Today’s Experiences, Tomorrow’s Health: Gentrification and Preventable Mortality in Alameda County

By

Melody Esther Tulier

A dissertation submitted in partial satisfaction of the requirements for the degree of

Doctor of Public Health

in the

Graduate Division

of the

University of California, Berkeley

Committee in charge:

Associate Professor Amani Nuru-Jeter, Chair
Associate Professor Mahasin S. Mujahid
Professor Lisa García Bedolla
Assistant Professor Carolina Katz Reid

Spring 2018
Today’s Experiences, Tomorrow’s Health: Gentrification and Preventable Mortality in Alameda County

© 2018

Melody Esther Tulier
Abstract

Today’s Experiences, Tomorrow’s Health: Gentrification and Preventable Mortality in Alameda County

By

Melody Esther Tulier

Doctor of Public Health

University of California, Berkeley

Associate Professor Amani Nuru-Jeter, Chair

**Background:** Gentrification, a macro-level factor in the San Francisco Bay Area, shapes the symbiotic relationship between context and composition in urban neighborhoods. Gentrification is a process in which formerly declining, under-resourced neighborhoods experience reinvestment and in-migration of increasingly affluent new residents. These processes can potentially diminish health protective mechanisms such as social networks, housing stability, and community resources. Conversely, it may enhance public services, sense of safety, and wealth.

**Methods:** The question framing this dissertation is: To what extent and under what circumstances does the macro-level process of gentrification exacerbate health inequities between existing low-income long-term residents and newer higher-income residents in gentrifying communities? To ground this study, Chapter 2 provides a mixed-methods systematic review of the literature analyzing the conceptual underpinnings of research on gentrification in relation to health and well-being, the mechanisms linking the exposure to health outcomes, and temporal and spatial considerations of both the exposure and etiology of the health outcome of interest. Chapter 3 uses all-cause mortality data from 2005 – 2013 in Alameda County to examine the association between preventable mortality, which is an indicator of health inequities, and gentrification in low-income and medium/high income census tracts, while accounting for lack of independence over time between both the exposure and outcome. In Chapter 4, to capture the potential
heterogenous effects of gentrification and the importance of identifying mechanisms linking gentrification and preventable mortality, we analyze qualitative data collected by in-depth interviews with long-term residents that have lived in two adjacent census tracts in the West Oakland neighborhood of Alameda County with distinct preventable mortality rates but similar stages of gentrification.

**Discussion and Significance:** Increasingly macrosocial approaches to public health are examining the health effects of resultant social structures and social systems that propel unequal power, relations, and resources. This dissertation uses the example of gentrification as case study to inform research trajectories, challenges, and points of innovation for future scholarship on macro-level factors. Research findings underscore the importance of examining macro-social factors as producers of spatially patterned health inequities in cities. An exclusive focus on individual and neighborhood level factors limits understanding on the forces producing health inequity. Grounding research with conceptual clarity, explicit use of theory, hypothesized mechanisms, and accounting for time and space can illuminate the role of gentrification and potential approaches to reduce inequities. Furthermore, discerning the complex synergistic roles of the life course of regions, neighborhoods and individuals and embracing rather than controlling for difference may help inform movements, policy and interventions toward reducing urban health inequities.
In honor of my beloved Tata – my grandmother Esther Quintana

Her indomitable strength, fierce determination, brilliant light radiating joy and wisdom, and selfless deep love continues within all of us
Acknowledgments

My meaningful academic career was enriched by numerous mentors – from uncompromising, committed teachers in the small Brooklyn Lutheran Elementary School, illuminating professors at Bryn Mawr College, supporting professors encouraging the integration of city planning and health at MIT, to the exacting and inspiring professors UC Berkeley.

For this doctoral degree, I am extremely indebted Dr. Amani Nuru-Jeter; A constant source of support and critical questioning, she has facilitated my transition from a student absorbing knowledge to a scholar creating knowledge.

