

Historical determinants of firearm violence:

Measuring the macro and micro level impact of structural racism on community firearm violence

Ariana Neusha Gobaud

Submitted in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy
under the Executive Committee
of the Graduate School of Arts and Sciences

COLUMBIA UNIVERSITY

2024

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Abstract

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Community firearm violence in the United States (US), defined as intentional fatal and nonfatal shootings that result from interpersonal violence, has a disproportionately negative impact on racialized and minoritized groups. Recent research indicates that areas with limited economic prospects, higher concentrations of poverty, and residential instability tend to experience increased firearm violence. These factors are commonly recognized as social determinants of health. It is hypothesized that these determinants are symptoms of deeper upstream factors, including structural racism and longstanding structural disinvestment. This dissertation aims to deepen the understanding of current trends in community firearm violence, especially in relation to the historical context of structural racism. This will be achieved through a systematic review of existing literature and comprehensive empirical research.

This dissertation is divided into five chapters, beginning with an introductory overview. The second chapter presents a systematic review of the literature, focusing on various methodologies for measuring structural racism and estimating its association with community firearm violence (**Aim 1**). Chapters 3 and 4 involve empirical analyses. In Chapter 3, I develop and apply a structural racism index to study its relationship with community firearm violence in U.S. cities (**Aim 2**). This investigation spans three distinct historical periods of structural racism, testing its long-term impact on the risk of community firearm violence. Chapter 4 examines the impact of

hot spot policing specifically through the use of stop, question, and frisk (SQF) on community firearm violence (**Aim 3**). It is posited that SQF perpetuates structural racism by disproportionately targeting minority communities, thereby contributing to the cyclical nature of violence within these neighborhoods. The aim is to determine if there is a measurable relationship between this single aspect of structural racism and the occurrence of community firearm violence in New York City. The final chapter, Chapter 5, synthesizes the research findings and situates them within the wider epidemiological discourse on firearm violence.

The results from **Aim 1** of this study highlight a range of methods used to measure structural racism, all consistently demonstrating a positive association between structural racism and the incidence of community firearm violence. The **Aim 2** findings demonstrate a statistically significant association between historical structural racism and increased incidence of community firearm violence in cities. Notably, the study identified significant associations between each of the three historical periods under study and a heightened risk of community firearm violence over time. Finally, **Aim 3** reveals that stop, question, and frisk practices are statistically significantly associated with an increase in community firearm violence in block groups in New York City, even after controlling for additional indicators of structural racism and spatial dependencies.

In conclusion, this dissertation demonstrates a consistent and significant relationship between historical structural racism and the incidence of community firearm violence. Structural racism has a long-standing and widespread influence on community firearm violence, evident across various cities and scales, from broad systems of inequality to individual neighborhoods. This

reality necessitates comprehensive, well-targeted interventions by policymakers and community leaders to tackle the deep-rooted causes of violence.

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Acknowledgments

First I would like to extend my deepest gratitude to my advisor and sponsor, Dr. Christopher Morrison, for his exceptional guidance throughout my doctoral journey at Columbia. His mentorship has been a perfect balance of encouragement and autonomy, enabling me to tackle the challenging inquiries posed in this dissertation. Dr. Morrison's influence has been instrumental in making my doctoral experience both rewarding and enriching.

I am deeply grateful to my entire committee, including Dr. Paris Adkins-Jackson, whose guidance encouraged me to delve deeply and think critically, enabling me to extend my understanding beyond scientific literature and grasp the complex dimensions of structural racism in this country. I am equally thankful to Dr. Charles Branas for his insightful and meaningful feedback, which has been instrumental to my work. A special word of thanks goes to Dr. Michael Kramer, who was my advisor during my master's studies at Emory; working with him has always been a delightful and enriching experience. Additionally, I would like to express my gratitude to Dr. Sara Jacoby, whose expertise not only contributed significantly to my dissertation but also provided a fresh and positive perspective on writing and research, enhancing the quality and depth of my work.

I would also like to thank the various lab groups I have had the privilege of being part of during my time at Columbia. The Geospatial and Applied Prevention Science lab has provided me with an invaluable platform for innovative thinking and practical application of research, enhancing my skills in spatial analysis and injury prevention strategies. A special thank you to Christina Mehranbod and Brady Bushover for serving as additional reviewers on my systematic review.

Additionally, the Marvin Grey Matter Family has been instrumental in fostering a collaborative and supportive environment, enriching my research experience with diverse perspectives and a strong sense of community. The insights and experiences gained from these groups have been fundamental to my academic and personal growth.

I am also thankful to the faculty and staff at Columbia Mailman for their contribution to my development as a more confident and insightful epidemiologist. Additionally, a thank you to the Columbia Center for Injury Science and Prevention and the Substance Abuse Epidemiology Training Program for their financial support during my time as a doctoral student, which has been essential to my academic journey.

Finally, I must express my heartfelt appreciation for my friends and family. The 2019 doctoral cohort has been an invaluable source of support during every phase of my doctoral training—from attending classes and preparing for the method exam to helping me stay focused on this dissertation. Above all, my deepest and warmest thanks go to my partner Shawn Gutman. His unwavering support for every facet of this program coupled with his patience and encouragement has been extraordinary and beyond compare.

Dedication

This dissertation is dedicated to the victims of firearm violence—those whose lives have been tragically altered or cut short by such acts. Their stories are at the heart of this research, serving as a constant reminder of the urgent need for understanding, change, and healing in our communities.

Chapter 1: Introduction

1.1 Specific Aims

Community firearm violence, defined as intentional fatal and nonfatal shootings that result from interpersonal violence,¹ is a leading cause of mortality in the United States (US).²⁻⁴ In 2020, a record high of 44,286 people were killed with a firearm.⁵ Geographic differences among all firearm deaths (i.e., suicide and homicide) exist based on the type of injury.³ Specifically, older men racialized as White^a and individuals living in rural areas are overrepresented among firearm suicide deaths while younger men racialized as Black and individuals in urban areas are overrepresented among firearm homicide deaths.^{6,7} The disproportionate exposure to firearm homicides among men racialized as Black adds to long-existing inequities in physical injury and long-term mental and physical health outcomes that have been heavily documented in the literature.⁸ Identifying conditions that contribute to community firearm violence specifically is essential to developing effective preventive interventions that reduce the absolute health burden of socio-demographic and geographically structured health inequities.

Given the geographic concentration of firearm incidents, significant research efforts have identified neighborhood-level factors that are associated with firearm violence, providing intervention points to decrease the incidence of firearm-related death.^{9,10} For example, violence is higher in communities where there are limited economic opportunities, where there are high

^a Recognizing that race is a social construct rather than a biological reality, this dissertation employs specific terminology. I will use terms such as “racialized as Black” or “racialized as White” to reflect the fluid and situational nature of racial identities, noting that these categories are the result of societal imposition, not intrinsic traits. This language aims to foster a nuanced and respectful discourse on race, acknowledging that while individuals are influenced by their racialization, it does not solely define them.

concentrations of poor and unemployed people, and where there is high residential instability.¹¹ In fact, Weisburd's law of crime concentrations finds that "for a defined measure of crime at a specific microgeographic unit, the concentration of crime will fall within a narrow bandwidth of percentages for a defined cumulative proportion of crime".^{12,13} While the focus on neighborhood-level factors associated with firearm death creates opportunities for intervention, efforts have been concentrated downstream. One example, hot spot policing, takes a microgeographic approach to address crime "hot spots" where law enforcement agencies focus resources in areas where crime is most likely to occur. Evidence suggests that hot spot policing practices reduce crime.¹⁴⁻¹⁶ Yet, some of these practices have been criticized for targeting young minorities and specific neighborhoods,¹⁷⁻¹⁹ thereby treating the *symptom* instead of targeting the upstream *causes* of crime concentration in specific areas.

It is crucial to recognize that the disproportionate burden of community firearm violence among men racialized as Black and the concentration of crime are not isolated phenomena. It is hypothesized that they are rather manifestations of the upstream effects of **structural racism**. Structural racism is defined as "the totality of ways in which societies foster racial discrimination, through mutually reinforcing inequitable systems of housing, education, employment, earnings, benefits, credit, media, health care, criminal justice that in turn reinforce discriminatory beliefs, values, and distribution of resources, which together affect the risk of adverse health outcomes".²⁰ This perspective shifts the focus from immediate neighborhood-level interventions to addressing the broader, systemic issues that underlie and perpetuate these patterns of violence and crime. Researchers have found strong positive associations between structural racism and firearm violence. However, research has often been limited to a single

aspect of this multifaceted issue (i.e., racial residential segregation²¹⁻²⁴ or economic inequality²⁵⁻²⁷). A knowledge gap exists regarding how structural racism is a product of mutually reinforcing disparities across various systems, each playing a role in perpetuating inequality. Moreover, the socio-historical context behind crime reduction due to hot spot policing might be linked to structural racism. It is important to investigate whether this connection extends to community firearm violence in cities.

The goal of this dissertation is to advance prior research by establishing the relationship between historical structural racism and the prevalence of community firearm violence in US cities. While community firearm violence does not only affect families racialized as Black, given the overrepresentation of men racialized as Black in community firearm violence incidents, focusing on Black-non-Black comparison emphasizes a major cause of injury disparities in the US. Characterizing the relationship between structural racism and community firearm violence may explain the macro-level environmental drivers that contribute to the substantial and inequitable problem, leading to policy intervention. This dissertation evaluates the effects of interconnected, unjust systems on community firearm violence, and isolates the unique impact of a single domain within the complex matrix of systems that contribute to structural racism on a smaller geographic scale.

Aim 1. To conduct a systematic review to identify different approaches to quantifying “structural racism” and its association with community firearm violence in the US.

Aim 2. (Macro-level) To examine the effect of historical structural racism on contemporary patterns of community firearm violence in US cities.

Aim 3. (Micro-level) To isolate the effect of a single domain of structural racism (i.e., criminal justice system) in New York City.

1.2 Theoretical framework

To understand the link between structural racism and community firearm violence, a comprehensive theoretical framework is essential. This framework structures ideas and clarifies the causal relationships. I employ multiple theories to shape this understanding. The **social-ecological model** shows that community firearm violence and structural racism are influenced by multi-layered processes.^{28,29} Although individual behavior contributes to community firearm violence, it is also greatly shaped by complex social and environmental factors, which offer intervention points at various organizational levels. Complementing this model, **ecosocial theory** provides a crucial perspective on how societal and historical contexts of inequality and discrimination interact with these multi-layered processes, deepening our understanding of how structural racism operates and influences health outcomes.³⁰⁻³² The **theory of fundamental causes** further positions structural racism as a primary driver of community firearm violence, affecting key levels identified in the social-ecological model.³³⁻³⁵ In addition, theories of crime, specifically **social disorganization** and **collective efficacy**, are crucial for this framework. Social disorganization theory suggests that high crime rates in certain communities are a result of the breakdown in social institutions, such as family, school, and community cohesion.³⁶ This breakdown leads to an inability to enforce norms and control criminal behavior. On the other

hand, collective efficacy theory focuses on the positive aspects of community organization, positing that strong social cohesion and shared expectations for social control in a community reduce crime rates.^{11,37} By employing these theories collectively, we gain a deeper understanding of how structural factors and community dynamics contribute to patterns of interpersonal violence, thus shedding light on the intricate connection between structural racism and community firearm violence.

1.2.1 Social-ecological model

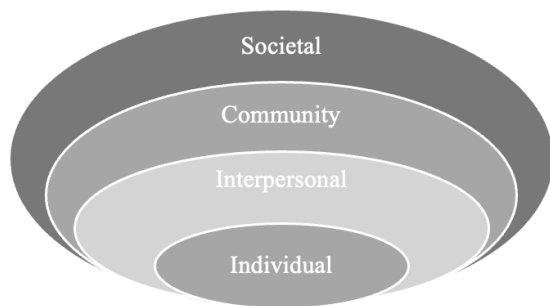


Figure 1.1. Social ecological model

The social-ecological model, originally developed in the field of developmental psychology, has since been adapted within the social sciences to address a wide range of issues, including health outcomes like community firearm violence.³⁸ The model emphasizes that

risk factors for such outcomes operate at multiple levels of organization. For the purposes of this dissertation the following groupings are relevant: individual, interpersonal, community, and societal (**Figure 1.1**). These levels of organization depict the complex interplay between individual behaviors and broader environmental factors in shaping health and well-being. The World Health Organization proposed the use of the social-ecological model by public health scholars and practitioners for violence prevention in its 2002 World Report on Violence and Health.^{39,40} The social-ecological model has been instrumental in moving the field of violence prevention forward because violence cannot be attributed to a single factor but is a result of a constellation of factors that function across multiple levels of organization.

The model can also be effectively applied to conceptualize how structural racism and its interactions across various levels of organization contribute to the prevalence of community firearm violence. A critical examination of existing research reveals a predominant focus on individual self-identified race, rather than racism, as a risk factor in the context of community firearm violence. It is essential to distinguish between race as a socially constructed classification and racism as a systemic force. Race, as understood in most of these studies, is a classification based on phenotype (i.e., observable traits) that has historically been used to govern the distribution of risk and opportunities.⁴¹⁻⁴⁴ This system of classification was created and maintained primarily to uphold social and political power hierarchies.

However, scientific evidence from a wide array of disciplines, including genetics, genomics, anthropology, sociology, psychology, and public health and epidemiology, compellingly challenges the notion of race as a biological construct.^{41,42} Instead, race must be recognized as a societally imposed identity that brings with it exposure to varying social constraints and privileges associated with that identity.^{45,46} This clarification is crucial because it shifts the focus from race as a static category to racism as a dynamic process that perpetuates inequality and affects health outcomes. Racism, not race, is the operative factor in the disproportionate rates of community firearm violence in certain communities. By acknowledging this distinction, researchers and policymakers can better understand the complex interplay of factors contributing to community firearm violence. It enables a more nuanced analysis that goes beyond individual-level factors to include the systemic, community, and societal forces at play. This perspective is vital for developing effective interventions and policies that address the root causes of

community firearm violence, particularly in racially marginalized communities. The model thus serves not only as a tool for understanding the issue but also as a framework for action to mitigate the adverse effects of structural racism on community health and safety.

Understanding the nuanced role of racism in community firearm violence, distinct from race, necessitates examining its impact across the social-ecological model. This exploration uncovers racism's multifaceted nature, spanning personal beliefs to systemic policies, and their influence on firearm violence. At the individual level, racism manifests as prejudiced beliefs or internalized negative attitudes towards a specific racialized group, which can motivate acts of violence. Relationship-level racism involves prejudiced interactions between individuals, such as racially charged disputes escalating to violence. Institutional racism at the community level involves policies that disadvantage people of color like firearm laws leading to the disproportionate incarceration of men racialized as Black. Lastly, structural racism at the societal level perpetuates inequalities in systems such as housing, education, and employment, all risk factors for firearm violence. This dissertation focuses on structural racism to emphasize the systemic inequities that fuel community firearm violence.

1.2.2 Ecosocial theory

After examining the various levels at which structural racism impacts community firearm violence through the lens of the social-ecological model, it becomes apparent that a more comprehensive theoretical approach is necessary to fully understand and address the root causes of these issues. Ecosocial theory builds upon the foundation laid by the social-ecological model by explicitly incorporating the concept of embodiment—how social experiences and conditions

get under the skin and affect health outcomes.³⁰⁻³² According to ecosocial theory, health is not just determined by factors at different organizational levels, but also by historical and current social inequalities, particularly those related to race, class, and gender.³⁰⁻³²

The theory argues that societal structures and the unequal distribution of power and resources shape individual and community health outcomes. In the context of community firearm violence, this means that the conditions leading to such violence are not only the result of individual behaviors or community-level factors but are deeply rooted in historical and systemic inequalities.^{23,34,47} By applying ecosocial theory, we can see that structural racism operates not just at a single level but interacts across all levels of organization, from individual internalized racism to institutional and structural forms of racism. This interaction perpetuates a cycle where disadvantaged racial groups are more likely to experience the adverse effects of community firearm violence. In addition, ecosocial theory emphasizes the need for historical context in understanding health disparities.³⁰⁻³² In the case of community firearm violence, this means recognizing how historical policies and systemic discrimination have shaped current patterns of violence in communities racialized as Black.

Integrating ecosocial theory provides a comprehensive and historically grounded understanding of how structural racism influences community firearm violence. This approach not only helps in identifying the multi-level factors contributing to community firearm violence but also emphasizes the importance of addressing systemic inequalities as a part of effective violence prevention strategies. Furthermore, ecosocial theory, taken with the social-ecological model,

provides a more robust framework for developing interventions that address the root causes of community firearm violence in racially marginalized communities.

1.2.3 Fundamental causes theory

The fundamental causes theory suggests that unequal resource distribution impacts health outcomes.⁴⁸ This includes community firearm violence, via various pathways at multiple levels of organization. Its application in firearm violence research is limited but crucial for understanding the disproportionate impact on men racialized as Black. The theory holds that a fundamental cause has four key components: 1) the cause influences multiple disease outcomes; 2) the cause affects disease outcomes through multiple risk factors; 3) the cause involves access to resources that can assist in avoiding health risks; and 4) the association between a fundamental cause and health is reproducible over time.⁴⁹ Furthermore, not targeting fundamental causes results in preserving the systems and structures that perpetuate health problems and disparities.⁵⁰ Building on these insights, ecosocial theory provides a valuable framework for understanding how social conditions and inequalities, especially those related to race and racism, are embodied and manifest in health disparities like community firearm violence.³⁰⁻³² The social-ecological model and fundamental causes theory, together with the ecosocial theory, show how intertwined social and physical conditions can worsen discriminatory practices.^{26,51,52} These practices sustain structural racism, a key factor in community firearm violence. By integrating these theories, it becomes clear that prevention measures must address this core issue.⁵³

1.2.4 Social disorganization theory and collective efficacy

Social disorganization theory, aligned with the multi-level approach of the social-ecological model, elucidates patterns of violence through community characteristics rather than individual attributes. Despite the overall decline in U.S. violent crime since the early 1990s,⁵² this decrease has been uneven, with certain neighborhoods continuing to face high crime rates.^{52,54,55} These areas are often marked by conditions indicative of social disorganization, like economic hardship, unstable residency, and diverse ethnic composition. The theory, which originated in the early 1920s at the University of Chicago by Robert E. Park and Ernest W. Burgess, emphasizes the predominance of community factors over individual ones in predicting criminal behavior.⁵⁶ Shaw and McKay (1942) further developed the theory to argue that weakened social bonds and diminished social control within a community are key drivers of increased criminal activity.⁵⁷ Strong connections and frequent interactions between neighbors, such as residents keeping an eye on what is happening in the community,⁵⁸ are effective means of maintaining high levels of social control and result in less neighborhood crime.

