 2018, police cleared a homeless encampment and installed unnecessary bicycle racks to prevent their return. These actions symbolize broader societal neglect, where the housing crisis is met not with compassion, but with barriers that exacerbate the struggles of those already marginalized.

Addressing the housing crisis requires moving beyond anecdotal evidence to systematically examine the factors driving insecurity. By identifying and analyzing the underlying socioeconomic and public health indicators, this study aims to shed light on the mechanisms perpetuating housing instability and inform data-driven policy solutions. The following sections detail the methodology and data sources employed to investigate these critical issues.

Dataset and Data Collection

The dataset, compiled by the Association for Neighborhood and Housing Development (ANHD), integrates data from various government agencies, segmented by borough and neighborhood into three main feature groups. Additionally, the National Eviction Map from the Eviction Lab provides trends in eviction filings and risks from 2000 to 2018, allowing us to analyze systemic housing inequalities and inform borough-specific interventions. By combining these datasets, we identified borough-specific challenges and developed targeted strategies to address displacement risks. The following table outlines each variable's description, source, and category.

Feature	Source	Category
COVID Vaccination Rate as of March 23, 2023	NYC Department of Health and Mental Hygiene (DOHMH) and Census American Community Survey (ACS) 2021 5-Year Estimates, Total Population	COVID-19 Risk and Impact
COVID-19 Death Rate (per 1,000 People), March 1, 2020 - December 31, 2022	NYC DOHMH and ACS 2021 5-Year Estimates, Total Population	COVID-19 Risk and Impact
Percent Uninsured, 2021	ACS 2021 5-Year Estimates, Health Insurance	COVID-19 Risk and Impact
Percent with Severe Crowding, 2021	ACS 2021 5-Year Estimates, Occupants Per Room (Renter-Occupied Housing Units)	COVID-19 Risk and Impact
Percent of Area Median Income, 2021	ACS 5-Year Estimates: Average Household Size, Median Household Income and U.S. Department of Housing and Urban Development (HUD) 2021 Income Limits Documentation	Demographics
Percent People of Color, 2021	ACS 2021 5-Year Estimates, Race	Demographics
Percent Limited English Proficiency, 2021	ACS 2021 5-Year Estimates, Limited English Speaking Households	Demographics
Percent with Rent Burden, 2021	ACS 2021 5-Year Estimates, Gross Rent as a Percentage of Household Income in the Past 12 Months	Housing Risk
Rate of Eviction Filings (per 1,000 Renter households), 2022	New York State Office of Court Administration (OCA) via the Housing Data Coalition in collaboration with the Right to Counsel Coalition, ACS 2021 5-Year Estimates, Tenure	Housing Risk
Rate of Tenant-Initiated Cases (per 1,000 Renter Households), 2022	New York State OCA, ACS 2021 5-Year Estimates, Tenure	Housing Risk
Rate of Immediately Hazardous Housing Code Violations in 6+ Unit Buildings (per 1,000 Units), 2022	NYC HPD Housing Maintenance Code Violations and New York City Department of Planning's PLUTO 21v3 database	Housing Risk
Rate of Unplanned NYCHA Service Outages (per Building), 2022	New York City Housing Authority (NYCHA) Service Disruptions scraped by the Housing Data Coalition and Development Data Book	Housing Risk
Change in Median Gross Rent. 2016-2021	ACS 2021 and 2016 5-Year Estimates, Median Gross Rent and Inflation Calculator using Consumer Price Index data (inflation factor = 1.09586)	Housing Risk
Change in Residential Sale Price per Square Foot, 2020-2022	NYC Department of Finance Annualized Sales	Housing Risk
Number of New Non-Affordable Units, 2022	NYC Department of Buildings Certificates of Occupancy and NYC HPD Housing New York Units by Building	Housing Risk
Expiring LIHTC units, 2023-2027	NYU Furman Center's CoreData.nyc	Housing Risk
Rate of Foreclosure Filings per 1,000 Small (1-4 Unit) Homes, 2022	PropertyShark via DAP Portal	Housing Risk
Share of Non-Bank Small (1-4 Unit) Home Purchase Loans, 2021	Home Mortgage Disclosure Act (HMDA), 2021	Housing Risk

Data Importance

COVID-19 risk and impact data highlight the pandemic's influence on housing insecurity, while demographic data expose systemic racism and socioeconomic inequalities. Housing risk indicators, such as evictions and poor infrastructure, identify displacement risks.

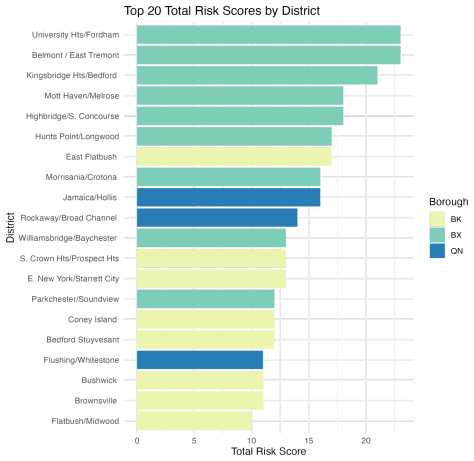
Data Cleaning

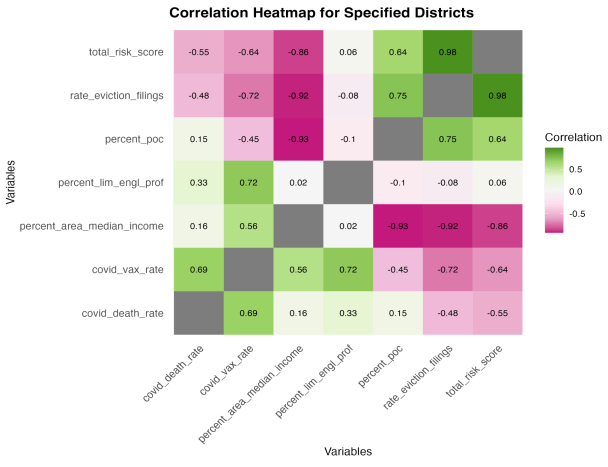
For initial cleaning, we handled complex categorical and numerical transformations. For numerical features in percentages, we stripped "%" symbols from columns, converted string percentages to numeric values, and handled the few null values left in the dataset. Specifically, for "Percent of Area Median Income," we extracted numeric values from the Area Median Income (AMI) percentages and removed textual annotations. We also contextualized continuous variables into low, medium, and high buckets for "Percent of AMI," "Severe Crowding," and "Rent Burden" to allow for easier analysis.

Exploratory Data Analysis (EDA)

To analyze the data effectively, we used exploratory data analysis (EDA) to visualize patterns, identify missing values, detect outliers, and explore correlations among variables. EDA ensures data preparation for machine learning models by minimizing errors and optimizing training. We utilized various visual tools, including distribution graphs to assess normality, heatmaps to explore correlations, and other visualizations to uncover key insights.