Dr. Mahasin Mujahid inspired me to pursue my doctoral degree; with her intellectual guidance and candor, she has facilitated my ongoing journey in exploring, understanding, and defining who I am as a scholar in social epidemiology.

Dr. Lisa García Bedolla shared her brilliance with me. She has helped me to develop into a strong mixed-methods methodologist. But perhaps most importantly, she has reminded me that I must “find my voice.” She has allowed me to embrace my culture, values and beliefs in a field that prizes objectivity and distance. And in that process, I have learned it is who I am, how I think, where I come from, that has shaped my research and approach – and it is because of those things, instead of in spite of, that I can succeed in academe.

Dr. Leonard Syme provided me hope – hope that I can and will become Dr. Tulier. He asked me profound questions pushing me to articulate what I believe and why, challenged my assumptions, and engaged in thoughtful conversations that helped me reformulate and reconceptualize my research.

Dr. Rachel Morello-Frosch instilled in me the art and strength of persistence, provided profound methodological and conceptual insights in urban health inequities and gentrification, and offered guidance on approaches to developing strengths in methods and research design during my doctoral training at UC Berkeley.

Dr. Carolina Reid has provided instrumental feedback on research design and an exemplary model of providing systematic, thoughtful feedback. She has been instrumental in helping me link my city planning background with public health scholarship.

The Institute for the Study of Societal Issues has been a pinnacle part of my graduate
career. Theoretical and methodological feedback from Dr. Deborah Freedman Lustig, Dr. David Minkus, and Dr. Christine Trost has been invaluable to maturing my research. My cohort members also provided a glorious source of intellectual and emotional nourishment.

I am also indebted to the Alameda County Public Health Department, and in particular Dr. Jane Martin and Matt Breyers for their enduring and enthusiastic support of this research.

This work would not have been possible without the support and generosity of West Oakland residents. Thank you for integrating me into your neighborhood for the past 5 years. I finally found my west coast home.

To my mom and dad, you always told me to do what I love. That is the most amazing gift any child could ever ask for as they develop into their own skin. Thank you for your unyielding belief in my abilities and helping me fly to new heights. I am also so grateful for the ongoing support and love of my entire family – they truly inspire me, keep me grounded, and remind me what truly is important in life.

Phenomenal friends have supported me throughout, but I want to honor in particular Elsie Achugbue, Miriam Zuk, Alexander Durbak, Ella Lazarte, Vicky Gomez, and Kelechi Uwaezuoke. You all have allowed me to shed tears, be vulnerable, and carry on stronger than before.

To my partner Jeff, your relentless support, encouragement, energy and patience is awe-inspiring. I am forever grateful for the emotional refuge you have provided, the creativity you have shared, and the trust, respect and confidence you have in me, which propels me forward. The best is yet to come.
# Table of Contents

Chapter 1 Introduction................................................................. 1

Chapter 2 Conceptualization, Mechanisms and Spatiotemporal Considerations: A Mixed-Methods Systematic Review of the Literature of Gentrification and Health Research in the United States.................................................................................................................. 6

1. Introduction .................................................................................. 6

2. Methods .......................................................................................... 8

2.1. Inclusion/exclusion criteria ......................................................... 8

2.2. Search strategy ............................................................................. 9

2.3. Identification and study selection .............................................. 9

2.4. Data extraction and analytic approach ................................... 11

3. Results .............................................................................................. 11

3.1. Conceptualization of gentrification ........................................... 12

3.2. Mechanisms linking gentrification and health ....................... 15

3.3. Spatiotemporal considerations .................................................. 26

4. Discussion ....................................................................................... 37

5. Conclusions ................................................................................... 39

Chapter 3 Gentrification and its Role in Exacerbating Health Inequities: An Exploratory Study Based in Alameda County, California ................................................................. 48

1. Introduction ................................................................................... 48

1.1. Neighborhoods, Health, and Gentrification ............................ 49

1.2. Gentrification in Alameda County, Fundamental Cause Theory, and Preventable Mortality .................................................. 50
2. Methods ................................................................................................................................................ 53