While some studies support social disorganization theory, evidence exists challenging the assertion that strong social ties are necessary for crime prevention. Research has failed to provide consistent evidence that dense social networks are associated with decreased violence at the neighborhood-level.^{59,60} As a result, Sampson and colleagues (1997) expanded on social disorganization theory and introduced the theory of collective efficacy. Collective efficacy is comprised of two subscales: social cohesion (i.e., the bonds among community members) and informal social control (i.e., the capacity of a community to regulate its own members and realize collective goals through informal instead of formal mechanisms).^{61,62} The emphasis is shifted

away from dense social networks and instead, more frequent interacting acquaintanceships are suggested to act as informal control of violence.⁶² Jointly these two theories—social disorganization and collective efficacy—highlight the importance of understanding how the spatial concentration of violence, including community firearm violence, might impact inequities in the risk from the individual level to the societal level.

1.3 Structural racism

Having developed a comprehensive theoretical framework to understand how structural racism drives community firearm violence, we must now tackle the empirical challenge: how to measure structural racism. The profound impact of structural racism on violence within communities racialized as Black has been vividly depicted through historical and contemporary narratives. For instance, Tupac Shakur's "Changes" offers a poignant musical expression, while television series like "The Wire" and films such as "New Jack City" provide compelling visual storytelling that illustrates these effects. The difficulty lies in translating these qualitative experiences into quantitative data. To do this we need to identify measurable indicators that can operationalize the concept of structural racism for statistical analysis, despite its inherent complexity as a latent construct. While direct measurement is elusive, proxy variables that reflect discriminatory practices and racial disparities can be used to create a composite index of structural racism. This index is crucial for empirically validating the relationship between structural racism and violence. In scholarly research, our definitions and applications of structural racism must account for the myriad of interconnected, inequitable systems that perpetuate its influence across societal levels.

1.3.1 Measurement of structural racism

Many measures of structural racism exist. In 2018, a systematic review of methods used to quantify exposure to structural racism was conducted.⁶³ Authors used the search terms (institutional racism, institutionalized racism, structural racism, systemic racism) with a publication date of January 1, 2007, to December 31, 2017, and found a range of measures across the domains of housing and residential patterns, social institutions, political participation, criminal justice, socioeconomic status, workplace environments, and immigration.⁶³ While some studies quantified structural racism through the existence of racist policies, such as redlining (i.e., a racialized discriminatory mortgage lending policy) and racial profiling by immigration officials, others estimated structural racism by measuring the racial gap in observed outcomes such as incarceration rates, higher education attainment, and employment.⁶³ Notably, the review demonstrated that there may not be a “gold standard” measure of structural racism. Measurement of the construct depends on spatiotemporal scale, historical context, and understanding of the underlying mechanism between structural racism and the specific outcome in question.^{64,65}

Recent literature has begun using psychometric techniques like factor analysis to measure a latent construct such as structural racism. The first was a study conducted by Dougherty and colleagues in 2020. Researchers used a factor score from a confirmatory factor analysis integrating several existing continuous-scale measures of structural racism across five domains as an explanatory variable in regression analyses.⁶⁶ The five domains included: housing, education, employment, health care, and criminal justice. Calculated at the county level across 1,563 counties, this measure was used to analyze how racist policies, particularly those at the county level, disproportionately disadvantage racially minoritized communities compared to

their peers racialized as White. The authors found their county-level measure of structural racism was associated with lower body mass index.⁶⁶ Notably, a qualitative interaction was present. Structural racism was associated with a lower BMI in individuals racialized as White, while it was associated with a higher BMI in individuals racialized as Black.⁶⁶

As approaches to measuring structural racism continue to evolve, it is important to think critically about how to build upon prior research. The historical context and the evolution of policies play a pivotal role in comprehending the trajectory of structural racism. To achieve a thorough understanding of its long-term effects, future research should integrate this historical perspective, thereby acknowledging and analyzing the temporal progression of these societal dynamics.

1.4 Structural racism and community firearm violence

While significant challenges exist in quantifying structural racism, researchers have attempted to establish connections between it and firearm violence. However, these associations are subject to limitations. The complexity of structural racism makes it difficult to isolate and measure its direct impact on firearm-related incidents. This section aims to explore these limitations and the implications they hold for understanding the relationship between structural racism and firearm violence.

1.4.1 Current research

The firearm violence literature has found positive associations with several domains of structural racism. The most common domains represented include the housing and economic systems.

These domains have been operationalized via racial residential segregation^{22,24} and income inequality^{27,61} respectively. A variety of physical and social environmental conditions have also been found to be associated with the incidence of community firearm violence in small areas.^{67,68} Although each of these measures is an independently important factor in the structural racism construct, a model relying on any one of these as the lone indicator of structural racism would be incomplete. The various domains of structural racism may share the same pathway or interact with one another to generate joint effects. The way structural racism is measured must reflect this relationship.

Research on structural racism and community firearm violence must consider the study setting. Community firearm violence impacts all communities in the US, though through different mechanisms across the urban-rural continuum.⁶⁹ Firearm suicide is more prevalent in the most rural counties while firearm homicide is more prevalent in urban counties. While firearm mortality is a national issue, the disproportionate risk among Americans racialized as Black is most prevalent in cities where this population makes up 68% of homicide victims.⁷⁰ This could be related to the fact that adults racialized as Black are more likely to live in urban areas than rural areas.⁷¹ To fully understand the inequities in risk of community firearm violence among Americans racialized as Black, a focus on urban areas (i.e., cities) is needed.

1.4.2 Challenges in current research

One challenge with studying community firearm violence is spatial scale.⁷² The two major national homicide reporting systems are the Federal Bureau of Investigation's Uniform Crime Reporting (UCR) Program and the Center for Disease Control and Prevention's National Vital

Death Reporting System (NVDRS). Publicly available data from the UCR are reported to the Department of Justice and aggregated to the county level,⁷³ yet due to aggregation bias, these nationally available county-aggregated crime data may be too spatially coarse to be meaningful when studying the population impact of neighborhood-level crime. The UCR also has large reporting gaps in terms of the percentage of jurisdictions that report data and the availability of race/ethnicity information. The smallest geographic unit captured by the NVDRS is the ZIP code which similarly may not represent a spatial scale small enough to be meaningful in understanding neighborhood-level crime. Additionally, both the UCR and NVDRS have been critiqued for severely underreporting the number of nonfatal injuries from a firearm.⁷⁴

One solution is using local police department data to count the number of firearm assaults in a single city. Police department data has been shown to capture approximately twice the number of firearm-injured individuals compared to hospital-based registries in the same city.⁷⁵ However studies utilizing this data are often limited to only researching cities that have a public registry of shooting incidents. To acquire subcounty estimates, researchers must negotiate data sharing with a complex patchwork of law enforcement agencies serving an area. Such efforts to produce a consistent, geographically extensive, and widespread data collection (e.g., for a whole state or the country at large) are often impractical. Due to this limitation, studies are often restricted to analyses of an individual or a select few cities yielding results that are not generalizable.^{34,76} This is an important limitation as public health leaders look to identify relevant interventions to reduce community firearm violence.

Another challenge specific to studying the relationship between structural racism and firearm violence is operationalizing the temporal aspect of structural racism. Structural racism is subject to change over time. Its evolution reflects shifts in social norms, policies, and practices, which can either mitigate or exacerbate racial disparities over different historical time periods. This characteristic highlights the necessity of robust analyses utilizing longitudinal data to capture the multifaceted impacts of structural racism over time. While research has identified various pathways linking racism to adverse health outcomes—including physical, social, and economic factors^{64,77-79}—these effects often occur simultaneously and accumulate across generations. By conducting longitudinal studies of neighborhoods or metropolitan areas, researchers can gain deeper insights into how the progression of structural racism influences community firearm violence, thereby addressing a crucial gap in our understanding of these complex relationships.

1.5 Conclusion

As community firearm violence continues to be an endemic problem in the US⁸⁰ with a disproportionate burden among men racialized as Black in cities, the impact of structural racism must be understood. Despite research examining the increased risk of firearm injury and death in this group, the role of structural racism warrants further examination. This dissertation aims to advance this scholarship by addressing many of the gaps outlined above. Chapter 2 of this dissertation presents the results of a systematic review that examines the state of the evidence regarding different approaches to quantifying “structural racism” and its association with community firearm violence in the US (**Aim 1**). Recognizing the lack of explicit testing of the longitudinal association between structural racism and community firearm violence nationally, Chapter 3 reports the results of tests examining the effect of historical structural racism on

contemporary patterns of community firearm violence in US cities across 3 historical time periods (**Aim 2**). Chapter 4 builds on these findings (and the findings from Chapter 2), by isolating the unique impact of a single domain within the complex matrix of systems that contribute to structural racism on a smaller geographic scale (**Aim 3**). This dissertation concludes with Chapter 5, which summarizes the results of the chapters and discusses the implications of these findings for future work.

Chapter 2: Operationalizing structural racism and its association with community firearm violence: A systematic review

2.1 Introduction

The profound impact of structural racism in the United States (US) is such that racialized and minoritized groups experience poorer health across outcomes²⁰ pinpointing structural racism as a fundamental cause of racial health inequities.^{81–83} Structural racism is “the totality of ways in which societies foster racial discrimination through mutually reinforcing inequitable systems that together affect the risk of adverse health outcomes”.²⁰ It is fundamentally a confluence of oppressive interconnected systems (referred to as domains e.g., housing, healthcare, criminal justice, education, etc.²⁰) that co-occur across time. In quantifying structural racism scientifically, we seek to not only measure the direct impacts of each domain but also understand the cumulative effects of these systems in which (or through which) these domains operate.⁸⁴ Studying structural racism requires a comprehensive approach that accounts for the historical roots of these inequities, the intersectionality of various forms of discrimination, and the pervasive, often subtle ways in which structural racism infiltrates societal structures.

Several theories offer valuable insights for understanding and measuring structural racism. The fundamental causes theory suggests that structural racism shapes a myriad of risk factors and resources, influencing diverse health outcomes over time, including community firearm violence.^{23,47,85} Ecosocial theory explores the interaction between social systems and ecological contexts across the life course, highlighting both the temporal and spatial dimensions of structural racism.^{30–32} It conceptualizes structural racism as a historical continuum, deeply embedded within societal layers, affecting health through various temporal pathways. The social

ecological model broadens this perspective by situating structural racism within a multi-level framework, ranging from individual experiences to broader community and societal influences. It emphasizes how historical policies and societal norms intertwine with individual and community factors, collectively impacting health outcomes. Finally, critical race theory provides a crucial framework for uncovering the historical aspects of structural racism.^{86,87} This academic and legal theory expands the understanding of racism beyond individual bias or prejudice, portraying it as an entrenched, enduring component of societal structures and institutions over time.⁸⁸ This theory strengthens our understanding of the ongoing effects and perpetuation of structural racism, thereby highlighting deep-seated systemic issues that continue to foster racial inequities. Together these theories suggest the importance of not only considering historical, societal, and ecological aspects of structural racism, but also temporal characteristics when understanding and measuring the construct.

Over time, studying structural racism has evolved notably. Initially, it was included within the paradigm of social determinants of health, emphasizing multiple axes of power and the impact on racialized groups.⁸⁹ This foundation set the stage for more focused discussions. The earliest instance of the specific term "structural racism" appearing in a PubMed article dates back to 2006.⁹⁰ However, it was not until more recently that there was an explicit emphasis on researching and funding studies specifically centered on structural racism and health. This research transition and focus is highlighted by the National Institutes for Health (NIH) call for proposals directly related to structural racism and health for the first time in 2021, marking a significant milestone in the academic and scientific exploration of this issue.^{90,91} Around that same time, the Robert Wood Johnson Foundation (Princeton, NJ) issued multiple requests for

community-focused research on structural racism and health, while the Centers for Disease Control and Prevention's (CDC) Director recognized racism as a significant public health threat.^{90,92} These developments collectively represent a pivotal shift towards recognizing and funding structural racism as a critical issue in public health.

There has also been a significant shift in the evolution of firearm violence research from a focus primarily on individual behavior and crime statistics to a more nuanced understanding of the interplay among social determinants and systemic issues like structural racism. Initially constrained by the Dickey Amendment of 1996, which effectively halted federal funding for research perceived as promoting gun control, the field faced significant challenges in advancing comprehensive studies.⁹³ However, over time, especially following the amendment's reinterpretation in 2018, there has been a gradual yet profound transformation in the approach to firearm violence research.⁹³ Scholars are collectively acknowledging the vital importance of factors like socioeconomic status, systemic inequalities, and racial disparities in influencing firearm-related incidents.^{67,68,94-96} This broader perspective, aligning with the evolving focus in public health research, highlights the complex and multi-layered nature of firearm violence, moving beyond individual behavior to a more holistic understanding of the issue in the context of structural determinants and societal dynamics.

Given the increase in research on both the topics of structural racism and firearm violence, a systematic review of the intersection of the two becomes not only relevant but necessary. This chapter describes a systematic review that examines and synthesizes firearm violence literature from 1990 to June 2023 to identify different approaches to measuring structural racism and

estimating its association with community firearm violence in the US. This review focuses on domains, statistical methodologies, and geographical areas employed to identify gaps in the literature.

2.2 Methods

2.2.1 Search strategy

I conducted a search for literature in databases with broad coverage across various scholarly disciplines like PubMed, Scopus, and Web of Science to gather relevant articles. The selection of search terms was deliberately all-encompassing to capture the evolution in terminology on structural racism over time. The search included titles and abstracts using search terms outlined in **Table 2.1**. "Racial discrimination," "racism," and "race" were included to encompass direct references to racial issues. "Social determinants of health" was selected for its wider scope in public health contexts. Terms like "segregation," "racial disparity," and "racial inequality" target specific manifestations of structural racism. "Systemic racism," "structural racism," "institutionalized racism," and "institutional racism" explicitly address the ingrained and pervasive aspects of the issue within societal structures. Other terms considered but ultimately not included were more specific to particular disciplines or less prevalent in the literature, such as "racial bias," "racialized social systems," or "ethnic disparities," to maintain focus on the structural component of racism and its impact on community firearm violence. Therefore, creating a list of search terms that capture the shift in language related to the quantification of structural racism is crucial for this research.⁷⁷ This approach ensures a comprehensive understanding of the topic and reflects its historical context and interdisciplinary nature.

To capture articles at the intersection of structural racism and community firearm violence, I selected search terms for their relevance and specificity to intentional interpersonal shootings as the outcome. "Violence" captures a broad range of aggressive behaviors, "homicide" specifies fatal consequences, and "crime" includes illegal activities, ensuring a comprehensive collection of firearm-related occurrences. Using these terms in tandem with "gun" or "firearm" narrows the focus to events explicitly involving firearms, whether as tools in violent acts or as factors in criminal incidents. Other terms considered but not included, such as "assault," "shooting," "armed conflict," or "weapon-related violence," could have introduced articles beyond the scope of community firearm violence, potentially diluting the focus on structural racism's influence on community firearm outcomes.

Table 2.1. Search term algorithm used to identify articles in PubMed, Scopus, and Web of Science

<p>“racial discrimination” OR racism OR race OR “social determinants of health” OR segregation OR “racial disparity” OR “racial inequality” OR “systemic racism” OR “structural racism” OR “institutionalized racism” OR “institutional racism”</p>
<p>AND</p>
<p>(violence OR homicide OR crime) AND (gun OR firearm)</p>

2.2.2 Inclusion and exclusion criteria

Eligible articles were peer-reviewed, published in English, and dated from January 1, 1990, to June 30, 2023. The choice of 1990 as a starting point is significant because it marks a period of heightened academic interest and policy changes in public health and firearm violence.^{97,98}

Articles were not included for further review if they did not operationalize structural racism; were non-original research articles such as reviews, meta-analyses, and editorials; and/or the primary outcome was not a community firearm violence incident. The initial screening of identified articles was conducted based on titles and abstracts, with a dual screening by two

collaborators (CAM and BB) of 20% of these to verify assessment reliability.⁹⁹ Using Covidence (Veritas Health Innovation Ltd; Melbourne, Australia), entries were sorted by author and publication year. I screened the first 172 titles and abstracts while the two collaborators independently screened 86. We met to discuss discrepancies. Dual review can help reduce the potential for random errors and bias. Instead of a 100 percent dual review, a reasonable alternative is to conduct a dual review on a small percentage of the citations, ensuring the reliability of assessments before going on to have the remainder of the citations assessed by a single reviewer. McDonagh and colleagues have suggested that a dual review of 10 to 20 percent of the studies is sufficient.⁹⁹ I then reviewed the titles and abstracts of the remaining articles for final inclusion. Articles that were included based on title and abstract screening, I independently reviewed for full-text inclusion. During this phase, articles were included if they did not meet the exclusion criteria described above.