A bar chart of the top 20 community districts by total risk score shows the Bronx (BX) dominating the highest risk rankings, with the first six districts from this borough, followed by Brooklyn (BK), which also has a significant share of high-risk districts. Notably, Manhattan, the wealthiest borough, does not appear. This disparity reflects historical and systemic vulnerabilities from policies like redlining, affordable housing conversions, and urban renewal that disproportionately impacted low-income neighborhoods.





This heat map visually represents the correlations between variables related to displacement risk. Eviction filings and the percentage of people of color (PoC) are highly correlated with displacement risk scores, reflecting systemic inequities and structural barriers that disproportionately affect marginalized communities. Eviction filings represent a direct legal threat to a household's ability to remain in their home, while communities of color often reside in neighborhoods shaped by targeted gentrification.

Analysis & Results

Public Health Analysis and Housing Risk in New York City

The interplay between public health and housing stability underscores a critical yet underexplored dimension of urban inequality, particularly in densely populated regions like New York City. Housing insecurity and public health disparities often share an intricate relationship, where one exacerbates the other. For instance, poor health outcomes can impose financial strains that destabilize housing conditions, while inadequate housing environments can amplify stress and restrict access to healthcare, perpetuating a cycle of vulnerability. Although initiatives like the "City of Yes" housing proposal aim to mitigate affordability issues and stimulate housing development, they often overlook the broader role of public health as a determinant of housing stability.

This study delves into the correlation between key public health indicators—such as vaccination rates, mortality rates, and uninsured percentages—and housing risk across New York City's boroughs. By leveraging data from the NYC Department of Health and Mental Hygiene (DOHMH) and the Association for Neighborhood & Housing Development, we aimed to uncover patterns and connections that could inform integrated policy solutions. Building on the broader research question of systemic inequalities and their influence on housing insecurity, this analysis specifically examines how public health conditions contribute to or mitigate housing risks, highlighting opportunities for targeted interventions.

Methodology

To examine the relationship between public health metrics and housing stability across New York City boroughs, we implemented a structured methodology combining data preparation, exploratory analysis, and statistical testing. Public health data, including COVID-19 mortality rates, vaccination rates, and uninsured percentages, was standardized to ensure consistency. Mortality rates were scaled per 1,000 residents, while vaccination rates and uninsured percentages were expressed as decimals. Housing risk scores were normalized to a 0–1 scale to improve comparability and integration.

Exploratory analysis uncovered borough-level trends and variations through visual tools such as bar charts, scatterplots, and heatmaps. Scatterplots highlighted specific relationships between public health metrics and housing risks, while heatmaps summarized broader interdependencies. Temporal analyses provided further insights into changes over time, deepening the understanding of these dynamics.

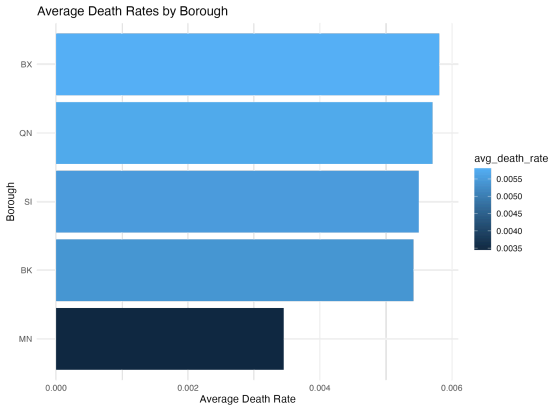
Statistical tests validated observed patterns and quantified disparities. Welch’s T-tests compared housing risk scores relative to vaccination rates, and ANOVA assessed differences across uninsured percentage categories. Additionally, chi-squared and Fisher’s exact tests evaluated associations between boroughs and eviction rate categories, ensuring robustness for smaller data subsets.

Outlier and distribution analyses pinpointed borough-specific vulnerabilities, with the Bronx frequently showing elevated public health risks and housing instability. Demographic analyses added context, illustrating how systemic inequities intersect with population characteristics.

This integrated approach provided a robust framework for identifying key factors linking public health to housing insecurity. These findings inform targeted, data-driven policies aimed at mitigating systemic inequities and enhancing stability across vulnerable communities.

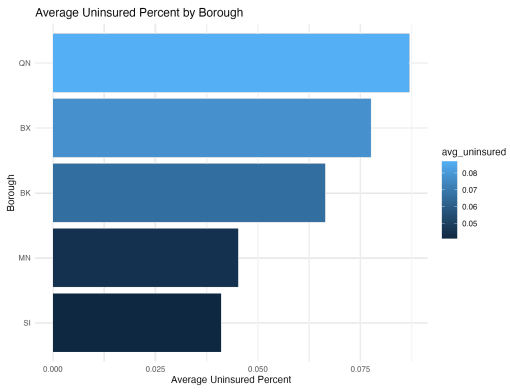
Public Health Findings

Examining public health metrics across New York City boroughs reveals critical insights into how health disparities contribute to broader patterns of housing instability and vulnerability. Mortality rates demonstrated striking disparities across boroughs, with the Bronx exhibiting the highest average mortality rate at approximately 0.0055 deaths per capita, compared to Manhattan's 0.0035 deaths per capita. This 57% difference underscores systemic health inequities, as residents of the Bronx face elevated rates of chronic illnesses, exposure to environmental hazards, and inadequate access to healthcare services. These vulnerabilities intersect with socioeconomic challenges, such as rent burden and overcrowding, contributing to heightened housing risk scores in the borough. A T-test comparing mortality rates confirmed that differences between boroughs like the Bronx and Manhattan were statistically significant, highlighting the severity of systemic inequities.



The bar plot titled “Average Death Rates by Borough” illustrates these disparities, with the Bronx significantly outpacing other boroughs in per capita deaths. This visualization reinforces the need for health-focused interventions, particularly in neighborhoods where mortality correlates strongly with higher housing risks. Addressing these systemic inequities requires a dual strategy that tackles both public health outcomes and housing vulnerabilities to create lasting change.

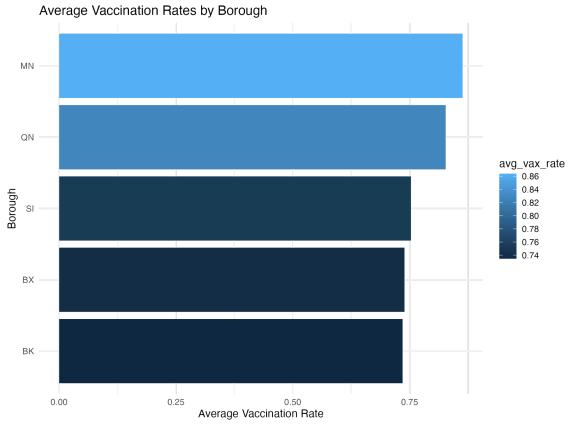
Building on the analysis of mortality rates, uninsured rates further illuminate disparities in healthcare access across boroughs. Queens and the Bronx reported the highest uninsured percentages, at approximately 8% and 7.5%, respectively, compared to Manhattan’s significantly lower 4%. These figures represent barriers to healthcare access that disproportionately burden these communities. Uninsured individuals often delay or forgo necessary medical care, exacerbating health issues and creating financial strain, both of which contribute to housing instability. ANOVA results demonstrated a significant relationship between uninsured percentage categories (low, medium, high) and housing risk scores, with neighborhoods reporting uninsured rates exceeding 10% consistently exhibiting higher housing risk scores. This underscores the cascading effects of healthcare access disparities on housing vulnerability.