2.1. Construction of Independent Variable: Gentrification ............................................................. 53

2.2. Construction of Outcome Variable: Preventable Mortality .................................................. 56

2.3. Census Tract Level Covariates ................................................................................................ 57

2.4. Statistical Analysis ....................................................................................................................... 58

3. Results ............................................................................................................................................... 59

3.1. Descriptive Statistics: Preventable Mortality Over Time ...................................................... 59

3.2. Regression Analyses .................................................................................................................. 62

4. Discussion ....................................................................................................................................... 66

4.1. Limitations ............................................................................................................................... 68

5. Conclusions ..................................................................................................................................... 69

Chapter 4 From Risky Places to Complex Experiences of Place and Health in Gentrifying West Oakland, California .................................................................................................................. 78

1. Introduction ................................................................................................................................... 78

1.1. Considerations of context, scale and change in the neighborhood effects literature .............. 79

1.2. Application of Fundamental Cause Theory and Ecosocial Theory, Neighborhood Change, and Preventable Mortality .............................................................. 81

1.3. Selection of Case Study Sites .................................................................................................. 84

2. Methods ....................................................................................................................................... 86

2.1. Setting ....................................................................................................................................... 86

2.2. Philosophies Guiding Design and Analysis ......................................................................... 87

2.3. Recruitment and subject population ....................................................................................... 88
List of Tables

Table 2-1 Key themes of definitions of gentrification with examples. ........................................ 13
Table 2-2 Categories of mechanisms and associated levels ..................................................... 16
Table 2-3 Conceptualization, mechanisms and levels linking gentrification and health.. 18
Table 2-4 Temporal and spatial considerations and concordance with health outcomes .......... 29
Table 3-1 Variables for measurement of the construct gentrification based on random forest ........................................................................................................................................................................... 55
Table 3-2 Sample size: number of low-income (LI) census tracts by stage of gentrification in 2010 and number of medium/high (MHI) census tracts by stage of upgrading ...................................................................................................................................................... 56
Table 3-3 Count of non-preventable causes of death (in order of highest value as of 2013) ........................................................................................................................................................................... 60
Table 3-4 Quasipoisson regression model testing association between gentrification and preventable mortality ................................................................................................................................ 63
Table 3-5 Association between stages of gentrification and preventable mortality........ 64
Table 3-6 Association between Stages of Gentrification and Preventable Mortality....... 65
Table 4-1 Socio-demographic profile of census tracts ................................................................. 84
Table 4-2 Participant characteristics .................................................................................................... 90
List of Figures

Figure 2-1 Flow chart following guidelines in the PRISMA statement (Moher et al., 2010) ........................................................................................................................................................................................................................................... 10

Figure 3-1 Preventable mortality rates over time for Alameda County (2005 – 2013) .... 61

Figure 3-2 Median preventable mortality rate between low-income and medium/high income census tracts in Alameda County .......................................................................................................................................................................................... 62

Figure 4-1 Linking fundamental cause theory and ecosocial theory ...................................................... 82

Figure 4-2 Geographic location of census tracts ......................................................................... 84

Figure 4-3 Preventable mortality rates by census tract (per 10,000 individuals)............... 86

Figure 4-4: Standardized preventable mortality rates, 2005 and 2013 ......................................... 98
Chapter 1 Introduction

“A fundamental structural question that is rarely, if ever, tabled at virtual or actual gatherings of those concerned with neighborhood effects . . . is: why do people live where they do in cities? If where any given individual lives affects their life chances as deeply as neighbourhood effects proponents believe, it seems crucial to understand why that individual is living there in the first place” (Slater, 2013).