2.2.3 Data extraction

Specific data elements extracted from each of the articles included the title, authors, publication year, study aim, design (e.g., cohort, case-control), unit of analysis (e.g., individual, ecological), exposure, outcome (e.g., fatal, nonfatal), covariates, data source, statistical analysis (e.g. logistic regression, Poisson regression), definition of structural racism, domain(s) of structural racism (e.g., housing, education, economics, health care, information systems, criminal justice, other), data reduction method (e.g., individual variables, composite/index measures, or latent variables), type of measure of association (e.g., odds ratio, risk difference), direction of effect (harmful, protective, null), statistical significance, and main finding. The categories for the domains of structural racism were set a priori, based on a consolidation of the systems outlined in Bailey et

al.'s definition of structural racism, while also allowing for the emergence of additional thematic areas.²⁰ Data extraction was conducted through a dual review process. Entries were again sorted by author and publication year in Covidence. I extracted the first 16 titles and abstracts while two collaborators (CAM and BB) independently extracted 8. We met to discuss discrepancies in batches of 4 articles and continued this process until we reached 95% agreement. The process of domain categorization was dynamic and collaborative, involving iterative discussions. For example, we categorized studies as operationalizing the housing domain if variables like residential segregation, homeownership rate disparities, and affordable housing access were included.

2.3 Results

Figure 2.1 displays the article selection process, illustrating the number of articles identified, excluded, and ultimately included in the final review. The initial literature search yielded 1,421 articles, out of which 565 were duplicates, resulting in 856 unique titles. The title and abstract review, which had an interrater reliability agreement of 85%, yielded 57 articles for further assessment. Their full texts were examined for suitability of inclusion in the review.

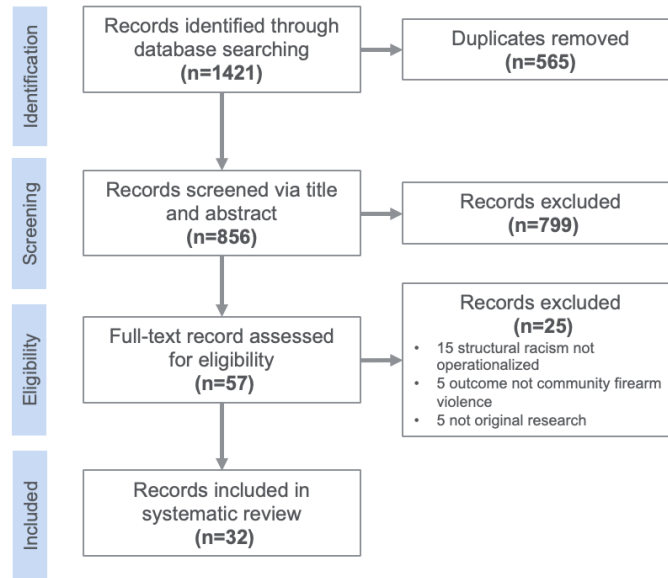


Figure 2.1. Flowchart illustrating included and excluded articles from the literature search

During this process, 25 articles were excluded for specific reasons: 15 of them did not operationalize structural racism, 5 were not original research, and 5 did not focus on community firearm violence as the primary outcome. Ultimately, a total of 32 studies met the inclusion criteria and were included in the review.

2.3.1 Sample characteristics

Publication of articles ranged from 2001 to 2023. Overall, among the studies reviewed, 15 (47%) focused on fatal and nonfatal community firearm violence incidents, 16 (50%) specifically examined fatal community firearm violence incidents, one (3%) study concentrated on nonfatal community firearm violence incidents, and one (3%) study analyzed mass shootings specifically. Data sources included police records, hospital/emergency room data, the Gun Violence Archive (an independent data collection and research group gathering daily information on firearm

violence incidents from public records¹⁰⁰), and national databases (i.e., Federal Bureau of Investigation's Uniform Crime Report, CDC's National Violence Death Reporting System, etc.). Domains of structural racism represented were the housing, economic, criminal justice, education, and health care systems. No additional thematic areas emerged. Within these domains, only singular historical time periods of structural racism were ever captured. No study clearly outlined measuring structural racism as it changes over time.

Fourteen (44%) of the included studies defined structural racism. However, definitions varied widely. Four (29%) studies quoted the definition by Bailey et al.²⁰, and two (14%) cited the World Health Organization, while the remaining (57%) studies presented unique definitions. Despite this heterogeneity, some key commonalities emerged. These include the systemic and institutional nature of structural racism, the unequal access to resources and opportunities based on racialized groups, and the connection between structural racism and the social determinants of health. Moreover, the definitions consistently emphasized the historical persistence of these inequities and their manifestation across interconnected structural systems.

The majority of included studies were ecological (n=27, 84%) utilizing various geographic or administrative units for analysis to investigate the impact of broader structural systems on community firearm violence. These included different geographic or administrative entities such as census block groups, census blocks, cities, counties, ZIP codes, and states. For example, Jacoby et al.³⁴ sought to explore the association between historical redlining practices (i.e., a racialized discriminatory mortgage lending policy) and the prevalence of modern firearm violence in census tracts in Philadelphia, Pennsylvania. Jacoby et al. observed that firearm injury

rates are highest in census tracts that were historically red-zoned after adjusting for socio-demographic factors at the time the map was created. A similar study conducted in Louisville, Kentucky by Bennis et al.¹⁰¹ explored the association between historical redlining practices and the prevalence of modern firearm violence in census block groups. They similarly found a significant association between neighborhoods redlined in the 1930s and firearm violence today.

Of the ecological studies included, eight (30%) were multi-level incorporating data at multiple units of analysis nested within each other to understand how structural racism at different levels interacts with and influences community firearm violence. One such article by Poulson et al.¹⁰² sought to outline the mediating neighborhood-level sociodemographic factors that contribute to higher levels of firearm violence in neighborhoods that experienced historic redlining in Boston, MA. The authors examined shooting rates per census block and then linked blocks to census tract sociodemographic data. They observed that redlining contributes to increased rates of firearm violence by altering neighborhood dynamics. Specifically, by limiting access to homeownership, exacerbating poverty, hindering educational achievements, and reinforcing racial residential segregation.

In the sections that follow, I categorize articles into two approaches to measuring structural racism: single domains and multiple domains (**Table 2.2**).

Table 2.2. Summary of included articles identified from the literature search, quantifying structural racism and its association with community firearm violence

Reference	Study design	Unit of analysis	Scale	Domain(s)	Approach¹	Outcome
Ali 2022 ²⁵	Cross sectional	Individual	NA	Economic	1	All shootings
Benns 2020 ¹⁰¹	Cross sectional	Ecological	Census block group	Housing	1	All shootings
Conrick 2022 ¹⁰³	Cross sectional	Ecological	State	Housing Economic Criminal Justice Education	2	Fatal shootings
Dalve 2021 ²⁶	Cross sectional	Ecological	Census tract	Economic	1	All shootings
Harfouche 2023 ¹⁰⁴	Cohort	Individual	NA	Housing Economic Education	2	All shootings
Houghton 2021 ¹⁰⁵	Cross sectional	Ecological	Metropolitan Statistical Area (MSA)	Housing Economic Criminal Justice Education	2	Fatal shootings
Jacoby 2018 ³⁴	Cross sectional	Ecological	Census tract	Housing	1	All shootings
Jay 2022 ¹⁰⁶	Cross sectional	Ecological	Census tract	Housing Economic	2	All shootings
Johnson 2021 ^{107(p202)}	Cross sectional	Ecological	County	Housing Economic Criminal Justice Education	2	All shootings
Johnson 2022 ^{108(p202)}	Cross sectional	Ecological	Census tract	Housing Economic Criminal Justice Education	2	All shootings

Kim 2019 ¹⁰⁹	Cross sectional	Ecological	Census tract; County; State; Other (Commuting Zone)	Housing Economic Criminal Justice Education	2	Fatal shootings
Knopov 2019 ²²	Panel analysis	Ecological	Census block; State	Housing	1	Fatal shootings
Kravitz-Wirtz 2022 ¹¹⁰	Cohort	Individual	NA	Housing Economic Education	2	Fatal shootings
Krzyzaniak 2023 ¹¹¹	Interrupted time series	Individual	NA	Housing Economic Education	2	All shootings
Maher 2022 ¹¹²	Cross sectional	Ecological	Census tract	Housing Economic	2	Mass shootings
Mehranbod 2022 ²³	Cross sectional	Ecological	City; ZIP code	Housing	1	Fatal shootings
Mesic 2018 ¹¹³	Cross sectional	Ecological	Census block; State	Housing Economic Criminal Justice Education	2	Fatal shootings
Ousey 2001 ¹¹⁴	Cross sectional	Ecological	City	Housing Economic Criminal Justice Education	2	Fatal shootings
Poulson 2021 ¹⁰²	Cross sectional	Ecological	Census block; Census tract	Housing Economic	2	All shootings
Poulson 2023 ¹¹⁵	Cross sectional	Ecological	Census block; Census tract	Housing Economic	2	All shootings

Poulson 2023 ¹¹⁶	Cross sectional	Ecological	Census block	Housing	1	All shootings
Rowhani-Rahbar 2019 ¹¹⁷	Cohort	Ecological	County	Economic	1	Fatal shootings
Salmon 2022 ¹¹⁸	Cross sectional	Ecological	Census tract	Housing Economic Healthcare Education	2	Fatal shootings
Schleimer 2022 ¹¹⁹	Cross sectional	Ecological	ZIP code	Housing Economic	2	All shootings
Siegel 2019 ²⁴	Cross sectional	Ecological	City	Housing	1	Fatal shootings
Siegel 2021 ¹²⁰	Cross sectional	Ecological	Census tract; City; State	Housing Economic	2	Fatal shootings
Siegel 2022 ⁸⁵	Cross sectional	Ecological	County	Housing Economic Criminal Justice Education	2	Fatal shootings
Siegel 2023 ¹²¹	Cross sectional	Ecological	State	Housing Economic Criminal Justice Education	2	Fatal shootings
Siegel 2023 ⁴⁷	Cross sectional	Ecological	City	Housing Economic Criminal Justice Education	2	Fatal shootings
Trinidad 2022 ¹²²	Cohort	Multi-level (individual + ecological)	Census tract	Housing Economic Healthcare Education	2	All shootings

Uzzi 2022 ¹²³	Cross sectional	Ecological	Census tract	Housing Economic	2	Nonfatal shootings
Wong 2020 ¹²⁴	Cross sectional	Ecological	City	Housing Economic	2	Fatal shootings

¹ Studies are categorized in two approaches. Approach 1 refers to studies that used a single domain to operationalize structural racism and approach 2 refers to studies that used multiple domains to operationalize structural racism.

2.3.2 Approach 1: Single domains

Among the 32 articles included, nine (28%) specifically assessed the association between a single domain of structural racism and community firearm violence (**Table 2.2**). The most commonly investigated domain among these nine studies was the housing system, accounting for six (67%) of the articles.^{22–24,34,101,116} Variable classifications for single domain studies along with the domain they fall in can be found in **Table 2.3**. Redlining was the primary exposure variable in four (67%) of these housing system studies.^{23,34,101,116} Three of the studies were conducted in individual cities and discussed above. Mehranbod et al.²³ is the first multi-city study to examine the association between historical redlining and contemporary community firearm violence. Mehranbod et al. observed associations were not stable across cities. For example, associations were relatively stronger in Baltimore, MD, and weaker in Los Angeles, CA. Overall, these studies consistently demonstrated that cities with a history of redlining witnessed higher rates of community firearm violence. The authors of the remaining two (33%) studies in this subset used racial residential segregation as their metric for the housing system. They employed the index of dissimilarity, which quantifies spatial distribution between two racial groups.^{22,24} Both studies concluded that higher levels of racial residential segregation were positively associated with increased incidences of community firearm violence. Taken together, all studies examining the housing system's role in community firearm violence underscore the profound impact of housing disparities within the broader framework of structural racism.

Table 2.3. Variables and domain classifications identified from included single domain studies

Domain	Variables
Housing	Redlining; index of dissimilarity; isolation index; residential segregation
Economic	Rate of food insecurity; neighborhood deprivation index; GINI coefficient

The economic system was the other single domain studied (n=3, 33%).^{25,26,117} These authors used various variables to define and measure the economic system within the context of structural racism (**Table 2.3**). Specifically, Ali et al. used the rate of food insecurity at the county level as an indicator of structural racism.²⁵ In contrast, Dalve et al. utilized a four-indicator neighborhood disadvantage index to gauge economic disparities,²⁶ while Rowhani-Rahbar et al. applied the GINI index,¹¹⁷ a measure of income inequality. This varied use of multiple variables in the latter two studies highlights the complexity of the economic system in the context of structural racism. Despite heterogeneity in measurement approaches, a common finding across all three studies was the positive association between economic disparities and higher rates of community firearm violence. These findings highlight the significant role of economic inequities in this context.

2.3.3 Approach 2: Multiple domains

Of the 32 articles included, 23 (72%) analyzed multiple domains of structural racism (**Table 2.2**). All studies included both the housing and economic systems. Operationalization of these domains demonstrated greater variety from studies in Approach 1. The complete list of variable classifications for multiple domain studies along with the domain they fall in can be found in **Table 2.4**. Within the housing system, metrics included the proportion of residents in rental units, the prevalence of single-parent households, the racial makeup of neighborhoods, Theil's

entropy index (which quantifies racial residential segregation), and the rate of unoccupied housing. In terms of the economic system, authors utilized indicators such as median household income, the economic Index of Concentration at the Extremes (ICE, a tool for assessing racialized economic segregation), poverty levels, and employment statistics. Additional domains represented included the education system (n=13, 57%), the criminal justice system (n=8, 35%), and the healthcare system (n=2, 9%). The most common metric to measure the education system was educational attainment. For the criminal justice system, studies incorporated variables such as the percentage of arrests for index crimes, crime rates, drug arrests, juvenile arrests, and incarceration rates. The two studies that operationalized the healthcare system included a variable describing health insurance status.

Table 2.4. Variables and domain classifications identified from included multiple domain studies

Domain	Variables
Housing	Redlining; percent of single parent households; percent of individuals living in rental housing; proportion of female-headed households with children; tree canopy; Theil's entropy index; index of dissimilarity; isolation index; entropy index; percent of housing units that are vacant
Economic	Poverty; labor force participation; proportion of households with public assistance income; unemployment; median household income; concentrated disadvantage index; index of concentration at the extremes for racialized economic segregation; GINI coefficient; income mobility
Criminal Justice	Arrests for index crime; total number of violence or property crimes occurring; drug arrests; incarceration rates
Education	Percent completion of high school or higher education

Six (26%) of these studies independently assessed each domain to examine the unique effects on community firearm violence. Fifteen (65%) studies created a multidimensional composite,

combining variables of structural racism across multiple domains. These studies went beyond singular metrics, creating more comprehensive measures that encapsulate a range of factors indicative of structural racism. For instance, some studies devised a measure of concentrated disadvantage incorporating variables such as the percentage of the population over 25 years of age lacking a high school diploma, the ratio of households in rental accommodation, and indicators of household amenities and living conditions. This approach aimed to provide a more nuanced measurement of structural racism.

Two (9%) studies employed confirmatory factor analysis to model structural racism as a latent construct. These studies encompassed variables in the housing, economic, criminal justice, and education systems.^{47,85} Siegel et al. provided a detailed analysis at the county level,⁸⁵ and later published another study extending this approach to the city level.⁴⁷ Both studies uncovered pronounced geographic disparities in the prevalence of structural racism, highlighting its varying intensity and manifestations across different regions. Despite heterogeneity in the measurement of structural racism, all the studies in Approach 2 collectively found structural racism to increase the risk of community firearm violence.

2.4 Discussion

The aim of this systematic review was to synthesize the literature to identify different approaches to measuring structural racism and estimating its association with community firearm violence in the US. This systematic review of studies published from 1990 to June 2023 reveals uniform findings. Despite heterogeneity in the measurement of structural racism, all studies found a positive association between structural racism and the incidence of community firearm violence.

The findings remained consistent across geographic areas, highlighting structural racism's varying intensity and manifestations across different regions.

A quarter of the articles identified focused on measuring structural racism through a single domain. This method can be useful for pinpointing specific interventions for individual systems and determinants. One example of a measure used to operationalize a single domain of structural racism was racial residential segregation.^{22,24} Racial residential segregation can be a proxy for segregated neighborhoods (i.e., housing system) where there is limited access to quality education, employment opportunities, and healthcare resources—all risk factors for firearm violence.^{67,68,94–96} Racial residential segregation alone does not account for how inequities in the housing, education, economic, and health care systems mutually reinforce one another. Solely linking racial residential segregation to increased risk in community firearm violence, especially for individuals racialized as Black, overlooks the broader spectrum of discriminatory policies and institutional dynamics that drive health disparities.¹²⁵

A paradigm shift in the literature is marked by studies increasingly incorporating multiple-domain approaches to operationalize structural racism. For example, the study by Jay and colleagues¹⁰⁶ explored the relationship between neighborhood-level economic segregation, as quantified by the Index of Concentration at the Extremes (ICE) for race-income, and urban greenery, specifically tree cover, in the context of firearm violence. This approach is insightful because it interprets racialized economic segregation as a manifestation of the economic system, while tree cover serves as a proxy for the housing system. The findings of this study are crucial as they establish a link between both ICE and tree cover with firearm violence, highlighting ICE

as a more dominant predictor. Advancing tree equity would not disrupt the fundamental causes of racial disparities in exposure to firearm violence but could help to mitigate those disparities.