The graph titled “Average Uninsured Percent by Borough” visualizes the proportion of uninsured residents in each borough. Queens and the Bronx stand out, emphasizing the correlation between limited

healthcare access and housing risk. These patterns provide compelling evidence for targeted healthcare initiatives aimed at reducing uninsured rates, which could play a pivotal role in stabilizing housing in high-risk neighborhoods.

Vaccination rates also revealed significant disparities, shedding light on inequities in public health outreach and infrastructure. The bar chart titled "Vaccination Rates by Borough" provides a visual comparison of vaccination coverage across boroughs, highlighting the stark differences in public health infrastructure. Manhattan achieved the highest vaccination coverage at approximately 86%, while Brooklyn and the Bronx lagged behind at around 74–75%. This gap reflects systemic inequities in resource allocation, particularly in underserved neighborhoods. Welch's T-tests confirmed significant differences in housing risk scores between districts with above-median and below-median vaccination rates, with higher vaccination coverage correlating with lower housing risks. Lower vaccination rates increase the burden of preventable diseases, which intensify financial and health challenges and further destabilize housing in vulnerable communities.

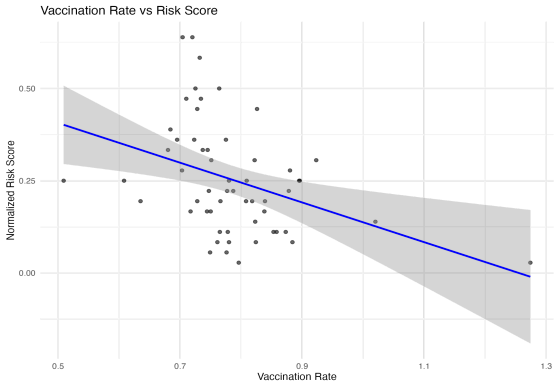


These findings emphasize the need for more equitable distribution of healthcare resources, with a focus on improving vaccination outreach and coverage in underserved areas like the Bronx and Brooklyn. Expanding vaccination efforts in these neighborhoods could alleviate preventable health burdens and support housing stability.

Correlation Analysis

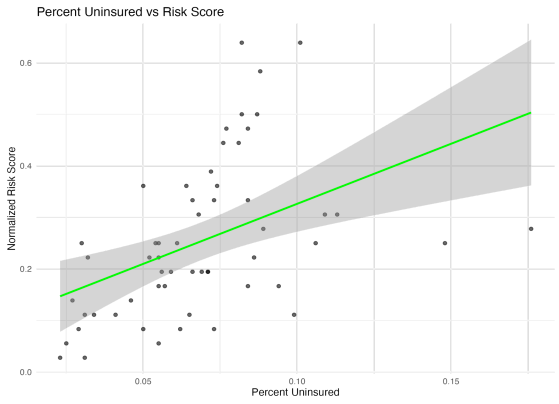
Building on the geographic patterns and vulnerabilities identified earlier, the correlation analysis offers a detailed quantitative perspective on the relationships between public health metrics and housing risks. By applying Pearson's correlation coefficient, we identified significant associations between key health indicators—vaccination rates, uninsured percentages, and mortality rates—and housing instability. These findings underscore the profound impact that disparities in healthcare access and outcomes have on housing security across New York City's boroughs.

To begin, one of the most notable relationships was between vaccination rates and housing risk. A moderate negative correlation ($r = -0.38$, $p < 0.01$) was observed, indicating that areas with higher vaccination rates tend to experience lower housing instability. This finding emphasizes the importance of preventative healthcare measures, such as immunization campaigns, in reducing financial and health-related stresses contributing to housing risks. Improved vaccination coverage not only mitigates the spread of preventable diseases but also

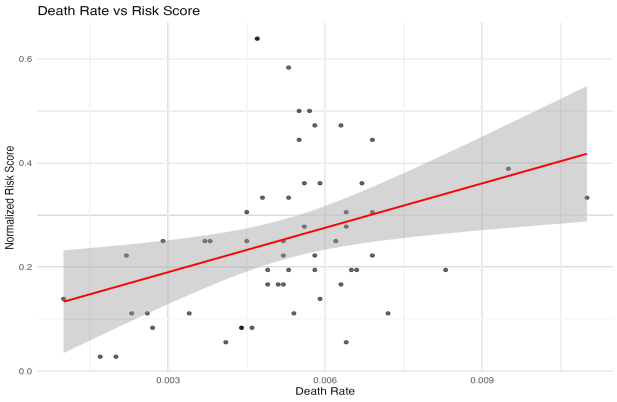


alleviates the economic burdens associated with prolonged illness or healthcare expenses. These results highlight the potential for public health initiatives to play a pivotal role in stabilizing housing for at-risk communities.

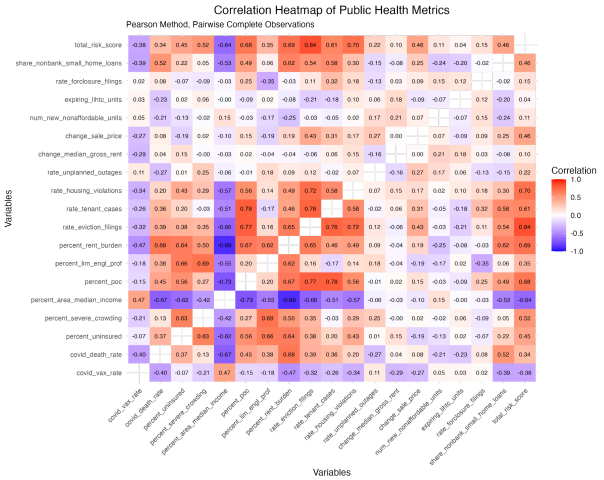
Moving beyond vaccination rates, the relationship between uninsured rates and housing risk further illustrates the critical intersection of public health and housing stability. A positive correlation ($r = 0.37$, $p < 0.01$) revealed that neighborhoods with higher uninsured percentages face elevated housing risks. This trend is particularly pronounced in districts within the Bronx and Queens, where uninsured rates exceed 10%. Without adequate health insurance, residents are more likely to delay or avoid seeking medical care, exacerbating health issues and increasing financial strain. These challenges directly contribute to vulnerabilities in housing, including eviction and displacement. Expanding access to affordable healthcare in these neighborhoods could serve as a critical intervention, reducing the cascading effects of health disparities on housing security.



Additionally, mortality rates demonstrated a significant positive correlation ($r = 0.34$, $p < 0.05$) with housing risk scores, further emphasizing the connection between public health crises and housing instability. Neighborhoods with mortality rates exceeding 0.006 deaths per capita consistently exhibited heightened housing risks. These results highlight how poor health outcomes compound economic and social instability, especially in communities already burdened by systemic inequities. Addressing these challenges requires a multifaceted approach prioritizing improved healthcare access and targeted housing policies.