Political, social, and economic historical and contemporary macro-level forces within cities and regions can determine why certain individuals live in particular neighborhoods. Cities are of increasing importance, as for the first time in nine decades, after the Great Recession, the largest metropolitan areas in the United States grew more rapidly than their suburbs (Frey, 2012). The locus of politics and power is shifting from federal and state governments downward to cities and metropolitan areas and from the public sector to a conglomeration of public, private and community actors (Katz and Nowak, 2018). Furthermore, the economic and social structures have also transformed, widening inequality. While scholars in the 1980s and 1990s focused on urban concentrated poverty, during this same period concentrated wealth and income rose. For example, in California, all metropolitan areas saw the income shares of the top one percent increase between 1989 and 2013, with the San Francisco metropolitan area having the highest share going to the top one percent. In 2013, 30.8 percent of the region’s income was going to the top one percent of households, in contrast to 15.8 percent in 1989 (Reidenbach et. al., 2016).

These forces manifesting in cities alter the distribution of health-altering resources and opportunities to individuals, neighborhoods, and broader communities. This spatial patterning indicates that neighborhoods are an integral node facilitating interaction and accumulation of social, economic, physical, and biological health risk and protective factors (Auchincloss and Diez Roux, 2008; Curtis and Jones, 1998; Diez Roux, 2001).

Within the field of social epidemiology, attention has been placed on the importance of social structures and systems rather than individual behaviors and other proximal risks
(Macintyre, 1993; Diez-Roux, 2001). Ng and Muntaner further this premise, arguing that social status and health inequalities truly reflect unequal power relationships, thereby mandating an examination of macrosocial phenomena (2014). Macro-level forces can include economic conditions, early childhood family and educational context to political economic systems and globalization (Glymour, 2013, Ng and Muntaner, 2014).

One particular macro-level social, economic, and political force relevant to the context of the San Francisco Bay Area is gentrification. Gentrification is an interactive process in formerly declining, under-resourced neighborhoods between economic investment and increasing sources of capital infusion and in-migration of new residents, generally with a higher socio-economic status. This process shapes a neighborhood’s social context, physical attributes, and other key resources and opportunities, which are critical to resident health outcomes (Hwang and Sampson, 2014; Timberlake and Wolfe, 2017). In turn, health inequities can be catalyzed or mitigated in these neighborhoods as a result of gentrification.

While gentrification can shape urban health inequities through social, economic, and political forces, current research approaches may stymie examination of the macro-level influence of gentrification and health inequities. First, to examine a complex, nuanced process such as gentrification, research should be conceptually rigorous, employ measurement methods reflective of the process, and consider spatiotemporal factors. A systematic review of the literature is crucial to understand research gaps, future trajectories for rigorous research, and identify methods to that will capture complex macro-level processes.

Secondly, researchers have attempted to incorporate context through integrating research on social, environmental, geographic, and institutional mechanisms and the influence of the environment on biological markers. Yet, the concept of change has not been studied extensively. This gap is critical since gentrification itself is increasingly conceptualized as a type of neighborhood change. In addition, embracing heterogeneous responses in relation to change is necessary for understanding the spectrum of ways neighborhoods influence individual and community health.

Finally, public health’s biomedical perspective historically focuses on single diseases in individuals and not populations. Yet, extending syndemic theory to the process of gentrification by grouping disease and health conditions based on common mechanisms experienced within the contextual conditions of gentrification may facilitate population-level policy development. Syndemic theory draws attention to disease
concentration where two or more diseases co-occur in a particular temporal or geographic context, the interaction of these diseases, and health conditions such as mental health and malnutrition which exacerbates any negative health consequences. These interact with existing macro-level health inequities such as poverty, inducing the formation, clustering, and spreading of disease (Singer et al., 2017; Tsai et al., 2017).