The shift towards the multiple-domain approach in measuring structural racism highlights a persistent challenge: comprehensively capturing the mutually reinforcing systems of discrimination. This complex task involves two crucial components in the measurement of any construct, including structural racism.¹²⁶ First, the reliability of the measure—it must consistently reflect the construct it is designed to measure.¹²⁶ Second, the measure's validity is vital, as it determines whether it accurately represents the underlying construct of interest.¹²⁶ Among various types of validity, construct validity is particularly crucial.¹²⁷ It refers to the degree to which a measurement tool truly assesses the specific concept or construct it intends to measure.¹²⁷ This involves a thorough evaluation of whether the tool effectively captures all dimensions and nuances of the construct. In the context of structural racism, theory suggests achieving a high degree of construct validity means not only capturing the visible manifestations of racism across various domains but also seeing how these relationships change over time. Measurement requires a comprehensive accounting of the interrelationships and cumulative impacts across systems to truly reflect the multifaceted and systemic nature of structural racism.

The evolution of measuring structural racism in firearm violence research illustrates this complexity. Researchers have created composite metrics, known as index or scale measures, that consolidate various individual indicators into a single value.^{34,103,104} These indices or scales combine indicators of structural racism across multiple domains and then examine the relationship between these measures and health outcomes. The primary limitation of this

approach is that it assumes all domains of structural racism are weighted equally since the measures are derived by simply averaging or summing across domains. However, there is no conceptual or theoretical basis to support this assumption. Moreover, the true meaning of the structural racism index remains ambiguous, as it relies on an arbitrary uniform weighting of both indicators within domains and the domains themselves. This equal weighting is not grounded in any established conceptual theory or empirical evidence derived from the data. In an attempt to respond to the limitations inherent in simply averaging or summing scores across dimensions, researchers have turned to latent construct analysis techniques to measure structural racism. Factor scores, derived from factor analyses, identify underlying patterns within a set of observed variables.^{47,85} Siegel and colleagues used this approach to construct latent measures of structural racism at county and city levels. By employing factor analysis and structural equation modeling, they were able to probe the underlying structures within the data, revealing interconnected correlations that constitute the construct of structural racism.

Both approaches to measuring structural racism (i.e., single- and multiple-domains) conducted to date demonstrate a growing comprehension of the complex and layered dimensions of structural racism. These studies have progressively unveiled the various ways in which structural racism intertwines with and impacts community firearm violence. Yet, an essential facet that remains insufficiently examined is the temporal aspect of structural racism. All of the studies included in the review only examined a single historical time period of structural racism. Exploring how structural racism changes over time can reveal patterns, offering insights into how historical contexts and long-term policies shape current realities. Furthermore, recognizing the temporal dynamics can aid in predicting future trends and impacts, providing a more thorough

understanding of how structural racism contributes to community firearm violence over different periods. Future research endeavors should consider focusing on tracing the historical trajectory of structural racism to understand its longitudinal effects. This approach will be critical in developing a comprehensive understanding of structural racism's enduring and changing impact on community firearm violence.

2.4.1 Limitations

This study provides a comprehensive assessment of the literature on quantifying structural racism and its relationship with community firearm violence. Among its strengths is the thorough synthesis of diverse research, offering an in-depth view of the current evidence and methodologies utilized in this field. This synthesis is particularly valuable as it delineates the evolutionary 'phases' in measuring structural racism, thereby charting the progression and shifts in research paradigms over time. Such a holistic overview is crucial for understanding the nuanced and complex nature of this research area.

However, there are inherent limitations to this review that should be acknowledged. While the search terms used were designed to be exhaustive in capturing literature related to structural racism, there remains the possibility of omitting relevant articles. Specifically, studies that may not explicitly use the identified search terms in their titles or abstracts but still address the association between structural racism and community firearm violence could have been inadvertently excluded. This limitation highlights the challenge of ensuring complete coverage in a research field characterized by varied terminology and evolving definitions. Additionally, the review does not attempt to assess the rigor of the studies beyond the number of dimensions they

incorporate due to great heterogeneity among the studies. Different studies use varying geographic scales, from local neighborhoods to entire states, which can significantly impact the findings and their applicability. Finally, the analysis is limited by its reliance on construct validity. While this method offers a comprehensive view, it risks overlooking the practical value of studies focusing on individual domains. These simpler, single-domain analyses often provide more direct applications for preventive interventions. In contrast, exploring multiple domains, although it yields a wider understanding, presents challenges in implementing focused interventions. Consequently, while this review contributes valuable insights, it might not capture the full spectrum of research in this rapidly developing area. This is particularly relevant in the context of developing actionable, preventive strategies to combat community firearm violence.

2.5 Conclusion

This systematic review provides a critical analysis of how structural racism is measured in public health research, focusing particularly on its relationship with community firearm violence. The findings of this review are instrumental for researchers and policymakers alike, highlighting gaps in the existing literature. Future research should incorporate approaches to measuring structural racism that reflect the evolution of mutually reinforcing discriminatory systems over time.

Chapter 3: Measuring the effect of historical structural racism on community firearm violence in US cities

3.1 Introduction

The crisis of community firearm violence in the US disproportionately burdens neighborhoods where people racialized as Black predominately live. While previous research has established structural racism as a fundamental cause of community firearm violence,⁸¹⁻⁸³ methods to measure and quantify structural racism still vary widely and continue to evolve. Early attempts to measure the impact of structural racism on community firearm violence were often limited to isolated aspects of this multifaceted issue, like residential segregation^{21,23} or economic inequality,^{26,27} both of which were found to correspond with increases in firearm violence. However, structural racism is the result of mutually reinforcing disparities across various domains, each playing a role in perpetuating inequity.²⁰ Focusing on a single domain of structural racism does not address its full impact on community firearm violence.

In recent years, research examining the association between structural racism and community firearm violence has broadened to encompass multiple domains when measuring structural racism.^{34,103-105,108,128-130} Researchers have created indices/scales and factor scores to explore the intricate interactions within structural racism.^{47,85} Despite these advancements, there is a gap in how this field approaches the subject. Current studies rely on a single historical period to examine the relationship between structural racism and contemporary community firearm violence. Incorporating a historical perspective is essential to fully comprehend how past policies

and societal changes have shaped current patterns and impacts of structural racism, providing a deeper and more accurate understanding of its long-term effects on community firearm violence.

Theoretically, community firearm violence can be understood through the lens of critical race theory which requires focus on its historical determinants.^{86,87} Critical race theory posits racism as not merely the product of individual bias or prejudice, but a more deeply ingrained, enduring, and central component of society and its institutions.⁸⁸ By examining the historical context of structural racism, we can more accurately trace the origins and evolution of policies, understand their short- and long-term effects, and recognize enduring patterns that continue to shape contemporary community firearm violence. Incorporating this historical perspective not only enriches the current understanding of the perpetuation and impact of structural racism but also helps in identifying deep-rooted systemic issues that influence and shape the dynamics of racial inequity in community firearm violence.

One such issue is the role of racial residential segregation on community firearm violence, as it provides insights into the origins of urban disparities and conflicts. A historical examination of racial residential segregation in the US reveals how deeply ingrained discriminatory policies and institutional practices were in shaping the urban landscape. Prior to the Civil Rights Movement, these policies and practices were systematically enforced, creating a foundation for deep-rooted racial divisions within urban environments. The inception of racialized places predated the Home Owners' Loan Corporation (HOLC) of the 1930s and its neighborhood grading maps, which nonetheless played a pivotal role in reinforcing the correlation between a neighborhood's property value and its racial composition.¹³¹ This spatial designation of neighborhoods as

"undesirable," marked by labels like Grade D or "redlined," further entrenched racial residential segregation.¹³² Such practices not only directed resources into communities racialized as White but also institutionalized barriers for communities racialized as Black, ultimately impacting access to employment, income, and home ownership. Importantly, the racialized theory of property value, conflating "race" with "financial risk," extended beyond the HOLC maps, leaving an indelible mark on geographies untouched by this intervention. Contemporary research has demonstrated a direct association between these redlined areas and higher rates of firearm violence today, highlighting the long-term, detrimental consequences of these historical policies.^{23,34,102,123} It is hypothesized that racial residential segregation contributes to neighborhood violent crime, including community firearm violence, indirectly and directly. Indirectly, through the way it produces isolation and structural disadvantage in predominately minority areas, and directly, by making it difficult for separate and unequal groups to work together to foster common goals and solve shared problems.¹³³ Thus, the historical legacy of racial residential segregation in the US has not only shaped the urban landscape but also contributed significantly to the ongoing disparities in firearm violence, illustrating a persistent and complex link between spatial segregation and systemic inequity.

Exploring the enduring impact of structural racism reveals how historical policies continue to shape present-day challenges, including disparities in exposure to community firearm violence. This phenomenon aligns with critical race theory, which suggests that significant racial progress often occurs only when it aligns with the interests of the dominant group. For example, the lasting effect of structural racism on racial residential segregation persisted beyond efforts toward desegregation and integration (i.e., the process of ending the separation of racial groups

and encouraging their intermixing in society¹³⁴). This endurance is exemplified by the limited success of the Fair Housing Act of 1968.¹³⁵ The act aimed to end discrimination in housing based on race, color, religion, sex, or national origin.¹³⁶ However, it achieved limited success in dismantling deeply entrenched racial inequalities. In the present day, communities marked by dense concentrations of minoritized residents grapple with a host of persistent challenges that result from “color-blind” discriminatory policies. These include ongoing residential segregation, a dearth of economic investment, limited access to essential resources such as food and greenspace, elevated levels of pollution (spanning air, noise, and water), and vulnerability to gentrification, even decades after the fact.^{137–140} Consequently, these factors contribute to disparate school term lengths, resulting in 50% to 100% fewer educational opportunities for students racialized as Black compared to their White counterparts.¹⁴¹ This educational inequity, coupled with limited access to protective elements like greenspaces,^{142–145} healthy foods,²⁵ and economic opportunity,¹¹ further exacerbates the heightened risk of exposure to community firearm violence in affected neighborhoods. Critical race theory’s emphasis on the narrative and experiential knowledge of marginalized groups thus underscores the need to acknowledge and address these historical and contemporary forms of structural racism in firearm injury epidemiology.

This study aims to examine the effect of historical structural racism on contemporary patterns of community firearm violence in US cities. Although the conceptual model incorporates hundreds of years of history, data limitations dictate the examination of three distinct historical periods to assess whether the enduring legacy of structural racism has increasingly influenced community firearm violence over time. I hypothesize a stronger association with community firearm

violence in the most recent period because I assume the cumulative effects of structural racism to have intensified. I anticipate that modern discriminatory policies and practices, as evolved forms of past injustices, to have a more pronounced impact on current patterns of community firearm violence.

3.2 Methods

3.2.1 Study sample

The unit of analysis for this study was cities to capture the incidence of community firearm violence in urbanized locations. This approach recognizes the distinct dynamics of firearm violence across urban-rural continuum.^{69,146} Research indicates that while firearm violence is a nationwide issue, its manifestation varies considerably between different locales. In rural counties, firearm suicide tends to be more prevalent, whereas urban counties witness a higher incidence of firearm homicide.^{69,146} Furthermore, the disproportionate impact of firearm mortality on individuals racialized as Black is predominantly evident in urban settings, where they constitute 68% of homicide victims.⁷⁰ This disparity may be linked to demographic trends, as adults racialized as Black are more likely to reside in urban rather than rural areas.⁷¹ Therefore, to thoroughly investigate the disparities in community firearm violence risk faced by Americans racialized as Black, an emphasis on urban contexts is essential. This urban-centric approach provides valuable insights into the intersection of race, geography, and violence, thereby facilitating a deeper understanding of the spatial dimensions of firearm-related inequities.

This study utilized the list of 500 cities identified by the Centers for Disease Control and Prevention’s (CDC) 500 Cities Project (currently known as PLACES) to define its sample.¹⁴⁷ The 500 Cities Project selected the 500 largest US cities based on population size according to the US 2010 Census. Information on the 500 cities, as well as the complete description of the dataset, is publicly available and can be downloaded from the CDC website.¹⁴⁷

3.2.2 Variables

Exposure variable. I explored the enduring impact of historical structural racism on city-level community firearm violence across three historical periods which were adapted from Adkins-Jackson and colleagues’ model of life course socioeconomic racism:¹⁴⁸ **Historical Period 1- Before the Civil Rights Act of 1968** (1900-1968), **Historical Period 2-After Desegregation/Integration** (1970-2000), and **Historical Period 3-Modern Times** (2010-19).

Figure 3.1 illustrates a conceptual model of the final representation.

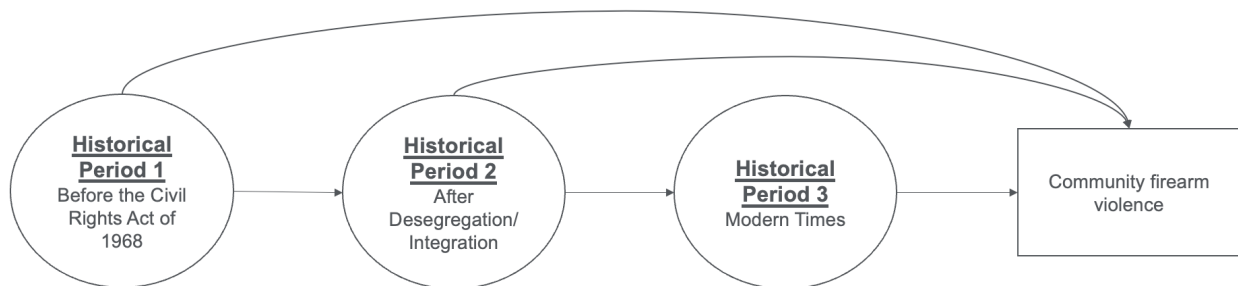


Figure 3.1. Full conceptual model demonstrating the impact of historical structural racism on community firearm violence in cities

In Historical Period 1 (1900-1968), racist institutional practices like redlining and threats of violence through sundown towns and historical state-sanctioned lynchings created and maintained residential segregation.¹⁴⁹ Sundown towns were cities and towns where individuals

not racialized as White were forced to leave before sundown to avoid harm done to them.¹⁵⁰ Historical state-sanctioned lynchings were acts of violence inflicted upon individuals racialized as Black by police and residents alike, many for whom justice was never obtained.¹⁵¹ A city's exposure to any one of these experiences would have resulted in residential segregation, indicating city-level racism before the amended Civil Rights Act of 1968. I used data from Mapping Inequality,¹⁵² History and Social Justice,¹⁵⁰ and Equal Justice Initiative¹⁵³ to create a binary variable where a city with an existing HOLC map, identified as a sundown town, or having one or more lynchings of an individual racialized as Black, was considered to have a "documented history" of racism (coded as 1) (**Table 3.1**).

The decision to include these three variables for Historical Period 1 was influenced by several factors. First, I was limited by the availability of data for this historical period. Second, the complexity and variability of these measures across different cities posed challenges in creating a standardized, comparable framework. The aim was to employ the most direct and consistently available indicators to reliably reflect the broader patterns of structural racism, manifesting through racial residential segregation, across various urban settings. Furthermore, I use the language of documentation to highlight that a city may appear to be non-racist due to a lack of documentation, given the current landscape of quantifiable data sources to illustrate structural racism. Thus, I coded cities without such documentation as 0. Data were available for each variable at the city level, except for lynching data. For lynchings, I used the centroid of each city to nest cities into counties, employing county-level data as the smallest geographic unit of analysis available.

Table 3.1. Historical Period 1-Before the Civil Rights Act of 1968 (1900-1968) Variables

Domain	Variable	Description	Formula	Years	Unit
Housing, Economic, Criminal Justice, Education	Redlining	Any city with a documented history of redlining (i.e., a racialized discriminatory mortgage lending policy)	Redline = 1 (Redlined) Redline = 0 (Not redlined)	1937	City
	Sundown town	Any city with a documented history of being a sundown town (i.e., towns with the expectation that individuals not racialized as White had to leave before sundown)	Sundown = 1 (Sundown town) Sundown = 0 (Not a sundown town)	1942-1968	City
	Lynching	Any county that had at least one lynching of an individual racialized as Black	Lynching = 1 (≥1 lynching) Lynching = 0 (0 lynching)	1877-1950	County

Historical Period 2 (1970-2000) occurs after the major events and legislation of the Civil Rights Movement and reflects strides made toward desegregation (sometimes referred to as integration). By 1990, structural racism splintered into institutional racism practiced by multiple distinct US institutions (e.g., criminal justice, education, etc.). To capture the impact of structural racism during this period, I examined home ownership via owner-occupied units, unemployment, persons living below the federal poverty line, jail population, and not having a high school diploma. Using data from the IPUMS Census¹⁵⁴ and the Vera Institute,¹⁵⁵ I computed the proportion of individuals racialized as Black experiencing each variable by dividing the total number of persons racialized as Black who: owned a unit they occupied, were unemployed, were living below the poverty line, were incarcerated in a jail, and who did not have a high school diploma by the total number of persons for each respective variable, per city (**Table 3.2**). All data were available at the city level except for the jail population. For the proportion of

individuals racialized as Black incarcerated in jail, I used the same approach as with the lynching data. I dichotomized all proportions from 0-1 into the highest racism (coded as 1), using the top quartile as the cutoff, and all other values (coded as 0).

I then conducted a confirmatory factor analysis (CFA) within an Oblimin rotation and diagonally least-weighted squares estimator with all variables at Historical Period 2. Oblimin rotation is appropriate when factors are expected to be correlated, and the diagonally least-weighted squares estimator is chosen to handle non-normal or categorical data, providing a robust approach to factor analysis in situations where traditional maximum likelihood estimation may not be suitable. Model fit statistics for the CFAs include both comparative fit index (CFI) and Tucker-Lewis index (TLI) between 0.90 and 1, and root mean square error of approximation <0.10 .¹⁵⁶ Where available, robust fit statistics were recorded. Factor loadings for variables in the CFA were observed (>0.5). Results yielded one continuous score (-1 to 1) per city. Finally, I coded values over the top quartile (1=evidence of high structural racism, 0=evidence of low-mid structural racism).