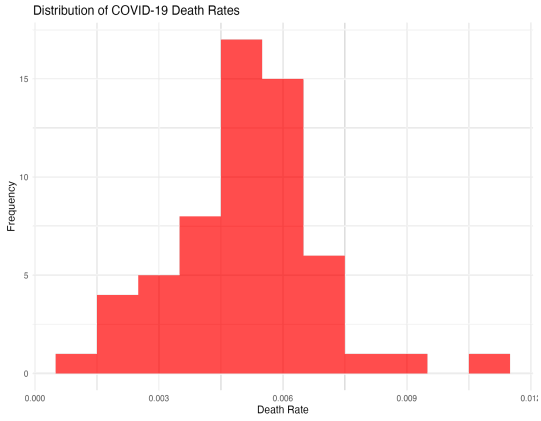
To synthesize these findings, the "Correlation Heatmap of Public Health Metrics" provides a comprehensive visualization of the relationships among vaccination rates, uninsured percentages, mortality rates, and housing risk scores. Darker shading represents stronger correlations, offering an intuitive overview of where these metrics intersect. For example, the heatmap underscores the significant relationship between uninsured rates and housing risks, identifying key areas for intervention.



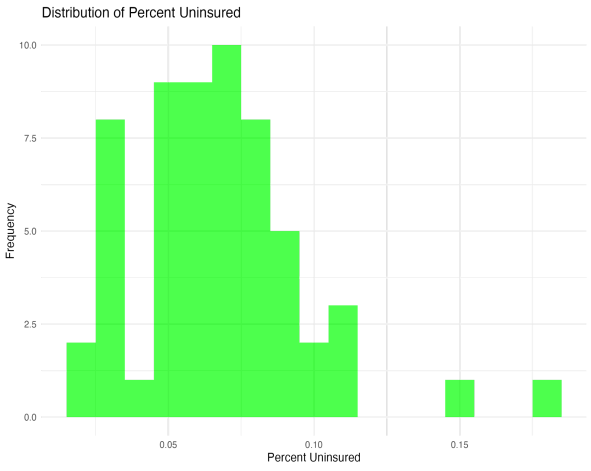
Taken together, these findings collectively highlight the need for integrated policy solutions that address health disparities as a core strategy for reducing housing instability. Prioritizing preventative healthcare, expanding affordable insurance, and improving medical services in underserved areas will strengthen individual health outcomes, bolster community resilience, and promote equitable urban development.

Geographic and Distribution Analysis

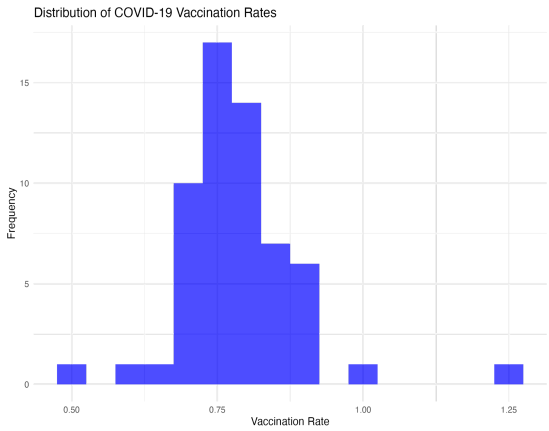
The geographic and distribution analysis provides a granular view of public health disparities across New York City boroughs, complementing the correlation analysis by revealing localized vulnerabilities and patterns. By examining the distribution of mortality rates, uninsured percentages, and vaccination rates, this analysis identifies where public health challenges are most concentrated and how they intersect with housing instability.



To start, the distribution of mortality rates revealed a slightly right-skewed pattern, with most districts experiencing rates between 0.004 and 0.006 deaths per capita. However, outliers in the Bronx and Brooklyn emerged, with mortality rates exceeding 0.006. These outliers highlight specific high-risk areas where residents face compounded health challenges, such as chronic illnesses and limited access to healthcare. For example, neighborhoods in the Bronx, already burdened by socioeconomic stressors, also exhibit elevated mortality rates that exacerbate housing instability. The "Distribution of COVID-19 Death Rates" graph visually captures these disparities, pinpointing neighborhoods with heightened mortality risks. This pattern underscores the pressing need for targeted healthcare interventions that address both the systemic and immediate causes of these disparities.



Shifting the focus to uninsured rates, the analysis revealed a bimodal distribution, with peaks around 5% and 7.5%. Manhattan and Staten Island exhibited lower uninsured rates, reflecting their stronger healthcare infrastructure and access. In stark contrast, neighborhoods in the Bronx and Queens showed significantly higher uninsured rates, some exceeding 15%. These outliers represent districts facing severe challenges in accessing affordable healthcare, often leading to delayed medical treatment and escalating financial strain. The "Distribution of Percent Uninsured" graph highlights these disparities, showing the contrast between well-served boroughs and underserved communities. This bimodal pattern reinforces the need for targeted policies aimed at expanding insurance coverage and improving healthcare accessibility in these high-risk areas.



Vaccination rates displayed a relatively normal distribution but revealed clear borough-level disparities. Manhattan consistently achieved the highest coverage due to robust public health infrastructure, while Brooklyn and the Bronx lagged with below-average rates in many neighborhoods. These gaps leave underserved communities more vulnerable to preventable diseases, compounding economic and health-related challenges that destabilize housing. The "Vaccination Rates by Borough" graph underscores the need for equitable resource distribution and targeted public health campaigns to close these gaps.

Together these distributions create a detailed and compelling picture of the geographic disparities in public health metrics—such as high mortality rates in the Bronx and Brooklyn, peaks in uninsured rates in the Bronx and Queens, and low vaccination rates in Brooklyn and the Bronx—align with housing instability findings. These patterns emphasize the interconnected nature of public health and housing risks, highlighting the need for holistic and integrated solutions.

Public Health Conclusions and Policy Recommendations

Public health disparities and housing instability intersect in boroughs like the Bronx, where high mortality rates (0.0055 per capita, NYC's highest), uninsured percentages (7.5%), and housing risks deepen financial and social vulnerabilities. Expanding affordable healthcare access, such as free or low-cost insurance in the Bronx and Queens, is essential to breaking these cycles. Integrating public health data into housing risk assessments can further improve resource allocation. For example, Bronx neighborhoods with mortality rates over 0.006 per capita and uninsured rates above 10% should be prioritized for mobile health clinics and rental assistance programs, addressing healthcare and housing risks together. Adopting integrated, data-driven policies addressing public health and housing disparities will promote equity and resilience in NYC's most vulnerable communities.

Vaccination campaigns show promise. Manhattan's 86% vaccination rate correlates with lower housing instability compared to Brooklyn and the Bronx (74–75%). Expanding outreach in underserved neighborhoods can reduce preventable health burdens and financial strains tied to housing instability. Linking vaccination campaigns with housing assistance in high-risk boroughs strengthens these efforts.