This dissertation seeks to contribute to these existing gaps in the following ways. Chapter 2 provides a mixed methods systematic review of the literature on gentrification and health and well-being. The main research question is the following: How and to what extent has the conceptualization of gentrification, mechanisms and levels of influence linking gentrification and health and well-being, and critical spatiotemporal factors relevant to the process of gentrification been incorporated into research? Chapter 3 uses a generalized linear mixed effects model to assess the association between preventable mortality and stages of gentrification (in low-income census tracts) and upgrading (in medium/high income census tracts), while accounting for lack of independence over time between the exposure and outcome of interest. Chapter 4 aims to identify mechanisms contributing to disparate rates of preventable mortality. Mechanisms are elucidated by analyzing qualitative data of long-term residents in two adjacent census tracts experiencing similar stages of gentrification and socio-demographic profiles but with distinct rates of preventable mortality.
References


Chapter 2 Conceptualization, Mechanisms and Spatiotemporal Considerations: A Mixed-Methods Systematic Review of the Literature of Gentrification and Health Research in the United States

1. Introduction

Similar to the human body, the urban environment is an intricate web of systems. Cities are an area of dense and diverse resources that interact though multi-level social and political forces including civil society, municipal government, as well as national and even global trends (Galea et al., 2005). This complexity requires a shift away from identifying a single exposure or single outcome. The health of urban populations is a result of a variety of social systems and social structures, mandating an examination of unequal power relations, which are macrosocial determinants of health (Ng and Muntaner, 2014). Macrosocial factors such as economic conditions and political systems affect people’s lives and their ecologic context (Glymour et al., 2013; Krieger, 2007; Ng and Muntaner, 2014). These factors shape health-altering social, political, economic and physical resource distribution simultaneously across individual, interpersonal, community, and institutional levels. Non-random and unequal distribution of resources shape population health and can exacerbate urban health inequities.

One upstream macrosocial factor shaping urban populations and the distribution of resources impacting health and well-being within urban areas is gentrification. Gentrification is a process in which formerly declining, under-resourced neighborhoods experience capital reinvestment and in-migration of increasingly affluent new residents. The process of gentrification is dynamic, uneven, and occurs in stages. (Clay, 1989; Helms, 2003; Hochstenback and van Gent, 2015; Hwang and Sampson, 2014; Kerstein,
1990; Maloutas, 2012). While gentrification transpires in neighborhoods, it is certainly a multi-level phenomenon linking chains of connections to large social structures and local contexts (Smith, 1996, p. 106).

Of prime importance in urban health research is the specification of research questions concerning how and why urban environments may affect health (Galea and Schulz, 2005, p. 278). It is particularly exacting when considering the web of systems in the urban context while also including the study of gentrification, with its multi-level processes linking macrosocial forces to local communities. The aim of this review is to explore: How have empirical studies addressed questions regarding the relationship between gentrification and health from a conceptual and methodological standpoint? Rigorous research requires conceptual clarity guiding methodology. The absence of conceptual clarity may obscure the ways in which gentrification influences health.

Research on urban health and gentrification is critical for three reasons. First, in the 1990s gentrification transitioned from a sporadic and localized phenomenon to a more intense, complex process occurring in economically riskier urban areas, and involving state and corporate actors (Hackworth and Smith, 2001; Hwang, 2016). Second, while urban scholars focused on studying the causes and consequences of concentrated urban poverty in the 1990s, more recently scholarship has focused on concentrated wealth in American cities and increasing economic inequality, which may be facilitated by gentrification (Alvaredo et al., 2013; Coulton, 1992; Mallach, 2015; Massey and Eggers, 1990; Morenoff et al., 2001; Small and Newman, 2001). Third, there are a growing number of disciplines studying gentrification expanding from sociology and geography to now including public health, economics, and political science, among others, therefore providing new theoretical contributions and methods to the field (Hwang and Sampson, 2014).

The myriad pathways through which gentrification can impact health, its multidimensional nature, and increased interdisciplinary interest, requires: 1. conceptual clarity and clear articulation of theoretical frameworks being employed; 2. attention to mechanisms linking the exposure and outcome of interest and levels of factors such as the psychosocial, interpersonal including social ties, and neighborhood factors such as safety; and 3. consideration of spatiotemporal scale (Krieger, 2014).