Table 3.2. Historical Period 2-After Desegregation/Integration (1970-2000) Variables

Domain	Variable	Description	Formula	Year	Unit
Housing	Owner occupied units	Proportion of individuals racialized as Black owning homes	$p_{oou_black} = \frac{oou_black}{total_oou}$	1990	City
Economic	Poverty	Proportion of individuals racialized as Black living below the FPL	$poverty = \frac{black_below_FPL}{total_below_FPL}$	1990	City
	Unemployment	Proportion of individuals racialized as Black that are unemployed	$unemploy = \frac{black_unemploy}{total_unemploy}$	1990	City
Criminal justice	Jail	Proportion of individuals racialized as Black in jail	$jail = \frac{black_jail_pop}{total_jail_pop}$	1990	County
Education	No high school diploma	Proportion of individuals racialized as Black 25+ without a high school diploma or higher	$education = \frac{black_no_hs}{total_no_hs}$	1990	City

Historical Period 3 (2010-19) reflects a transition to contemporary practices of "color-blind" discrimination. These practices, ostensibly race-neutral, disproportionately affect communities racialized as Black. Despite the lack of overt racial targeting, these communities face a higher incidence of adverse outcomes in several critical areas (**Table 3.3**). They are more frequently denied mortgage lending, a key factor in achieving home ownership and financial stability. Environmental injustices are also prevalent, as evidenced by increased exposure to water pollution. Food deserts are another significant challenge, limiting access to healthy and affordable food options. In the realm of law enforcement and criminal justice, these communities encounter a higher rate of police killings and arrests, reflecting systemic biases. Additionally, the disparity extends to the education sector, with schools in these communities receiving lower

revenue per pupil, impacting the quality of education available to students. This period highlights the subtlety and complexity of modern discriminatory practices, which, while not explicitly race-based, continue to perpetuate inequities and disproportionately impact Black communities in multifaceted ways.

To create variables for this period, I used data from the Home Mortgage Disclosure Act,¹⁵⁷ Environmental Protective Agency,¹⁵⁸ US Department of Agriculture,¹⁵⁹ Mapping Police Violence,¹⁶⁰ Federal Bureau of Investigation’s Uniform Crime Reports,¹⁶¹ and National Neighborhood Data Archive.¹⁶² For mortgage lending denial, police killings, and arrests, I computed proportions following the same method as Historical Period 2. For variables that were “color blind”, meaning race was not a part of the raw variable (i.e., water pollution, food desert, and per pupil revenue), I first identified cities that had one or more health-based water violations, the majority of census tracts within the city were food insecure, and school districts that were in the bottom quartile of per pupil revenue. I then considered cities to have evidence of high structural racism (coded as 1) if the city *also* had greater than or equal to the national proportion of residents or students (school districts) racialized as Black—all other cities were coded as 0. Data for water pollution and police killings were available at the city level and for all others, I followed similar methods as other variables outlined above.

I then conducted a CFA with all variables at Historical Period 3 following the same methods described for Historical Period 2. Again, the resulting factor scores were coded into binary values, using the top quartile as the cutoff (1=evidence of high structural racism, 0=evidence of low-mid structural racism).

Table 3.3. Historical Period 3-Modern Times (2010-19) Variables

Domain	Variable	Description	Formula	Years	Unit
Housing	Mortgage lending denial	Average proportion of individuals racialized as Black who were denied home loans	$denial = \frac{black_denial}{total_denial}$	2010-2017	Census tracts
	Water pollution	Any health-based violation	1 = one or more health-based violation + ≥ national average Black residents in city, otherwise 0	2010-2019	City
Economic	Food desert	Majority (≥20%) of the census tracts in a city are food insecure (i.e., 1) Poverty rate is ≥20% OR median family income does not exceed 80% state-wide; and 2) ≥33% of the population located more than 1 mile (urban) or 10 miles (rural) from the nearest supermarket or large grocery store)	1 = highest quartile of the census tracts in a city are food insecure + ≥ national average Black residents in city, otherwise 0	2019	Census tracts
Criminal justice	Police killings	Proportion of police killings that are among individuals racialized as Black	$police_killing = \frac{mpv_black}{mpv_total}$	2013-2019	City
	Arrests	Proportion of individuals racialized as Black who are arrested	$arrest = \frac{black_arrest}{total_arrest}$	2013-2019	County
Education	Per pupil revenue	Average per pupil revenue (bottom quartile) and proportion of Black students above the national average	1 = bottom quartile PPR + ≥ national average Black students, otherwise 0	2010-2018	School districts

Outcome variable. I used data from the Gun Violence Archive (GVA), an independent data collection and research group gathering daily information on firearm violence incidents from public records (suicides and suicide attempts are excluded).¹⁰⁰ Available fields in the GVA data describe the date when the shooting occurred, the address, geographic coordinates of the shooting event, and the total number of individuals killed or injured in the incident. These data are publicly available through the GVA website and searchable starting from 2013. The data

have previously been validated for research in large cities, albeit with caution for use longitudinally.¹²⁸ I geocoded and aggregated the data across 5 years (2015-19) to calculate the total number of all shootings, fatal shootings, and nonfatal shootings for each city. I then calculated the rate of shootings (all, fatal, and nonfatal) per 100,000 population using city population estimates from the American Community Survey (2015-19).¹⁶³ Finally, I log-transformed the data because the data were heavily right-skewed (i.e., the majority of the data points were concentrated on the left side of the distribution). This transformation compressed the range of values, making the data more symmetric and reducing the influence of extreme values because of the model assumptions described below.

3.2.3 Statistical Analyses

I first estimated the independent associations between each historical period individually and firearm violence outcomes (all, fatal, and nonfatal shootings). I then used a structural equation model (SEM) to examine a model where all historical periods were included, leveraging its capability to analyze complex relationships between multiple variables simultaneously. The goal of SEM is not to determine risk. It is to estimate effects with all pathways in one model so that we are not examining a multivariate issue with a univariate approach. SEM is useful when estimating interrelated dependence relationships. It is ideal for assessing both direct and indirect associations. In this study, I utilized SEM to explore the connections between different historical periods (Historical Period 1, Historical Period 2, Historical Period 3) and firearm violence outcomes (all, fatal, and nonfatal shootings). An important assumption of this model is the need for symmetric data, as the SEM relies on the covariance between variables to estimate the relationships accurately. By fitting semi-log-linear regression models within the SEM framework

(i.e., only the dependent variable log-transformed), I estimated the log of the risk of city-level firearm violence between 2015-19. This approach allowed us to test the association of each historic period independently and in conjunction with each other, providing insights into both individual and collective impacts on community firearm violence. Though not a risk, the beta estimates from SEM demonstrate the strength and direction of these relationships. Results help explain the intricate dynamics between historical influences and contemporary community firearm violence.

3.3 Results

Out of the initial 500 cities, 397 were selected for inclusion in the final sample as they had complete data available for all three historical periods (**Table 3.4**). Included cities were statistically significantly similar to excluded cities for all variables except arrests in Historical Period 3. The average proportion of individuals racialized as Black who were arrested in included cities was 25.4% compared to 30.3% in excluded cities (p -value = 0.02). Included cities collectively encompassed 239 counties across 40 different states. From 2015 to 2019, there were 96,028 total shootings in the included cities, 70% of which were nonfatal. The average rate of all shootings per 100,000 was 964.7 (SD = 128). A total of 252 cities in the sample (63.4%), had a documented history of structural racism in Historical Period 1. Descriptive statistics for variables included in Historical Periods 2 and 3 can be found in **Table 3.4**.

Table 3.4. Descriptive characteristics of US cities included in the study (n=397)

Variable	Number of Cities (%)	Mean (SD)
All shootings (per 100,000)		964.7 (128.0)
Fatal shootings (per 100,000)		314.1 (36.3)
Nonfatal shootings (per 100,000)		650.6 (95.3)
Historical Period 1: Before the Civil Rights Act of 1968 (1900-68)		
Redlining	114 (28.7)	
Sundown town	78 (19.6)	
Lynchings	119 (30.0)	
Historical Period 2: Desegregation/Integration (1970-2000)		
Unemployment (%)		19.9 (20.9)
Jail (%)		36.1 (22.6)
Owner occupied units (%)		8.6 (11.9)
Poverty (%)		22.0 (22.5)
No high school diploma (%)		14.9 (18.2)
Historical Period 3: Modern Times (2010-19)		
Mortgage lending denial (%)		11.8 (13.7)
Police killings (%)		27.1 (33.3)
Arrests (%)		25.5 (18.9)
Water pollution	96 (24.2)	
Food desert	80 (20.2)	
Per pupil revenue	241 (60.7)	

Confirmatory Factor Analyses (CFAs). For Historical Period 2, a 1-factor model achieved adequate model fit based on a CFI of 0.996, TLI of 0.992, and RMSEA of 0.061. Unemployment loaded highest (0.966) and jail population loaded lowest (0.590). Adequate fit and high factor loadings suggest these variables encompass a unidimensional latent variable (see **Table 3.5** for fit statistics). Similarly, for Historical Period 3, a 1-factor model achieved a modest fit (CFI 0.902, TLI 0.836, RMSEA 0.124). Mortgage lending denial loaded highest (0.703) and police killings loaded lowest (0.522). These values suggest these variables encompass a unidimensional

latent variable (see **Table 3.6** for fit statistics).

Table 3.5. Factor loadings and fit statistics for Historical Period 2-After Desegregation/Integration (1970-2000)

Variable	Loading
Unemployment	0.966
Jail	0.59
Owner occupied units	0.824
Poverty	0.924
No high school diploma	0.918
Fit statistics	
CFI	0.996
TLI	0.992
RMSEA	0.061

Table 3.6. Factor loadings and fit statistics for Historical Period 3-Modern Times (2010-19)

Variable	Loading
Mortgage lending denial	0.703
Water pollution	0.534
Food desert	0.522
Police killings	0.541
Arrests	0.663
Per pupil revenue	0.66
Fit statistics	
CFI	0.902
TLI	0.836
RMSEA	0.124

Independent associations. Each historical period was independently significantly associated with an increased risk of city-level firearm homicide (**Table 3.7**). A documented history of structural racism was associated with a significant increase in the log of the risk of all shootings per 100,000 at Historical Period 1 (0.58, 95% CI: 0.34, 0.82); and evidence of high structural racism

was associated with a significant increase in Historical Period 2 (1.57, 95% CI: 1.34, 1.79) and Historical Period 3 (1.60, 95% CI: 1.38, 1.83). This was similar for the log of fatal shootings per 100,000 [Historical Period 1 (0.38, 95% CI: 0.17, 0.59); Historical Period 2 (1.32, 95% CI: 1.12, 1.52); Historical Period 3 (1.29, 95% CI: 1.08, 1.49)]. The strongest effects were seen among nonfatal shootings. A documented history of structural racism at Historical Period 1 was associated with a 0.69 increase in the log of the risk of nonfatal shootings per 100,000 (95% CI: 0.42, 0.97); and evidence of high structural racism was associated with a 1.75 increase at Historical Period 2 (95% CI: 1.48, 2.01) and a 1.82 increase at Historical Period 3 (95% CI: 1.56, 2.08).

Table 3.7. Semi-log-linear model results estimating the association between individual historical periods and community firearm violence in US cities, 2015-19 (n=397)

	log(All Shootings per 100K)		log(Fatal Shootings per 100K)		log(Nonfatal Shootings per 100K)	
	Beta	95% CI	Beta	95% CI	Beta	95% CI
Historical Period 1- Before the Civil Rights Act of 1968 (1900-68)	0.58	(0.34, 0.82)	0.38	(0.17, 0.59)	0.69	(0.42, 0.97)
Historical Period 2- After Desegregation/Integration (1970-2000)	1.57	(1.34, 1.79)	1.32	(1.12, 1.52)	1.75	(1.48, 2.01)
Historical Period 3- Modern Times (2010-19)	1.60	(1.38, 1.83)	1.29	(1.08, 1.49)	1.82	(1.56, 2.08)

Structural Equation Model (SEM). All historical periods had similar associations as independently with documented/high structural racism being associated with greater city-level firearm homicides (see **Figure 3.2** for all shootings). A table of all results (i.e., all, fatal, and nonfatal shootings) can be found in **Appendix A**. Being a city with a documented history of structural racism was associated with a 0.24 increase in the log of the risk of all shootings per

100,000 at Historical Period 1 (95% CI: 0.08, 0.54) compared to cities without documentation. Additionally, being a city with evidence of high structural racism was associated with a 0.84 increase in the log of the risk at Historical Period 2 (95% CI: 0.53, 1.23), and a 0.93 increase in the log of the risk at Historical Period 3 (95% CI: 0.75, 1.47) compared to cities with low-mid structural racism. A documented history of structural racism at Historical Period 1 predicted evidence of high structural racism at Historical Period 2 (beta=0.23, 95% CI: 0.14, 0.31), and evidence of high structural racism at Historical Period 2 predicted evidence of high structural racism at Historical Period 3 (beta=0.71, 95% CI: 0.64, 0.77).

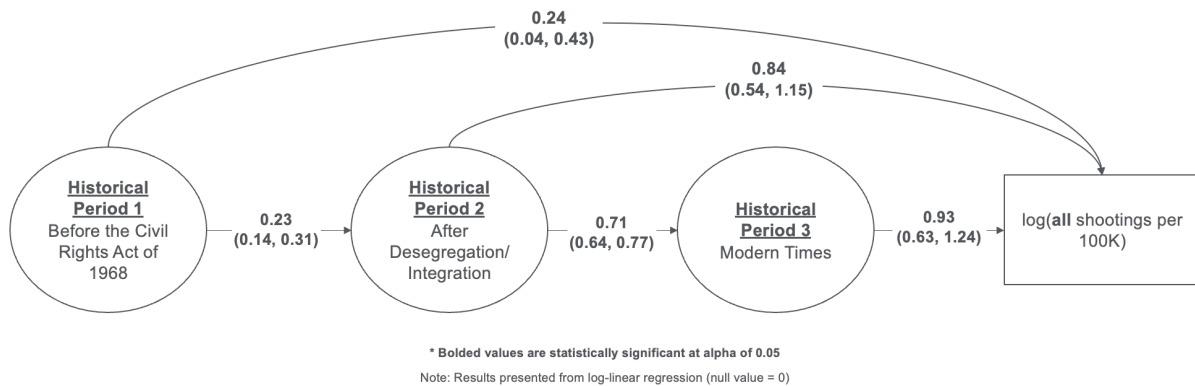


Figure 3.2. Structural equation model semi-log-linear results for the association between historical structural racism and all shootings in cities, 2015-19 (n=397)

3.4 Discussion

The aim of this research was to examine the effect of historical structural racism on contemporary patterns in community firearm violence in US cities. This study explored this association across three distinct historical periods of structural racism with a primary focus on uncovering how the persistence of social and ecological damage forged through structural racism has created the context in which community firearm violence is perpetuated. The results present robust and compelling evidence of the enduring influence of structural racism on community

firearm violence in urban areas. Notably, I observed significant associations between each of the historical periods and an increased risk of community firearm violence. This particularly holds true for Historical Period 3, affirming my hypothesis that the most recent historical period exhibits the strongest impact. A significant emphasis lies on the noteworthy prominence of these effects, particularly in the context of nonfatal shootings, underlining the necessity of considering both fatal and nonfatal incidents when understanding the full scope of community firearm violence.

My findings echo the insights from previous research that have highlighted the detrimental consequences of structural racism on firearm violence. Many of these studies, however, have traditionally focused on specific facets of structural racism, such as residential segregation and redlining, which have contributed to concentrated poverty, limited economic opportunities, and, subsequently, higher rates of firearm violence.^{23,24,34,102,116,164} Recent research underscores the importance of examining structural racism across multiple domains rather than isolating individual components.^{47,121} My study extends beyond existing literature emphasizing the additional significance of integrating a temporal perspective into the study of structural racism.

Additionally, it becomes evident that a more inclusive approach in firearm violence research is necessary—one that encompasses both intentional interpersonal fatal and nonfatal incidents to fully understand their societal implications and ties to systemic issues. Previous research has primarily concentrated on fatal shootings.^{27,103,105,110,113,118,130} However, nonfatal shootings carry significant implications for individuals, families, and communities. Furthermore, limiting analyses to fatal shootings, which represent the most extreme outcome, will not suffice for

designing or evaluating effective interventions. This is because such a narrow focus overlooks a wide range of significant interactions and outcomes that are critical for understanding the full scope of the issue. These can include but are not limited to non-lethal uses of force, discriminatory policing practices, and psychological impacts on communities. To develop comprehensive and effective interventions, it is crucial to consider this broader spectrum of incidents. Doing so enables a more nuanced understanding of the systemic issues at play. This will allow for the creation of targeted strategies that address the root causes and varied manifestations of the problem, rather than just its most visible or severe symptoms. To bridge this knowledge gap and guide prevention efforts effectively, it is essential to develop an understanding of the differences between intentional interpersonal fatal and nonfatal shootings and how they have been impacted by structural racism over time.

A central finding from this research, guided by critical race theory, reveals not only the enduring impact of structural racism but also its nuanced dynamics over time. While we may assume that exposures more proximal in time to the outcome are the most relevant, my findings reveal a compelling narrative of historical continuity. Specifically, my findings highlight that the detrimental effects of historical structural racism are not only mediated through modern-day structural racism but also independent effects exist. This suggests that the influence of structural racism has not diminished but, rather, has remained persistent. It is imperative to recognize that the consequences of historical structural racism are not mere historical artifacts; they continue to exert enduring impacts on contemporary societal dynamics. Furthermore, this analysis reveals an important intertemporal link between different historical eras with evidence of structural racism in one time period predicting its presence in subsequent periods. This highlights the persistence

and interconnectedness of structural racism across historical eras reflecting the deeply ingrained nature of discriminatory policies and practices. Structural racism perpetuates a cycle of violence and inequity in communities resulting in severe public health and safety consequences.