Collaboration between housing and health sectors is critical to tackling systemic inequities. Pairing eviction prevention programs with healthcare outreach in areas like the South Bronx addresses immediate needs while laying the groundwork for long-term stability. Borough-specific strategies—boosting healthcare access for immigrant populations in Queens, where limited English proficiency rates are highest, and increasing tenant protections in Brooklyn, where foreclosure filings are prevalent—can deliver targeted, impactful results. These efforts collectively pave the way for a healthier, more equitable, and resilient New York City.

Socioeconomic Analysis

On December 5, 2024, New York City celebrated the passage of the "City of Yes" for housing opportunities. This housing proposal aims to create 80,000 new homes by 2040 and invest $5 billion in housing infrastructure updates, improvements, and developments ("Mayor Adams Celebrates Passage"). While this initiative marks a significant step toward addressing the city's affordability crisis, it alone cannot resolve the deeply rooted issue of housing insecurity, which stems from numerous complex factors beyond rent and affordability.

Cost burdens are the primary driver of housing insecurity ("New Yorkers in Need"). As rent prices continue to rise while incomes stagnate, financial pressures on New Yorkers intensify. New York City's median rent price is nearly double the national median (Gerstein, Julie). This disparity disproportionately impacts middle- and low-income households, forcing many to make difficult trade-offs, such as sacrificing food, healthcare, and education, to afford rent.

Education and language proficiency further hinder housing security. Millions of New Yorkers lack English proficiency, creating barriers to accessing government programs and services ("Language Access for"). Households with limited educational opportunities also face challenges in finding stable employment, which restricts their ability to afford housing. These linguistic and educational barriers often push individuals into lower-paying jobs, perpetuating a cycle of poverty and housing instability in a competitive housing market.

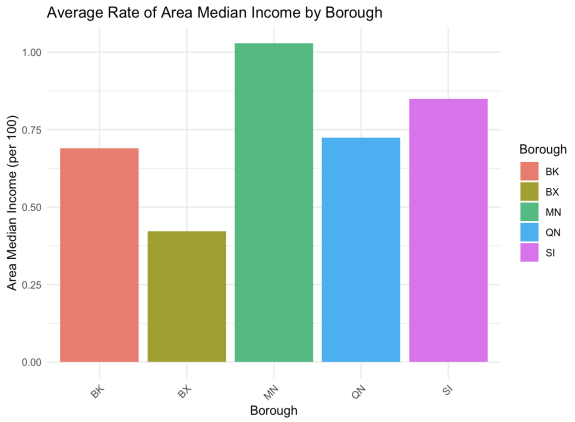
Adding to these challenges is the racial disparity in homeownership. Although white residents make up 32% of the city's population, they account for 42% of homeowners (Stein, Oksana). In contrast, people of color, who face systemic discrimination, are disproportionately excluded from homeownership opportunities, increasing their risk of displacement.

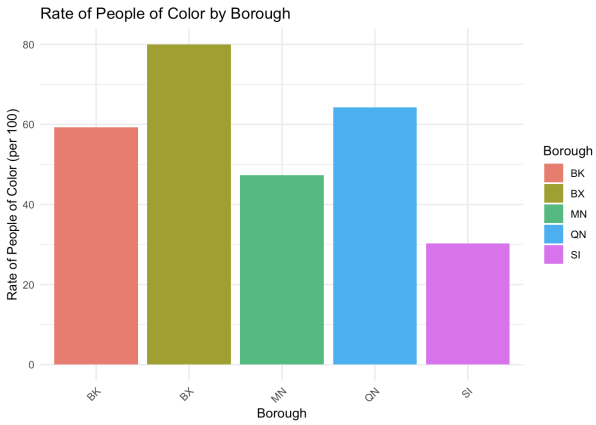
Addressing these issues of economic, educational, and racial inequalities is essential for improving housing stability. While the "City of Yes" proposal represents a step in the right direction, much more needs to be done to tackle these systemic challenges.

Socioeconomic Findings

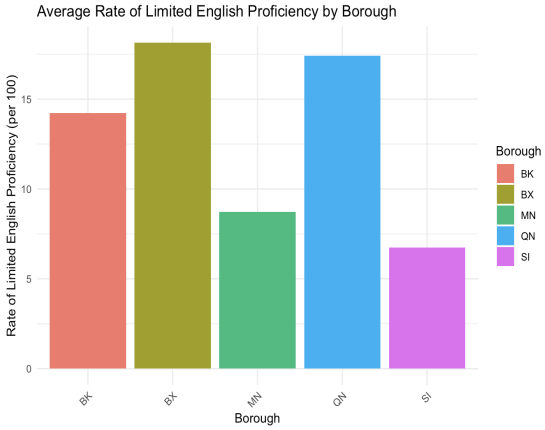
In our analysis, we examined correlations between socioeconomic factors and housing risks using a dataset from the Association for Neighborhood & Housing Development, focusing on how limited English proficiency, area median income, and racial demographics intersect with housing risk. Key columns such as "Percent of Area Median Income," "Percent People of Color," and "Percent Limited English Proficiency" revealed patterns influencing housing risk and identified areas for targeted interventions. To ensure consistency, we cleaned the data by converting "Percent of Area Median Income" into "Area Median Income Rate" (income per 100 people) and adjusting "Percent People of Color" and "Percent Limited English Proficiency" to represent rates per 100 residents. The "Total Risk Score," initially on a 36-point scale, was normalized to a 0–1 range and renamed "Housing Risk."

The bar plot titled “Average Rate of Area Median Income by Borough” highlights economic disparities in New York City. Manhattan (MN) has the highest average income rate, indicating greater financial stability, while the Bronx (BX) has the lowest, reflecting significant economic challenges.





The bar plot titled 'Rate of People of Color by Borough' reveals that the Bronx has the highest proportion of people of color (per 100 residents), in stark contrast to Manhattan, which shows the lowest. This disparity underscores the intersection of racial demographics and housing challenges and contrasts sharply with Manhattan's higher area median income, highlighting systemic inequities across boroughs.

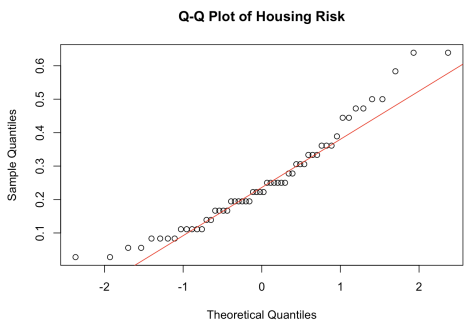


The bar plot titled “Average Rate of Limited English Proficiency by Borough” shows Queens (QN) with the highest rate of limited English proficiency (per 100 residents), while Manhattan has the lowest. These findings point to how language barriers contribute to housing insecurity.