We provide an assessment of the empirical literature on the relationship between gentrification and health in the United States. Incorporating context, locality and temporality into our examination, and the criteria for rigorous research listed above, we
review the literature through three critical frames—conceptualization, mechanisms, and spatiotemporal scale. Reviewing this research through these frames may help multiple disciplines produce the most rigorous and transparent science possible that would identify innovative areas for future research, potential mechanisms linking gentrification and health, and policy development and implementation to reduce urban health inequities.

2. Methods

2.1. Inclusion/exclusion criteria

Selected articles had to be empirical studies using either quantitative or qualitative data examining the relationship between gentrification and health. We define gentrification as a socio-economic process within neighborhoods where formerly declining disinvested neighborhoods experience reinvestment and in-migration of increasingly affluent new residents. Secondly, we specified studies must be focused on the Anglo-American context of gentrification. Third, we defined health broadly, and included an array of health outcomes and determinants of health and well-being. Rationales for each of these criteria are outlined below.

In line with Maloutas’ call for conceptual clarity and theoretical rigor by exposing contextual assumptions within gentrification research, we specify the process of gentrification operating in an Anglo-American context (2012). This includes neo-liberal regulation, commodification of housing, and restructuring of urban space which moves capital back to the city (Maloutas, 2012; Smith, 1979). Given the varied trajectories and increasing globalization of gentrification, some argue that gentrification is now so generalized that the “concept captures no less than the fundamental state and market-driven ‘class-remake’ of cities throughout the world” (Shaw, 2008). Often urban renewal, neighborhood ascent, and urban revitalization are used interchangeably. For example, these terms are used to describe the process of gentrification or a completely distinct process, such as in the United Kingdom where urban generation is led by government policies and not market forces or in Paris where the urban core has never experienced disinvestment (Maloutas, 2012). Therefore, for this systematic review, we incorporated a broad array of terms that may be associated with gentrification, and thoroughly reviewed the article to assess if words such as urban renewal were used in the context of an Anglo-American gentrification.

Third, guided by social determinants of health framework and fundamental cause theory, we defined health and well-being broadly, therefore including articles with a
range of outcomes. The social determinants of health and health inequities places importance on the social, political, economic, and cultural conditions in which people live and work and the structural drivers of these conditions (Woolf and Braveman, 2011). Furthermore, based on fundamental cause theory, the ability to control disease and death is mediated by access to fundamental and flexible resources, including knowledge, money, power, prestige, and beneficial social connections (Link and Phelan, 1995).

### 2.2. Search strategy

Web of Science and PubMed were searched for empirical studies in the United States with no restrictions on publication date. Keywords related to the exposure included gentrification, gentrified, urban renewal, urban change, and socio-economic asset. Keywords related to the outcome used in Web of Science given its interdisciplinary scope (in comparison to PubMed's exclusive focus on biomedical, science and health literature) included health, disease, medical, medicine, and wellness. The final search was conducted on April 1, 2018.

### 2.3. Identification and study selection

The search located 383 entries through PubMed and 199 entries through Web of Science, with 36 duplicate entries (Figure II-1). A review of 546 titles and abstracts using the above mentioned-eligibility criteria resulted in the exclusion of 461 articles. The remaining 85 full-text articles were examined based on our exclusion/inclusion criteria, discussed above. This resulted in the exclusion of 55 additional articles
Search last conducted on April 1, 2018
Pub Med:
(Gentrification OR Gentrified OR "Urban renewal" OR "urban change" OR "socio-economic ascent") AND United States
Web of Science:
((gentrification OR gentry OR "urban renewal" OR "urban change") AND (health OR disease OR medical OR medicine OR wellness))
DocType=All document types; Language=All languages;
2.4. Data extraction and analytic approach

For each study, we extracted the following information: author(s), title, and year to assess the growth of the literature on gentrification and health over time. Employing MaxQDA software, we coded the following key components of each article: conceptualization of gentrification, levels of mechanisms (i.e. interpersonal, neighborhood, institutional) and mechanisms through which gentrification influences health, variables used to measure gentrification, frequency of gentrification measurement to capture change over time, spatial scale of gentrification, health outcomes, and population of interest. We employed content analysis to identify common themes across studies. Below we provide a broad overview of the results in addition to an analysis of current research through three critical frames: conceptualization, mechanisms, and spatiotemporal scale.