3.4.1 Limitations

In general, it proves challenging for quantitative analyses of extended historical processes to fulfill the prerequisites for accurately pinpointing unbiased causal effects. A significant constraint in this context arises from the scarcity of historical data that could be employed to fulfill requirements related to conditional exchangeability assumptions. Despite advancements in data curation, allowing researchers to partially reconstruct the social contexts influencing the distribution of historical treatments and their subsequent outcomes,¹⁶⁵ the lack of widespread, standardized data collection mechanisms hampers the capacity to consider historical information and ensure confidence that unobserved factors do not influence outcomes. As such, I frame the results as comparing cities having high evidence of structural racism and low to mid evidence of structural racism.

Further data availability limitations exist regarding both the exposure and outcome data. The original sample of 500 cities was reduced to 397 cities based on data availability across all three historical periods. This reduction in the sample size raises concerns about selection bias as the omitted cities may possess distinct characteristics or experiences that differ from those included in the final sample. However, sensitivity analyses suggested that included cities were not statistically significantly different from included cities. Additionally, while the theoretical framework acknowledges the potential value of extending the analysis to even earlier periods, the lack of comprehensive historical data constrains the ability to explore this possibility fully.

Concerning outcome data, no comprehensive national data source for community firearm violence currently exists. Publicly available data from government agencies are typically only available for fatal injuries at the city or county level.^{72,73} Data aggregated at this level may be too spatially coarse to be informative when studying the population impact of firearm violence at the neighborhood level. Further, hardly any data on nonfatal shootings exists, and the data sources that do exist are unreliable. Nonfatal shootings are important because they have major consequences for individuals, families, and communities. In addition, we cannot expect to design or evaluate effective interventions by only measuring the most extreme outcome (i.e., fatal shooting). Studies often turn to local law enforcement data when studying neighborhood-level firearm violence. However, this makes a national study rather difficult. The GVA's archive of firearm violence incidents across the US includes location information and has been shown to improve in sensitivity over time.¹²⁸ In the absence of a true gold standard for firearm injury data at the city level, the GVA remains an acceptable option.

Finally, a constraint lies in the potential for the latent construct of structural racism created across three historical periods to encapsulate abstract concepts more aligned with public health theory than practical application. This may limit direct implications for interventions, emphasizing the need for further research to bridge the gap between theoretical understanding and practical strategies to combat structural racism and its associated impacts on firearm violence.

3.5 Conclusion

These findings illuminate the long-term influence of historical structural racism on contemporary community firearm violence in US cities. Through the comprehensive model, I effectively captured the persistent impact of structural racism across three historical periods, employing diverse analytical approaches. Intervention strategies should account for the interconnectedness of structural racism across different historical periods and systems of inequality. A holistic approach that is both comprehensive and substantial in scope is needed to effectively reduce structural racism and promote community well-being. It is imperative that future efforts center on dismantling structural racism to achieve lasting social justice and community safety.

Chapter 4: Examining the Interplay of Structural Racism and Community Firearm Violence in New York City

4.1 Introduction

Researchers in criminology and related fields have highlighted the advantages of directing crime prevention strategies toward specific high-crime areas. Crime, including community firearm violence, concentrates in very small units of geography.^{10,166-168} Weisburd's law of crime concentrations finds that "for a defined measure of crime at a specific microgeographic unit, the concentration of crime will fall within a narrow bandwidth of percentages for a defined cumulative proportion of crime".^{12,13} For large cities, half of all crime is half of all crime is concentrated between 4.2 (Sacramento) and 6% (Cincinnati) of street segments.¹⁶⁷ Smaller cities follow a similar pattern, with half of all crime concentrated between 2.1 (Brooklyn Park; Redlands) and 3.5% (Ventura) of street segments.¹⁶⁷ These micro-geographic hot spots have substantial implications for public health strategies and interventions. Understanding and addressing the underlying causes of such concentrated violence is crucial. These hot spots often coincide with areas suffering from systemic issues such as poverty, limited access to education and healthcare, and the effects of structural racism.

Many scholars suggest that law enforcement could more effectively tackle crime by concentrating their efforts on these consistently high-crime locations (i.e., hot spot policing).¹⁶⁹⁻
¹⁷² In the past two decades, seven systematic reviews with six accompanying meta-analyses have consistently shown that targeted police interventions in these hot spots effectively prevent crime and disorder.¹⁷³⁻¹⁷⁹ The interventions range from increased patrols to community policing efforts tailored to specific neighborhood issues, all aimed at disrupting patterns of criminal behavior.

However, a common concern with hot spot policing is the potential for crime displacement, which is the shifting of criminal activity from the targeted area to nearby locations, as offenders move to avoid police detection. Despite these concerns, empirical evidence suggests that crime displacement is minimal.¹⁷³⁻¹⁷⁹ Moreover, these interventions have been observed to generate unexpected positive outcomes, such as the diffusion of crime control benefits, where areas adjacent to the hot spots also experience a decrease in crime.

Among these hot spot policing interventions, stop, question, and frisk (SQF) is a notable example. SQF refers to instances in which an officer stops an individual for whom they have a reasonable cause. Due to policies, that give the police legal coverage for these actions, the officer can proceed to ask questions to determine if the individual is participating in an illegal act. During the stop, if the officer believes a person is carrying a weapon, the officer can search or frisk the individual. A recent systematic review of SQF on crime and individual-level outcomes found mixed results.¹⁸⁰ While SQF has been linked to significant crime reductions in targeted areas and even diffusion of crime control benefits to nearby areas, there are also notable negative consequences.¹⁸⁰ These include increased mental health issues, deteriorating attitudes towards police, and higher levels of self-reported crime and delinquency among individuals subjected to SQF.¹⁸⁰

Hot spot policing is supported by two theoretical mechanisms: deterrence and crime opportunity reduction.^{181,182} Deterrence theory posits that augmenting police presence in areas known for high crime rates can yield a deterrent effect.¹⁸³ This approach is based on the principle that if potential offenders perceive a heightened risk of being caught due to increased police visibility,

they may be less inclined to engage in criminal activities within these targeted areas. The underlying assumption is that the fear of apprehension and subsequent legal consequences acts as a powerful motivator in dissuading individuals from committing crimes. Studies and experiments supporting this theory suggest that when police presence is intensified in crime-prone “hot spots”, it can lead to a significant reduction in crime rates, primarily due to this perceived risk among potential offenders. Alternatively, the theory of crime opportunity reduction takes a slightly different approach. Rather than relying solely on the presence of law enforcement as a deterrent, this strategy involves police actively engaging in problem-oriented policing and situational crime prevention tactics.¹⁷² The focus is on altering the environmental and situational factors that are often associated with recurring criminal activities. This may include measures such as improving street lighting, increasing community surveillance, or modifying urban landscapes to reduce concealment opportunities for criminal activities. The essence of this approach is to identify and mitigate the underlying causes that facilitate the occurrence of crime, thereby reducing the opportunities for crime to take place. While both deterrence and crime opportunity reduction share the common goal of reducing crime in high-risk areas, SQF is primarily supported by deterrence theory.

While hot spot policing is theoretically posited to mitigate crime, such research often inadequately addresses the racially disparate impact on victimization within these areas. Specifically, residents racialized as Black and Hispanic experience a higher risk of victimization in crime hot spots compared to their White counterparts, a disparity that cannot be solely explained by the spatial distribution of the residential population. For instance, an analysis of data from Philadelphia during 2020-2021 reveals a stark disparity: residents racialized as Black

were 13.8 times more likely to fall victim to shootings than residents racialized as White.¹⁸⁴ This rate of victimization surpasses what would be predicted merely by the concentration of residents in these neighborhoods, indicating that there are other variables at play influencing this disproportionality. The effectiveness of hot spot policing practices such as SQF must be reconciled with the critical issue of racial bias. It is essential to consider the complex social dynamics and systemic factors that contribute to the heightened risk of victimization among racialized communities. The implementation of hot spot policing, therefore, requires a nuanced approach that not only addresses the incidence of crime but also actively works to mitigate the potential for racial bias in law enforcement practices, ensuring that the goal of enhancing public safety does not inadvertently exacerbate racial disparities.

The aim of this study is to isolate the effect of a single domain of structural racism (i.e., criminal justice system) in New York City (NYC). NYC is one well-known example where SQF practices have been questioned for racial biases. In 2013, a judicial ruling held that the New York Police Department's (NYPD) implementation of SQF breached the Fourth Amendment by conducting unreasonable searches and seizures, and the Fourteenth Amendment, as it disproportionately targeted individuals racialized as Black and Hispanic—a pattern not fully explainable by local demographic variances alone.^{185–187} Despite over four million stops from 2004 to 2012, these encounters seldom resulted in arrests or uncovered illegal activities, instead often inciting stress, feelings of disempowerment, and potentially escalating tensions.^{188(p201),189–191} I posit that findings from previous research suggesting reductions in crime due to hot spot policing should be re-evaluated to account for the influence of underlying structural racism. I hypothesize that the true impact of SQF on community firearm violence may be minimal or, in some cases,

potentially harmful. This hypothesis is based on the premise that such policing strategies may exacerbate existing community tensions and distrust, potentially undermining the overall safety and cohesion within these communities.

4.2 Methods

4.2.1 Study population

As of 2022, NYC has a population of 8.3 million, with 23.4% of individuals racialized as Black.¹⁹² To explore the relationship between SQF encounters and shooting incidents in NYC, I selected census block groups nested in census tracts as the unit of analysis (n=6,493). This nested structure accounts for the possibility that observations of block groups within the same census tract are more likely to be similar to one another than observations of block groups from different tracts.

4.2.2 Data and variables

Exposure variable. I obtained SQF data from the NYPD for 2015-19.¹⁹³ The NYPD database includes information at the event level for individuals stopped by a police officer in NYC. Available fields in the data describe the time, date, detailed information on the stop (i.e., reason for the stop, whether contraband was found, whether physical force was used, etc.), detailed information on the individual stopped (i.e., age, sex, race, height, weight, eye color, hair color, etc.), and location of the stop. Each row signifies a single SQF encounter. Data are available from 2003 to 2022. Data used for this analysis included the date and location of each SQF encounter.

I summed the total number of SQF encounters per block group year and constructed a categorical variable divided into tertiles (“low”, “medium”, “high”) to analyze the data. This decision to not treat SQF encounters as a continuous variable was based on several key considerations. First, there was notable variance in the annual count of SQF encounters across different block groups. Second, I believe that the impact of SQF encounters is not linear. A mere incremental increase in the count of SQF encounters may not correspond to a proportionate change in their effect or significance. Finally, there is a qualitative difference between areas with low and high frequencies of SQF encounters. This difference is more effectively captured through categorical classification rather than a continuous scale. By categorizing SQF frequency, the analysis can more accurately reflect the diverse nature and potential consequences of SQF encounters in various block groups.

Outcome variable. I also obtained shooting data from the NYPD for 2015-19.¹⁹⁴ The NYPD database includes every shooting victim as a result of interpersonal violence in NYC. The data are manually extracted every year and reviewed by the Office of Management Analysis and Planning before being posted on the NYPD website. Available fields in data describe the time, date, and geographic coordinates of the shooting incident. Each row signifies a single individual shot, and information related to suspect and victim demographics (sex, age, race) and whether the shooting was fatal or non-fatal are included. Data are available from 2006 to the present. Data used for this analysis included the date and location of each shooting incident. I summed the total number of shootings per block group year and modeled this as the outcome.

Control variables. To mitigate the confounding effects of structural racism in this analysis, I selected a comprehensive range of indicators: rates of mortgage lending denials, the prevalence of food deserts, tree canopy coverage, school suspension rates, and the density of alcohol outlets, both on- and off-premise (**Table 4.1**). This selection process was strategic, aiming to isolate the unique impact of policing within the complex matrix of factors that contribute to structural racism. Such an approach facilitates a more precise examination of the discrete consequences attributed to SQF practices.

I used data from the Home Mortgage Disclosure Act,¹⁵⁷ US Department of Agriculture,¹⁵⁹ NYC Open Data,^{195–197} and DATA.NY.GOV.¹⁹⁸ For mortgage lending denial, I computed Black-non-Black differences by dividing the total number of persons racialized as Black who were denied a home loan by the total number of home loan denials. This approach, focusing on Black-non-Black disparities rather than the more traditional Black-White comparison,^{24,113} is crucial as it encompasses a broader range of racial dynamics and socio-economic contexts, providing a more inclusive and nuanced understanding of racial inequalities and their implications across NYC. For assessing food deserts, I used the proportion of the population in each census tract population that is beyond ½ mile from the supermarket. This metric is crucial for understanding access to healthy food options and its correlation with structural racism. The tree canopy coverage, school suspension rates, and the density of alcohol outlets were each quantified by summing the total counts per census block group. These varied indicators collectively provide a multifaceted and robust measure of structural racism's impact, enabling a more thorough understanding of its complex and pervasive effects on the urban landscape and its inhabitants.

Table 4.1. Control variables

Domain	Variable	Description	Formula	Year	Unit
Housing	Mortgage lending denial	Average proportion of individuals racialized as Black who were denied home loans	$p_{black_denial} = \frac{black_denial}{total_denial}$	2010-2017	Tract
	Census of Trees	Total number of trees per block group	$total_tree = sum(trees)$	2015	Block group
Economic	Food desert	Proportion of the tract population that is beyond 1/2 mile from the supermarket	NA	2015	Tract
	Alcohol outlets	Count of on premise alcohol outlets	$AO_{on} = sum(on\ premise\ AO)$	2019 and earlier	Block group
		Count of off premise alcohol outlets	$AO_{off} = sum(off\ premise\ AO)$	2019 and earlier	Block group
Education	School measure	Total number of students with two or more suspensions and/or removals	$total_susp = sum(suspensions)$	2015-2016 + 2017-2018	Block group

4.2.3 Statistical analysis

I performed a multi-level negative binomial panel analysis to examine the association between the incidence of shootings (Y) in block group i within census tract j over time t . The negative binomial model was chosen due to the over-dispersion observed in the shooting data. The model is defined as:

$$Y_{ijt} | \mu_{ijt} \sim \text{Negative Binomial}(E_{ij} \exp(\mu_{ijt}), \theta)$$

Here, E_{ij} represents the land area of block group i in tract j , which functions as the offset in the model. The expected count μ_{ijt} is the log-linear predictor of the shooting incidence rate per year. The term $E_{ij} \exp(\mu_{ijt})$ gives the mean of the negative binomial distribution for the shooting

incidents, while θ represents the dispersion parameter, accounting for the over-dispersion in the count data.

I modeled the log of the incidence rate linearly:

$$\mu_{it} = \beta_{00} + \beta_{01}X_j + \beta \cdot X'_{ijt} + \varphi_i + \omega_t$$

Here, β_{00} represents the overall model intercept, while β_{01} is the random intercept for census tract j , capturing the variation across tracts. The vector β includes fixed effect coefficients for the covariates in matrix X'_{ijt} , which encompasses variables such as SQF encounters, the baseline rate of SQF encounters and shooting incidents, and selected indicators of structural racism. I used data from 2014 to calculate the baseline rate of SQF encounters and shooting incidents because it follows the landmark 2013 court ruling that deemed SQF practices in NYC unconstitutional, leading to substantial changes in SQF implementation and policy. The term φ is a conditional autoregressive random effect that controls for the loss of unit independence, identified using a matrix of adjacent block groups with 1 km distance neighbors. The term ω_t is included to account for the temporal fluctuations deviating from the average linear trend over the five-year period across all block groups. To determine whether un-modeled spatial dependencies in the data had affected the estimates, I applied Moran's I test to the deviance residuals and compared the results of a null model to the final model.

I restricted analyses to block groups that had 1 or more SQF encounters documented from 2014 to 2019. This decision was guided by the need to address inherent positivity violations.¹⁹⁹ Block groups without documented SQF encounters might differ significantly in many unmeasured ways from those with documented SQF encounters. This approach helps ensure that the

comparisons made are between more similar and thus comparable groups, enhancing the validity of the research findings.

I calculated the Incidence Rate Ratios (IRRs) using the coefficients derived from the estimated model. These IRRs measure the relative rate of shooting incidents in block groups, categorized based on their frequencies of SQF encounters. Specifically, I compared block groups with a “medium” frequency of SQF encounters (4-6 incidents) and those with a “high” frequency (7 or more incidents) against block groups that had a “low” frequency of SQF encounters (1-3 incidents). Models 1 and 2 were aspatial and did not account for any spatial dependencies. Model 1 included the exposure variable and the baseline rate of SQF encounters and shooting incidents. Model 2 additionally adjusted for the indicators of structural racism and the block group population per 1,000. Models 3 and 4 were spatial and estimated using *R-INLA*, which calculates the Integrated Network Laplace Approximation of a fully Bayesian model.^{200,201} Both models replicated the analysis conducted in Models 1 and 2 (respectively), with the addition of the time-invariant conditional autoregressive random effect to capture the spatially structured error.

Sensitivity Analysis. To improve generalizability, I conducted a sensitivity analysis reincorporating the block groups that had zero documented SQF encounters. Consistent with the main analysis, the exposure variable was categorized into tertiles. Following the recalculation of these tertiles, I calculated the IRRs, which quantified the relative rate of shooting incidents in block groups categorized by varying frequencies of SQF encounters. Specifically, I compared block groups with a “medium” (1-2 SQF encounters) and “high” (3 or more SQF encounters) frequency of SQF incidents to those classified as having a “low” frequency (0 SQF encounters).

4.3 Results

The final dataset comprised of 1,207 census block groups in 818 census tracts, observed over five years (2015-19), culminating in a total of 6,053 block group years. Throughout this period, 35,473 SQF encounters, and 2,594 shooting incidents were recorded (**Table 4.1**). On average, each block group year observed 5.9 SQF encounters (SD = 6.7) and 0.4 shooting incidents (SD = 1.0). The data revealed a wide range of frequencies in these encounters: the highest number of SQF encounters recorded in a single block group year was 101, while the maximum number of shooting incidents in a block group year reached 12. Comprehensive summary statistics for other variables included in the study are also systematically presented in **Table 4.2**. A map of the distribution of SQF encounters and shooting incidents for 2015 can be found in **Figure 4.1**. Maps of the annual distribution of SQF encounters and shooting incidents can be found in **Appendix B**.