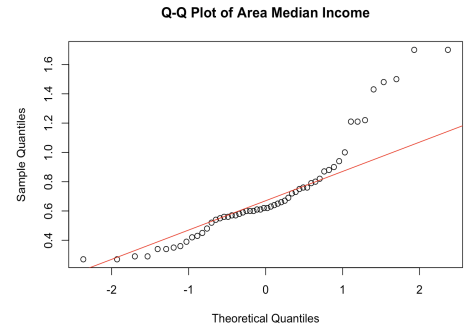
The bar graphs highlight key socioeconomic disparities across NYC boroughs, showing how income, race, and language proficiency contribute to housing insecurity. These insights guided our use of statistical techniques to measure their correlation with housing risk.

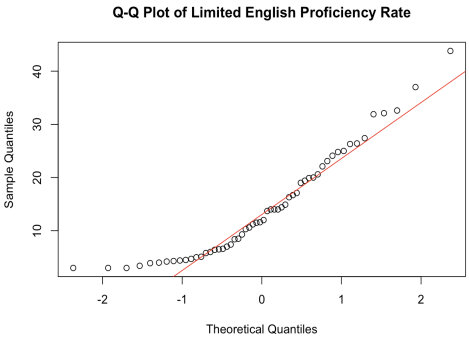
Statistical Testing

To analyze socioeconomic factors and housing risk, we used Q-Q plots and the Shapiro-Wilk test, which confirmed no variables were normally distributed. Consequently, we applied Spearman’s correlation, a non-parametric method, to measure their relationships.



The Q-Q plot for "Housing Risk" shows the data aligns closely with theoretical quantiles, suggesting potential normality; however, slight tail skewness indicates deviations.





The Shapiro-Wilk test confirmed this with a p-value of 0.0093, showing the data is not normally distributed. Consequently, a non-parametric approach was adopted to analyze the "Housing Risk" variable.

For "Area Median Income," the Q-Q plot displayed significant deviations from the theoretical quantile line, clearly indicating non-normality. The Shapiro-Wilk test corroborated this, producing a p-value of 2.27e-05, further validating the need for non-parametric methods.

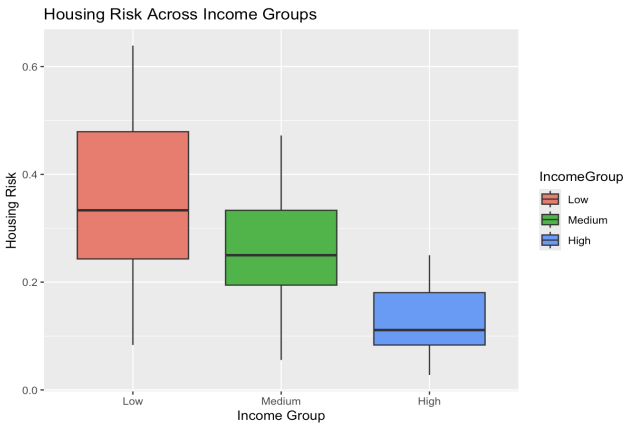
The Q-Q plots for "People of Color" and "Limited English Proficiency Rate" both showed consistent deviations from the theoretical quantile line, indicating non-normal distributions. These observations were confirmed by the Shapiro-Wilk tests, which yielded p-values of 0.01567 and 0.0004641, respectively, reinforcing the conclusion that neither variable follows a normal distribution.

Collectively, the results of the Q-Q plots and Shapiro-Wilk tests indicated that none of the analyzed variables adhered to a normal distribution. As a result, Spearman's correlation, a non-parametric method, was selected to evaluate the relationships between these factors and housing risk. This approach ensured robust and appropriate analysis given the data characteristics.

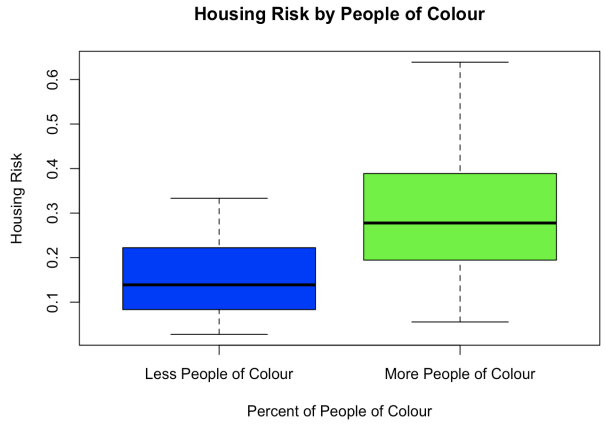
Correlation Analysis of Socioeconomic Factors

Spearman's correlation was used to assess the strength and direction of relationships between housing risk and socioeconomic factors, such as area median income, the proportion of people of color, and limited English proficiency. This non-parametric method provided robust insights into these relationships despite the non-normality of the data.

The box plot titled "Housing Risk Across Income Groups" illustrates the distribution of housing risk among three income levels: low, medium, and high. These groups were derived from quantiles based on the 33rd and 67th percentiles of area median income. The visualization highlights that housing risk is significantly higher among low-income groups. Statistical validation using Spearman's correlation revealed a strong negative relationship between income levels and housing risk, with a

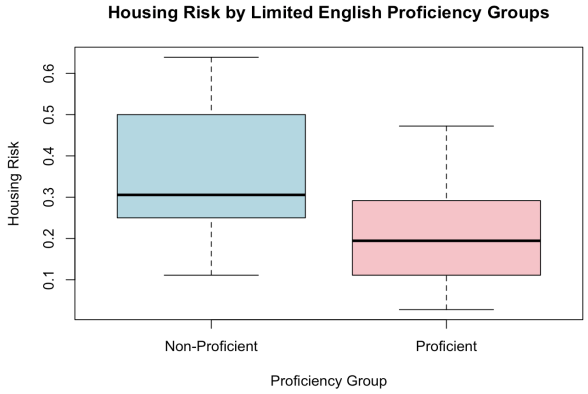


correlation coefficient (rho) of -0.7219 and a p-value of 3.425e-10. This confirms a highly significant relationship, indicating that as income levels increase, housing risk decreases.



The "Housing Risk by People of Color" box plot compares housing risk between areas with a lower proportion of people of color (less than 50%) and areas with a higher proportion (50% or more). The visualization demonstrates that areas with a greater proportion of people of color experience significantly higher housing risks. Additionally, the interquartile range (IQR) for these areas is larger, reflecting greater variability in housing risk. Spearman's correlation analysis validated this observation, showing a positive correlation coefficient (rho) of 0.6938 and a p-value of 3.06e-09, indicating a statistically significant relationship. This finding highlights systemic inequalities, where communities with higher concentrations of people of color face greater housing challenges.

Language barriers play a critical role in shaping housing insecurity, as illustrated by the "Housing Risk by Limited English Proficiency Group" box plot. This visualization compares areas with "Non-Proficient" residents (limited English proficiency rates of 19.2% or higher) and "Proficient" residents (below 19.2%). This threshold, determined using a decision tree model, highlights that "Non-Proficient" areas face significantly higher housing risks and greater variability. Spearman's correlation analysis supports this finding, showing a positive relationship (rho = 0.3629, p = 0.00598). These results underscore how language barriers increase housing vulnerability by limiting access to essential resources and services.



Socioeconomic Conclusions and Policy Recommendation

These findings demonstrate that housing risk in New York City is influenced by a complex interplay of economic, racial, and linguistic factors. Low income, systemic racial disparities, and limited English proficiency independently and collectively exacerbate housing challenges, perpetuating cycles of vulnerability for marginalized communities. Addressing these interconnected factors requires a multifaceted and equitable approach to housing policy.

Effective policies should prioritize increasing affordable housing access for low-income families, alongside protections against discrimination in housing markets disproportionately affecting communities of color. Expanding language-accessible services, such as tenant education programs and legal aid, can help individuals with limited English proficiency navigate housing systems more effectively.

Additionally, policymakers should consider integrating geospatial analysis to identify and target neighborhoods most affected by housing risks, ensuring that resources are directed to areas of greatest need. Investments in community-based initiatives, such as financial literacy programs and housing counseling, can further empower vulnerable populations and reduce the barriers contributing to housing insecurity. By adopting a data-driven and equity-focused framework, New York City can create a more inclusive and resilient housing environment for all its residents.

Housing Instability Analysis

Housing instability in New York City is deeply rooted in systemic challenges, where socioeconomic inequalities, racial disparities, and language barriers intersect to exacerbate housing risks. Building on earlier analyses that examined the interplay between public health indicators—such as uninsured rates, mortality, and vaccination coverage—and housing instability, this section focuses on how income inequality, racial demographics, and linguistic limitations contribute to housing insecurity. Through the use of visualizations, statistical testing, and geospatial analysis, this segment uncovers critical patterns and correlations that highlight the structural inequities shaping housing vulnerabilities. Addressing these multifaceted issues is essential to developing targeted interventions and integrated policy strategies that can enhance housing stability for New York City's most vulnerable communities.

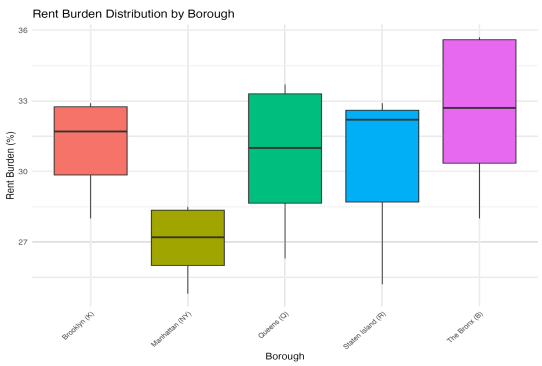
Methodology

To analyze disparities in eviction and foreclosure filings across NYC boroughs, we used a structured, data-driven approach combining exploratory data analysis (EDA), statistical visualization, and hypothesis testing. Data from the Eviction Lab was standardized for consistency across boroughs, with key variables including eviction filings, foreclosure filings, poverty rates, and rent burdens.

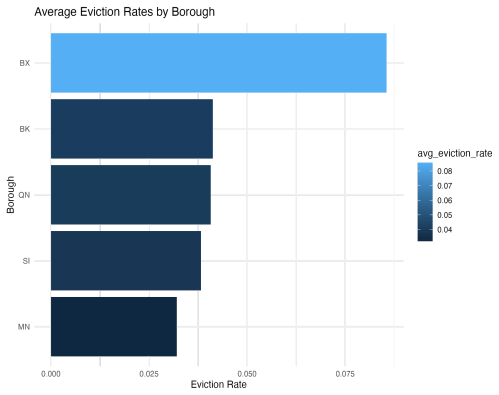
Visualization tools such as bar plots, scatterplots, and heatmaps revealed borough-specific patterns and trends. For statistical analysis, Welch's t-tests compared eviction filing rates across high- and low-rent burden areas, chi-square tests assessed borough-eviction risk relationships, and Spearman's correlation measured associations between rent burdens, poverty rates, and eviction risks. Temporal trends were analyzed with time-series visualizations to uncover systemic vulnerabilities.

Housing Instability Findings

Housing instability in New York City reflects deeply entrenched disparities, with eviction rates and rent burdens disproportionately impacting boroughs such as the Bronx and Brooklyn. The "Rent Burden Distribution by Borough" graph illustrates the Bronx's highest average rent burden (32.79%) compared to other boroughs, intensifying economic pressures for its predominantly low-income residents. Brooklyn, slightly lower at 31.22%, experiences substantial housing stress due to

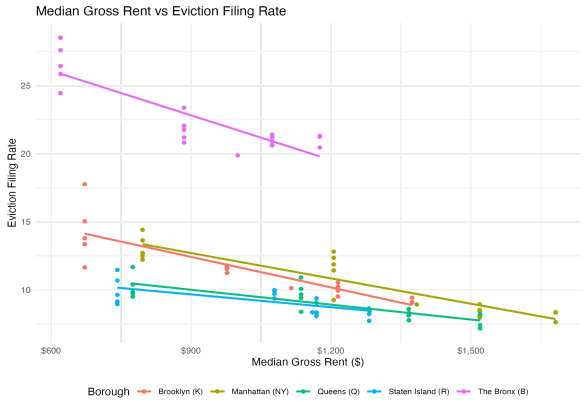


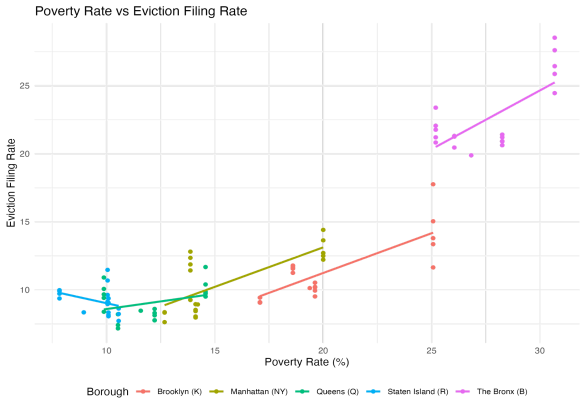
systemic challenges. Conversely, Manhattan, with a lower average rent burden (27.09%) but higher median rents ($1,265), faces affordability challenges for middle-income renters.



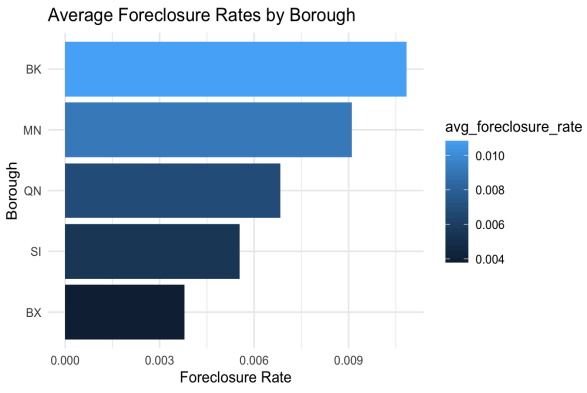
The "Average Eviction Filings by Borough" graph underscores the Bronx's vulnerability, revealing the highest eviction filings per capita. This correlates with its poverty rate of 27.66% and a high eviction filing rate averaging 22.63%, as shown in the "Poverty Rate vs Eviction Filing Rate" scatterplot. Brooklyn, with a poverty rate of 20.37% and an average eviction filing rate of 11.45%, also faces significant eviction risks. These findings illustrate the intersection of economic hardship and housing precarity, particularly in marginalized communities.