Table 4.2. Descriptive characteristics of New York City census block group year included in the study, 2015-2019 (n=6,053)

Variable	Mean	SD	Minimum	Maximum
Stop, question, and frisk (SQF)	5.9	6.7	1	101
Shootings	0.4	1.0	0	12
Baseline SQF (2014)	17.4	23.1	1	296
Baseline shootings (2014)	0.5	1.2	0	13
Mortgage lending denial (%)	16.6	21.6	0	100
Census of trees	104.8	112.4	0	1,065
Food desert (%)	2.2	11.6	0	100
School suspension	4.6	17.5	0	254
On-premise alcohol outlets	1.6	4.0	0	45
Off-premise alcohol outlets	1.1	1.3	0	10
Block group population (per 1,000)	1.5	0.8	0	7.8

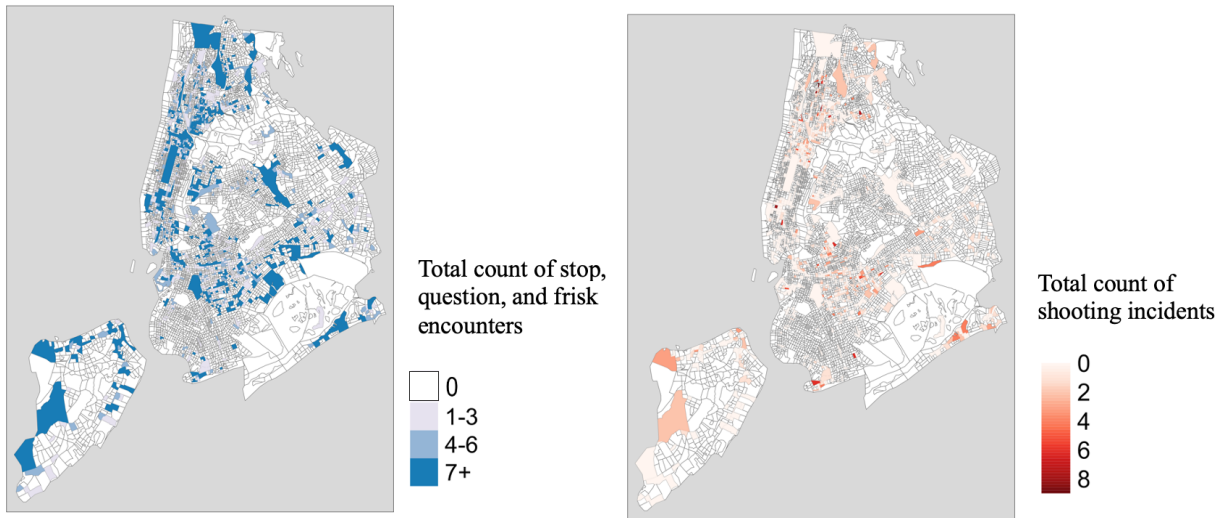


Figure 4.1. Map of stop, question, and frisk encounters and shootings incidents in census block groups in New York City in 2015

4.3.1 Model 1 and 2 results (aspatial)

Models 1 and 2 both revealed a statistically significant positive association between SQF encounters and shooting incidents (**Table 4.3**). Census block groups with medium and high documented frequency of SQF encounters were associated with a statistically significant positive increase in shooting incidents compared to census block groups with low documented frequency. Controlling for indicators of structural racism, the relationship between SQF encounters and shooting incidence persisted. The results of the sensitivity analysis were similar and can be found in **Appendix C**. Moran's I test found a reduction in spatial autocorrelation in the deviance residuals for the full model (Moran's I = 0.0132, $p < 0.001$) compared to the null model (Moran's I = 0.0005, $p = 0.409$).

Table 4.3. Model results for aspatial multi-level negative binomial panel analysis estimating the association between stop, question, and frisk (SQF) encounters and shooting incidents in New York City block groups¹ nested in tracts (2015-2019)

	Model 1		Model 2	
	IRR	95% CI	IRR	95% CI
Low (1-3 SQF encounters)		REF		REF
Medium (4-6 SQF encounters)	1.20	(1.03, 1.41)	1.22	(1.05, 1.41)
High (7+ SQF encounters)	1.26	(1.08, 1.47)	1.35	(1.17, 1.57)
Baseline SQF (2014)	1.00	(1.00, 1.01)	1.00	(1.00, 1.01)
Baseline shoot (2014)	1.28	(1.20, 1.37)	1.19	(1.13, 1.26)
Year	0.90	(0.86, 0.94)	0.90	(0.87, 0.94)
Mortgage lending denial			1.33	(1.22, 1.45)
Census of trees			0.49	(0.45, 0.55)
Food desert			0.77	(0.67, 0.88)
School Suspension			1.02	(0.97, 1.08)
On premise AO			0.78	(0.72, 0.84)
Off premise AO			0.99	(0.93, 1.06)
Block group population (per 1,000)			1.19	(1.08, 1.31)

¹ Excludes block groups with 0 SQF encounters

* Bolded values are statistically significant at an alpha of 0.05

4.3.2 Model 3 and 4 results (spatial)

Models 3 and 4, which replicated analyses in 1 and 2 (respectively) while adjusting for spatially structured error, both revealed a sustained statistically significant positive association between SQF encounters and shooting incidents (**Table 4.4**). Census block groups with medium and high documented frequency of SQF encounters were associated with a statistically significant positive increase in shooting incidents compared to census block groups with low documented frequency. Controlling for indicators of structural racism, the relationship between SQF encounters and shooting incidence persisted. The results of the sensitivity analysis were similar and can be found in **Appendix C**.

Table 4.4. Model results for spatial multi-level negative binomial panel analysis estimating the association between stop, question, and frisk (SQF) encounters and shooting incidents in New York City block groups¹ nested in tracts (2015-2019)

	Model 3		Model 4	
	IRR	95% CrI	IRR	95% CrI
Low (1-3 SQF encounters)		REF		REF
Medium (4-6 SQF encounters)	1.21	(1.06, 1.39)	1.21	(1.06, 1.39)
High (7+ SQF encounters)	1.43	(1.24, 1.63)	1.42	(1.24, 1.63)
Baseline SQF (2014)	1.01	(1.01, 1.01)	1.01	(1.00, 1.01)
Baseline shoot (2014)	1.21	(1.15, 1.27)	1.18	(1.12, 1.24)
Year	0.91	(0.86, 0.96)	0.91	(0.87, 0.96)
Mortgage lending denial			1.23	(1.14, 1.33)
Census of trees			0.87	(0.77, 0.99)
Food desert			0.88	(0.76, 1.01)
School Suspension			1.04	(0.99, 1.09)
On premise AO			0.93	(0.87, 1.01)
Off premise AO			1.00	(0.94, 1.05)
Block group population (per 1,000)			1.18	(1.08, 1.29)

¹ Excludes block groups with 0 SQF encounters

* Bolded values are statistically significant at an alpha of 0.05

4.4 Discussion

This study's findings contribute to a complex and critical discourse on the efficacy and repercussions of hot spot policing strategies, specifically SQF. In spatial models after adjusting indicators of structural racism and spatially structured error, census block groups with medium and high documented frequency of SQF encounters were associated with a statistically significant positive increase in shooting incidents compared to census block groups with low documented frequency. These findings suggest that SQF encounters are associated with a significant increase in community firearm violence, which stands in stark contrast to the intended outcomes of such policing strategies.

Historically, hot spot policing has been supported by two theories: deterrence and crime opportunity reduction. These theories suggest that a heightened police presence in areas frequently experiencing criminal activities can play a pivotal role in deterring potential offenders and minimizing the opportunities for crimes to take place.^{181,182} Findings from two previous studies evaluating the use of SQF as a hot spot policing practice in NYC support these theories. Weisburd and colleagues (2015) examined the impact of SQF on crime on street segments using short time periods.²⁰² MacDonald and colleagues (2016) implemented a comparative analysis of monthly crime statistics within designated impact zones (i.e., high crime areas) against those from other city regions, providing a granular assessment of hot spot policing's effectiveness.¹⁵ Both these studies concluded that the SQF practices were associated with crime reduction, aligning with the proactive policing models they examined. However, my research presents a contrasting narrative. My findings indicate that the application of SQF practices is associated with an increase in shooting incidents in NYC, thereby suggesting not just an absence of the intended deterrent effect but a possible aggravation of community firearm violence. Of note, the outcome in the two previous studies was crime broadly. The authors did not specifically look at the association with community firearm violence. This distinction is crucial because while SQF may influence general crime rates, its impact on more severe and specific forms of crime, such as shootings, could be fundamentally different.

The current discourse on the efficacy of SQF practices necessitates a comprehensive analysis that extends beyond the simplistic crime reduction narrative. While conventional empirical evidence has supported the notion that focused policing in hot spots can suppress crime,¹⁷³⁻¹⁷⁹ the nuanced reality revealed by my research suggests greater complexity in the hypothesized

mechanism. In environments where SQF practices are prevalent, an atmosphere fraught with tension and mistrust can emerge. This not only undermines the relationship between law enforcement and the community but also, paradoxically, may escalate the likelihood of violent incidents, such as shootings, rather than diminish them. This counterintuitive outcome suggests a need for a closer inspection of how these practices are implemented and perceived on the ground. By incorporating controls for indicators of structural racism and spatial autocorrelation, my findings expose the uneven burden borne by marginalized communities. The disproportionate targeting of residents, especially those racialized as Black and Hispanic,^{203,204} emphasizes policing strategies must be not only evaluated through the lens of crime statistics but also through their societal and psychological impacts on the communities they are meant to serve. Several studies already have found increased mental health issues, deteriorating attitudes toward police, and higher levels of self-reported crime and delinquency among individuals subjected to SQF.¹⁸⁰ This calls for a pivot in research methodologies and policing policies that prioritize equity, community engagement, and trust-building as central components of public safety strategies.

Furthermore, my results highlight the need to address structural racism as a root cause of community firearm violence specifically. The impact of policing strategies, such as SQF, cannot be isolated from the broader context of systemic inequalities and historical injustices that shape society. Structural racism, entrenched in various societal institutions, contributes to a range of disparities, from socioeconomic imbalances to differential access to resources and opportunities. These disparities often manifest in marginalized communities leading to higher instances of crime, including community firearm violence. When policing strategies like SQF are

implemented within this context they do not operate in a vacuum. Instead their impact is intertwined with these deeper, systemic issues. This interconnection means that any attempt to evaluate the effectiveness of specific policing strategies must consider how these strategies intersect with and are influenced by structural racism. For instance, the implementation of SQF might disproportionately target certain racial or ethnic communities, not necessarily because of higher crime rates, but due to pre-existing biases and stereotypes. Such practices can exacerbate community tensions, erode trust in law enforcement, and contribute to a cycle of disenfranchisement and violence.

Focusing solely on policing strategies without addressing the root causes of firearm violence may lead to short-term solutions that fail to address the long-term sustainability of safer communities. Policing tactics must be informed by an understanding of the social determinants of firearm violence and efforts to reduce community firearm violence must be balanced with the imperative to uphold civil liberties and promote equitable treatment across communities. Historical evidence points to laws such as harsh mandatory minimum prison sentences for illegal gun possession that have led to racial disparities in arrests and incarceration rates, disproportionately affecting Americans racialized as Black. These laws have not only failed to alleviate the burden of community firearm violence but have also contributed to a situation where men racialized as Black are more likely to be stopped by police,²⁰⁵ arrested, denied bail,^{206,207} convicted,²⁰⁸ wrongfully convicted,²⁰⁹ and issued longer sentences compared to men racialized as White.²¹⁰ Alarming while Americans racialized as Black constitute only 13% of the US population, they represent 40% of the total incarcerated population.^{211,212}

4.4.1 Limitations

This study has several limitations. First, this study has limited generalizability. The selection of NYC as a study setting was informed by the accessibility of SQF data, historical patterns of policing inequality, and the presence of a broad spectrum of underrepresented communities. These distinct characteristics may render the findings less applicable to other locales. To ascertain the definitive impact of SQF practices on community firearm violence, a comparative analysis across various settings is imperative. Additionally, despite the mandate for the NYPD to document SQF encounters,²¹³ there are credible concerns and verified instances of underreporting.²¹⁴ The extent to which the SQF data is comprehensive remains uncertain.²¹⁵ Consequently, the dataset utilized in this study may significantly underestimate the frequency of SQF encounters within the study's timeframe. This potential underrepresentation could skew the perceived influence of SQF practices on community firearm violence in NYC.

4.5 Conclusion

This analysis provides a revealing perspective on the interplay of SQF practices and the wider context of structural racism, suggesting that these policing strategies operate within a complex web of societal inequities. The entanglement of SQF with such broader dynamics necessitates a critical reassessment of these practices. It is imperative to consider their ramifications not only on crime statistics but also on public health and community safety, especially within marginalized communities that bear the brunt of aggressive policing tactics and structural disparities. Future research and policy development should explore innovative, community-centric approaches that empower informal social control mechanisms.

Chapter 5: Conclusions

5.1 Overview

The goal of this dissertation is to advance prior research by establishing the relationship between historical structural racism and the prevalence of community firearm violence in US cities. First I conducted a comprehensive review of the literature regarding different approaches to quantifying “structural racism” and its association with community firearm violence (**Aim 1**). Recognizing the lack of explicit articulation and testing of the longitudinal association between structural racism and community firearm violence nationally, I proceeded to analyze the impact of historical structural racism on current trends and patterns of community firearm violence in US cities across 3 historical time periods (**Aim 2**). Finally, building off these insights, I isolated the unique impact of a single domain within the complex matrix of systems that contribute to structural racism on a smaller geographic scale (**Aim 3**). This multi-faceted approach aimed not only to illuminate the intricate dynamics of structural racism and community firearm violence but also to contribute towards developing more effective strategies for reducing such inequities in urban settings.

5.2 Summary of findings

In **Aim 1** I systematically examined and synthesized literature from 1990 to June 2023 to identify approaches for measuring the construct of structural racism and its association with community firearm violence in the US. My investigation revealed two primary methods: single-domain and multiple-domain approaches. Despite the varied nature of these measurements, a consistent finding across all studies was the positive association between structural racism and the incidence of firearm violence. This body of research collectively identifies a significant link

between structural racism and increased risks of community firearm violence in cities, with variations in intensity and geographic units of analysis. However, a notable gap in the literature is the lack of exploration into the temporal dynamics of structural racism. This involves investigating how the influence and manifestations of structural racism have evolved over time. Such an examination is crucial, as it can reveal changing patterns and trends in structural racism, illuminating the impact of historical contexts and enduring policies on contemporary community firearm violence in cities.

In **Aim 2** I conducted a multi-level cross-sectional ecological analysis to examine the effect of historical structural racism on contemporary patterns of community firearm violence in US cities. This exploration spanned three distinct historical time periods. My research found substantial evidence suggesting the persistent effects of structural racism on community firearm violence in cities across several decades. A key finding was the significant association between each historical phase and a heightened risk of such violence. This relationship was especially pronounced in modern times, supporting my hypothesis that the most recent historical time period demonstrates the most substantial effect. This may be attributed to the persistent effects of structural racism over time.

In **Aim 3** I conducted a multi-level panel ecological analysis to test the association between hot spot policing, a potential key marker of structural racism, and community firearm violence in NYC. After controlling for various indicators of structural racism and spatial dependencies, my analysis indicated that census block groups with a medium or high documented frequency of SQF encounters experienced a statistically significant increase in shooting incidents compared to

those with a low documented frequency. These results imply that SQF tactics are associated with a notable rise in community firearm violence, a finding that sharply contrasts with the intended objectives of such policing methods.

5.3 Significance of findings

The findings from this dissertation provide a comprehensive and nuanced understanding of the relationship between historical structural racism and community firearm violence in US cities. A significant constraint arises from the scarcity of historical data that could be employed to fulfill requirements related to conditional exchangeability assumptions. However, I emphasize that evidence does not negate the presence of structural racism.

Aim 1 establishes a foundational understanding of how structural racism can be measured and its direct association with community firearm violence. The findings from **Aim 2** are critical for policymakers and community leaders, as they indicate that contemporary issues of firearm violence in cities cannot be fully addressed without acknowledging and rectifying the historical roots of structural racism. **Aim 3** not only examines a specific manifestation of structural racism but also reinforces the understanding that structural racism is a complex and layered phenomenon. It manifests in various forms across different geographic scales and is deeply entwined with broader systems of inequality. This comprehensive approach across the three aims provides a multifaceted view of structural racism's role in community firearm violence, offering critical insights for effective policy and community interventions.

5.4 Future directions

The growing body of literature exploring the relationship between structural racism and firearm violence presents numerous opportunities for further study. I employed quantitative techniques to evaluate the association between historical structural racism and community firearm violence across US cities (**Aim 2**). Future research could employ qualitative methods such as interviews and focus groups to capture the personal narratives and perspectives of individuals who have experienced the consequences of firearm violence and structural racism firsthand. By doing so we can enrich the quantitative findings with experiential insights, adding a critical human element to the data. This integration would not only deepen our understanding but also highlight the tangible impacts of these issues in everyday life.

Additionally there is a need for continued research investigating upstream interventions. In **Aim 3**, my focus was on examining the unique impact of the criminal justice system, specifically through SQF policing practices. However, understanding the impact of these practices is only a starting point. To truly address the root causes of community firearm violence, it is imperative to test upstream interventions that target the systemic conditions of structural racism. This includes but is not limited to evaluating policies and programs aimed at reducing social and economic inequalities, improving community-police relations, enhancing educational opportunities, and promoting access to mental health services. These interventions require a multidisciplinary approach integrating insights from sociology, psychology, public health, and criminology to understand the multifaceted nature of firearm violence. Ultimately such research will contribute to the development of comprehensive, evidence-based strategies that not only address the

symptoms of community firearm violence but also tackle structural racism as a fundamental cause of inequities in the risk of firearm violence.

Finally the study of firearm injury epidemiology in the US is constrained by data availability and variability, complicating efforts to conduct generalizable research. Uniform data across different datasets would greatly aid researchers conducting multi-city studies on community firearm violence, potentially enhancing the accuracy of commonly used data sources such as the Gun Violence Archive (GVA). Given that the GVA is a small, independent data collection group, partnerships with local police departments or the Centers for Disease Control and Prevention (CDC) could be invaluable. Such collaborations could aim to create a comprehensive data repository for community firearm violence research, encompassing all types of firearm injuries and including detailed geographic information.

5.5 Conclusion

Addressing the multifaceted dimensions of structural racism and its impact on community firearm violence demands a concerted effort that spans beyond traditional quantitative methods. The overarching theme that emerges is the necessity for large-scale, innovative solutions to address the deeply entrenched issues of structural racism and firearm violence. Future research, by broadening its scope and deepening its inquiry into the temporal, spatial, and intersectional dynamics, holds the potential to not only enhance our understanding but also inform the development of effective interventions. As this dissertation concludes, it becomes evident that the challenge posed by structural racism and firearm violence is immense, yet so must our commitment to devising solutions that are equally robust, nuanced, and widespread.

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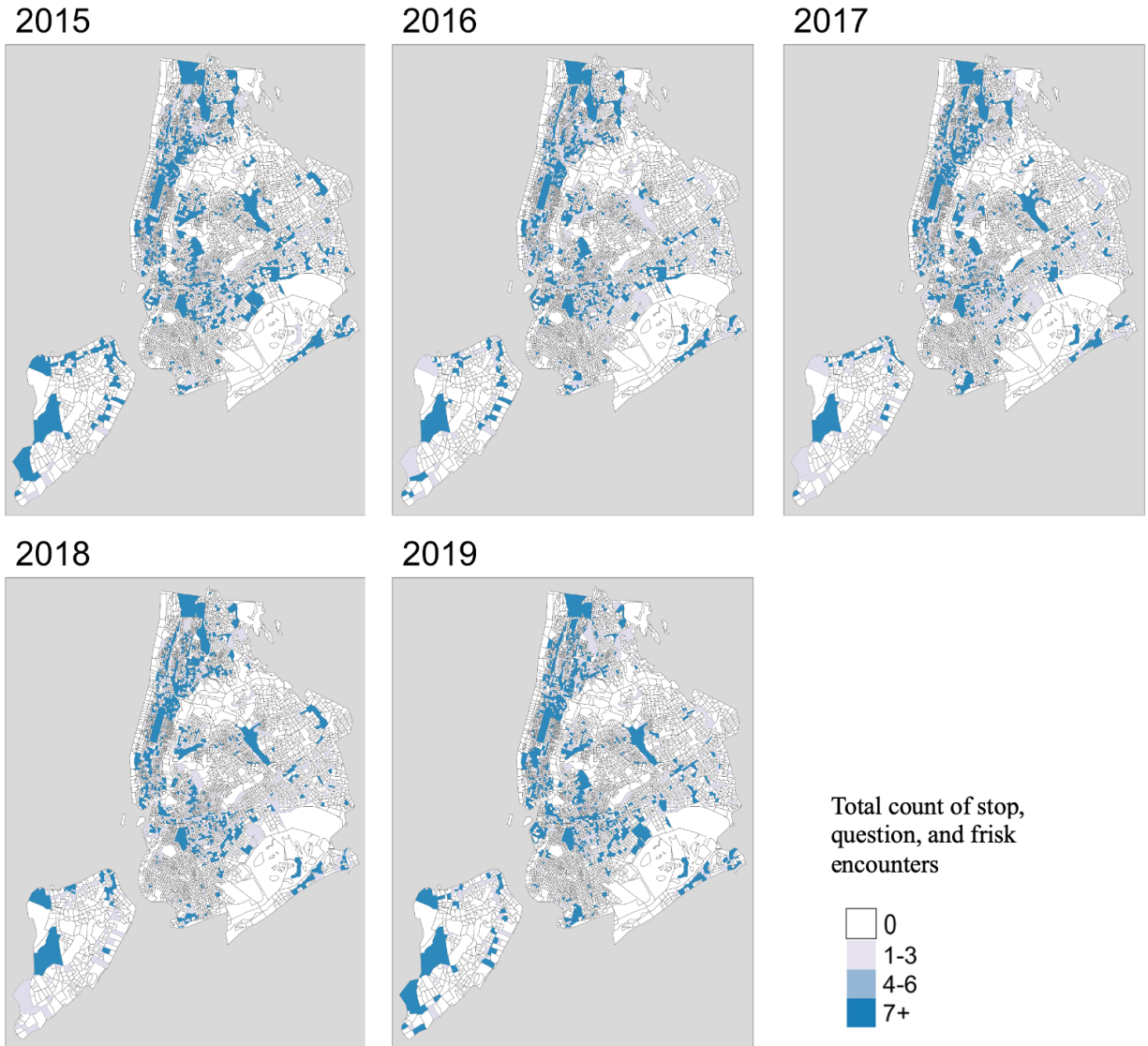
Appendix A: Table for Aim 2

Appendix Table A.1. Structural equation model semi-log-linear results for the association between historical structural racism and community firearm violence in cities, 2015-19 (n=397)

	log(All Shootings per 100K)		log(Fatal Shootings per 100K)		log(Nonfatal Shootings per 100K)	
	Beta	95% CI	Beta	95% CI	Beta	95% CI
Historical Period 1- Before the Civil Rights Act of 1968 (1900-68) on Historical Period 2- After Desegregation/Integration (1970-2000)	0.23	(0.14, 0.31)	0.23	(0.14, 0.31)	0.23	(0.14, 0.31)
Historical Period 2- After Desegregation/Integration (1970-2000) on Historical Period 3- Modern Times (2010-19)	0.71	(0.64, 0.77)	0.71	(0.64, 0.77)	0.71	(0.64, 0.77)
Historical Period - Before the Civil Rights Act of 1968 (1900-68) on Shootings	0.24	(0.04, 0.43)	0.09	(-0.09, 0.26)	0.31	(0.08, 0.54)
Historical Period - After Desegregation/Integration (1970-2000) on Shootings	0.84	(0.54, 1.15)	0.82	(0.55, 1.09)	0.88	(0.53, 1.23)
Historical Period 3- Modern Times (2010-19) on Shootings	0.93	(0.63, 1.24)	0.67	(0.40, 0.95)	1.11	(0.75, 1.47)

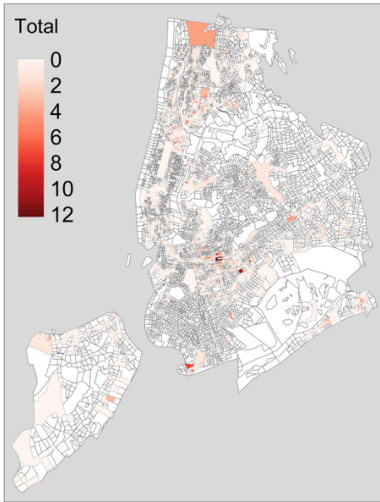
* Bolded values are statistically significant at alpha of 0.05

Appendix B: Maps for Aim 3

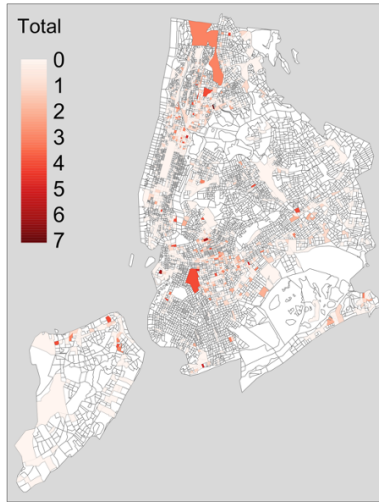


Appendix Figure B.1. Annual count of stop, question, and frisk encounters by census block group in New York City (2015-19)

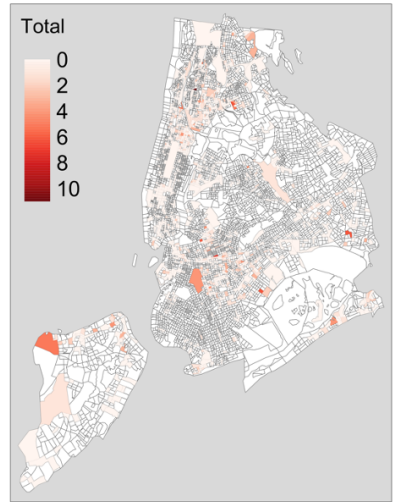
2015



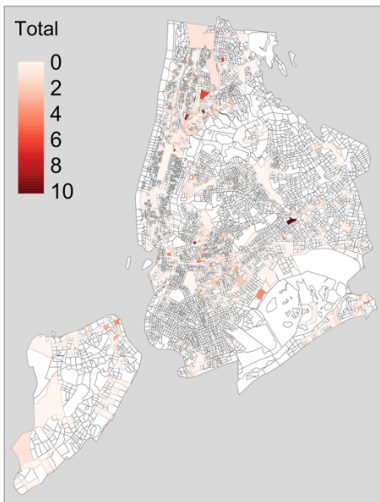
2016



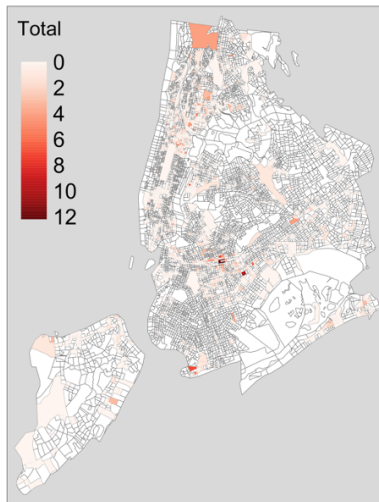
2017



2018



2019



Appendix Figure B.2. Annual count of shooting incidents by census block group in New York City (2015-19)

Appendix C: Sensitivity Analyses Aim 3

Appendix Table C.2. Model results for aspatial multi-level negative binomial panel analysis estimating the association between stop, question, and frisk (SQF) encounters¹ and shooting incidents in New York City block groups¹ nested in tracts (2015-2019)

	Model 5		Model 6	
	IRR	95% CI	IRR	95% CI
Low (0 SQF encounters)		REF		REF
Medium (1-2 SQF encounters)	1.58	(1.42, 1.76)	1.61	(1.44, 1.79)
High (3+ SQF encounters)	2.10	(1.88, 2.34)	2.17	(1.94, 2.42)
Baseline SQF (2014)	1.02	(1.01, 1.02)	1.02	(1.01, 1.02)
Baseline shoot (2014)	1.31	(1.25, 1.37)	1.26	(1.20, 1.31)
Year	0.89	(0.87, 0.92)	0.89	(0.87, 0.92)
Mortgage lending denial			1.77	(1.65, 1.89)
Census of trees			0.58	(0.54, 0.63)
Food desert			0.61	(0.56, 0.67)
School Suspension			1.05	(1.01, 1.09)
On premise AO			0.85	(0.80, 0.91)
Off premise AO			1.11	(1.06, 1.16)
Block group population (per 1,000)			1.27	(1.19, 1.36)

¹ Includes block groups with 0 SQF encounters

* Bolded values are statistically significant at an alpha of 0.05

Appendix Table C.2. Model results for spatial multi-level negative binomial panel analysis estimating the association between stop, question, and frisk (SQF) encounters¹ and shooting incidents in New York City block groups nested in tracts (2015-2019)

	Model 7		Model 8	
	IRR	95% CrI	IRR	95% CrI
Low (0 SQF encounters)		REF		REF
Medium (1-2 SQF encounters)	1.55	(1.40, 1.71)	1.49	(1.34, 1.64)
High (3+ SQF encounters)	2.19	(1.98, 2.43)	2.03	(1.83, 2.25)
Baseline SQF (2014)	1.02	(1.02, 1.03)	1.02	(1.02, 1.03)
Baseline shoot (2014)	1.27	(1.22, 1.32)	1.23	(1.18, 1.28)
Year	0.90	(0.86, 0.94)	0.90	(0.87, 0.92)
Mortgage lending denial			1.29	(1.20, 1.38)
Census of trees			0.87	(0.80, 0.95)
Food desert			0.73	(0.66, 0.80)
School Suspension			1.06	(1.02, 1.10)
On premise AO			0.98	(0.93, 1.05)
Off premise AO			1.09	(1.04, 1.14)
Block group population (per 1,000)			1.27	(1.19, 1.36)

¹ Includes block groups with 0 SQF encounters

* Bolded values are statistically significant at an alpha of 0.05

Appendix D: Conference Abstracts

Abstract accepted for oral presentation at National Firearm Violence Research

Conference in Chicago, IL (November 2023)*

Measuring the effect of historical structural racism on community firearm violence in 500 US
cities

Ariana N. Gobaud, Paris B. Adkins-Jackson, Sara F. Jacoby, Michael R. Kramer,
Charles C. Branas, Christopher N. Morrison

Background/purpose: The community firearm violence epidemic, including intentional fatal and nonfatal shootings, in the United States (US) disproportionately affects racialized and minoritized groups. Despite comprising 14% of the population, nearly two-thirds of homicide victims are racialized as Black. Modern research suggests firearm violence is higher in communities where there are limited economic opportunities, relatively high concentrations of poverty, and residential instability. These factors are typically thought of as social determinants of health. However, factors upstream from these determinants, like structural racism, are theorized to be core etiologies of the disproportionate burden of firearm violence in communities with a majority of persons racialized as Black. Minimal research has explored these structural pathways. This study examines contemporary patterns in community firearm violence in relation to historical structural racism in 500 major US cities.

Methods/approach: We constructed structural racism indicators across two historical periods for each city—Time 1: Pre-Civil Rights (1930-1945) and Time 2: Desegregation/Integration (1970-2000). At Time 1, we identified cities that had a documented history of “redlining” (i.e., a racialized discriminatory mortgage lending policy) and/or being a sundown town (i.e., towns with the expectation that non-White individuals had to leave before sundown to avoid repercussions). For Time 2, we computed 1990 Black-White dissimilarity indices of residential segregation, poverty, incarceration, and owner-occupied units. We loaded items from Time 2 into a confirmatory factor analysis to compute a unidimensional latent variable. We used quasi-Poisson regression analyses to test the association between these two historical time periods and the total number of 2015-19 fatal and nonfatal interpersonal shootings per 10,000 population obtained from the Gun Violence Archive.

Results/outcome: Between 2015-19, 133,381 shootings occurred. There were 238 cities with a documented history of redlining and/or being a sundown town. The rate of shootings per 10,000 population was 38% higher in cities with structural racism at Time 1 (95%CI: 1.14,1.67).

Time 2 items accounted for 98% of the variance of a 1-Factor model. All items loaded adequately (residential segregation: -0.95, poverty: 0.91, incarceration: 0.64, and owner-occupied units: 1.00). For every one-unit increase in Time 2 structural racism, there was an 80% increase in the rate of shootings per 10,000 population (95%CI: 1.71,1.90).

Conclusions/implications: These findings reveal the impact of historical racism on contemporary community firearm violence in US cities. Dismantling structural racism will

require a concerted effort over decades. Future research should explore pathways through which structural racism affects firearm violence and foci for intervention.

*This oral presentation won the *Impact Award* at the conference.

**Abstract accepted for oral presentation at Society for the Advancement of Violence
and Injury Prevention (SAVIR) in Chapel Hill, NC (April 2024)**

Examining the Interplay of Structural Racism and Community Firearm Violence in the Urban
Landscape of New York City

Ariana N. Gobaud, Paris B. Adkins-Jackson, Sara F. Jacoby, Michael R. Kramer,
Charles C. Branas, Christopher N. Morrison

Statement of Purpose: Recent studies indicate structural racism influences community firearm violence (i.e., fatal and nonfatal intentional interpersonal shootings). Yet, little is known about the impact of community-level policing practices, like stop, question, and frisk (SQF), that disproportionately target residents racialized as Black and Latinx within geographic areas referred to as crime hot spots. Consequently, it is crucial to delineate the association between structural racism, via community-level policing, and community firearm violence. This ecological panel analysis explores these relationships in New York City.

Methods/Approach: Utilizing New York Police Department data from 2015-19, we analyzed the relationship between SQF and shooting incidents using quasi-Poisson models. These models assessed shootings per square meter in block group areas, controlling for baseline SQF rates and annual shootings. We first estimated associations between SQF and shootings, then examined the extent to which indicators of structural racism (e.g., mortgage lending denial rates, tree census data, the presence of food deserts, school suspension rates, the density of both on- and off-premise alcohol outlets) explained these relationships.

Results: During the study period, 69,576 SQFs and 5,533 shootings were recorded. The analysis revealed a significant positive association between SQFs and shooting incidents (IRR:1.018, 95% CI:1.016,1.020). The association remained after adjusting for indicators of structural racism (IRR:1.017, 95% CI:1.015,1.020).

Conclusion: Contrary to evidence that SQFs reduce crime, our findings suggest that these practices may contribute to higher levels of community firearm violence. This result highlights the complex implications of such policing methods within the context of structural racism.

Significance/Contribution: Our analysis indicates that SQF practices do not exist in isolation but are intertwined with broader structural racism dynamics. This underscores the need for a reevaluation of policing strategies, considering their public health and community safety impacts, particularly in marginalized communities disproportionately affected by aggressive policing and structural inequities.