The "Median Gross Rent vs Eviction Filing Rate" scatterplot shows a negative correlation between median gross rent and eviction filing rates. Boroughs like Manhattan, with higher median rents, report lower eviction filing rates, reflecting greater financial stability among renters. Conversely, the Bronx and Brooklyn, with lower median rents, experience higher eviction rates, driven by tenant financial precarity.





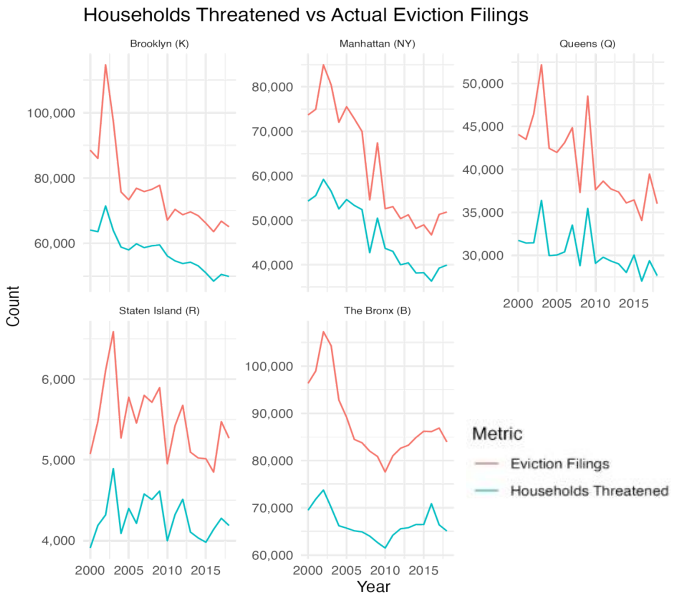
Brooklyn also leads in foreclosure risks, as shown in the "Average Foreclosure Filings by Borough" graph. This trend reflects challenges tied to rising property values, gentrification, and economic displacement of homeowners, diverging from the renter-centric risks prevalent in the Bronx. These findings reveal the need for targeted support for homeowners in Brooklyn, including foreclosure prevention programs and financial counseling.



Temporal Analysis and Health Implications

Expanding the scope of housing instability analysis to examine trends over time reveals how systemic vulnerabilities in eviction patterns have persisted across New York City boroughs. Temporal trends in eviction patterns, visualized in the "Households Threatened vs Actual Eviction Filings" graph, reveal the

persistence of systemic vulnerabilities. From 2000 to 2018, the Bronx consistently reported the highest numbers of threatened households, peaking at 70,000 annually, while actual filings exceeded 90,000 in the early 2000s. Brooklyn exhibited similar trends, with threatened households numbering around 60,000 and actual filings surpassing 100,000 at their peak in 2003. These gaps indicate systemic barriers, with many residents facing evictions without prior warnings.



Manhattan, in contrast, demonstrated smaller gaps between threatened households and actual filings, reflecting more predictable displacement trends. Queens showed moderate levels of both metrics, with occasional spikes indicating periods of vulnerability. Staten Island, with the lowest figures and gaps, displayed stronger resilience or fewer systemic pressures.

These temporal patterns highlight the structural drivers of housing precarity. High eviction rates and persistent gaps in boroughs like the Bronx and Brooklyn point to compounded socioeconomic vulnerabilities, including economic instability and systemic inequities. Statistical analyses, including chi-square tests, revealed significant associations between borough and eviction rate categories ($p < 0.05$), supporting these findings.

Housing Instability Conclusions and Policy Recommendations

Addressing New York City's housing instability requires a multi-faceted approach that targets both immediate risks and systemic drivers. Proactive strategies, such as enhanced legal aid and community-based housing support services, are crucial for reducing evictions and displacements. These measures address not only short-term vulnerabilities but also long-standing inequities, such as poverty and financial instability, which disproportionately impact boroughs like the Bronx and Brooklyn.

Tailored, data-driven interventions are essential to stabilizing housing in high-risk areas. In the Bronx, policy measures should focus on rent burden relief, affordable housing access, and enhanced tenant protections, while in Brooklyn, addressing foreclosure risks and offering homeowner support is critical. Integrating housing and public health data systems can further enable policymakers to proactively identify and assist at-risk populations, providing earlier and more effective interventions. By combining localized policies with broader structural reforms, these efforts can disrupt cycles of housing insecurity and foster lasting stability across New York City’s most vulnerable communities.

Next Phases of Research

To deepen our research, we will focus on understanding how public health metrics intersect with housing vulnerability. We will incorporate additional healthcare data, such as access to preventive care and mental health services, to gain a clearer picture of how medical challenges contribute to displacement risks. Environmental health factors, particularly in areas with high mortality rates and housing instability, will also be explored.

Our analysis has highlighted the need for a more detailed investigation into socioeconomic patterns, especially in areas where language barriers coincide with high uninsured rates. A deeper look at these intersections, particularly in boroughs like Queens with high limited English proficiency rates, will help us understand how linguistic isolation affects both healthcare access and housing stability.

The temporal patterns in our data indicate the importance of tracking long-term trends in both health outcomes and housing stability. Future research will explore how changes in healthcare access correlate with eviction patterns over time, especially in high-risk areas like the Bronx, where the gap between threatened and actual evictions remains significant.

Building on our current findings, we will develop comprehensive geospatial analyses to visualize the overlap between health disparities, socioeconomic vulnerabilities, and housing risks. These visualizations will help identify “hot spots” where multiple risk factors converge, enabling more targeted and effective interventions.

Overall Conclusion

Our analysis reveals that housing insecurity in New York City is driven by a complex interplay of public health disparities, socioeconomic inequities, and systemic barriers. The Bronx, with mortality rates 57% higher than Manhattan and uninsured rates of 7.5%, exemplifies how health vulnerabilities exacerbate housing risks. Similarly, areas with limited English proficiency rates above 19.2% experience heightened housing instability, highlighting how language barriers restrict access to essential services and support.

These challenges manifest differently across boroughs, with unique patterns of vulnerability emerging from our temporal analysis. The Bronx shows consistently high eviction rates and significant gaps between threatened and actual evictions, while Brooklyn faces particular challenges with foreclosure risks. Manhattan's relative stability in both health metrics and housing security underscores the role of healthcare access and economic resources in fostering community resilience.

The disparities uncovered in our analysis reflect deeply entrenched systemic inequities, which require comprehensive solutions. Programs must address not only immediate housing needs but also the underlying health and socioeconomic barriers. By recognizing and addressing these interconnected factors, policymakers can create more effective interventions that support both community health and housing stability, working toward a more equitable New York City where all residents have access to secure and healthy housing environments.

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