3. Results

Of the 546 publications reviewed, 14 met our inclusion criteria. Two of these articles used qualitative data in their analysis while the remaining employed quantitative data. All studies using quantitative data were observational cross-sectional studies. While longitudinal measures are used to identify the process of gentrification, all studies measured health at one point in time. Only one article was published before 2010, and eight of the 14 were published after 2015. Studies included a broad array of health outcomes, reflecting the various mechanisms potentially linking gentrification to health outcomes. For example, Coulter et al., identify residential mobility over time, space, and structural conditions to access to health protective factors, such as moving to a safer neighborhood, increased access to educational or economic resources, and stable social support (2015).

The reviewed studies encompassed a range of outcomes. These included: socio-spatial patterns of exclusion, mobility and industrial air toxic risk exposure (Abel and White, 2011; Anguelovski, 2015; Ding et al., 2016) access to healthy food and food insecurity (Breyer and Voss-Andrae, 2013; Whittle et al., 2015), housing instability (Desmond and Gershenson, 2017), financial health (Ding and Hwang, 2016), self-rated health (Gibbons and Barton, 2016; Smith et al., 2018), crime (Kreager, 2011), health care access (Lim et al., 2017), homelessness (Linton et al., 2017), and preterm birth (Huynh and Marako, 2013). All studies focused on lower-income residents exposed to gentrification, with one study focusing on people living with HIV/AIDS (PLWHA) (Whittle et al., 2015) and the elderly (Smith et al., 2007). None of the papers explicitly employed theories to guide conceptualization and research design. The two qualitative studies used a case study
approach to explore the experience of gentrification and exclusion of Latinos (Anguelvoski, 2015; Betancur, 2009). The 12 quantitative studies employed a cross-sectional design.

### 3.1. Conceptualization of gentrification

Integral to understanding the relationship between gentrification and health is developing conceptual clarity around gentrification itself. We reviewed how leading gentrification scholars conceptualized the process of gentrification. While an exhaustive review is beyond the scope of this paper, Table II-1 illustrates four key ways (or themes) gentrification has been conceptualized, along with exemplary definitions from the literature. This is used to identify and analyze which conceptualizations dominate current literature and potential research gaps. First, socio-economic upgrading is a dominant theme across all definitions of gentrification and is often accompanied by displacement or a racial dimension to gentrification (Goetz, 2011; Glass, 1964, p.xviii). The second theme includes conceptualizing gentrification as part of a broader urban restructuring process of industry, employment patterns and private capital (Smith, 2002, p. 87). A third theme conceptualizes gentrification as a political conflict and not solely an economic process of reinvestment, as it contributes to the loss of land rights, access to resources, and public services among the most vulnerable populations (Morales 2015). The last key category articulates a stage model of gentrification, reinforcing the notion of a multi-level process including pioneer gentrifiers, corporate investors and government support along a spectrum of urban change (Clay, 1979; Hackworth and Smith, 2001; Lees, 2008). All or parts of this continuum of gentrification can be experienced by neighborhoods and its residents. As such, Lees advocates for a 'geography of gentrification' which incorporates context, locality, and temporality into the analysis of gentrification for a specific area (2010). For example, stages of gentrification may be influenced by economic downturns, propelling foreclosures and massive investment from investors, histories of disinvestment, and changes in strength of urban governance structures. Furthermore, identification of the stage of gentrification facilitates potential intervention at the onset of gentrification.
Table 2-1 Key themes of definitions of gentrification with examples.

<table>
<thead>
<tr>
<th>Citation</th>
<th>Excerpt/Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Socio-economic upgrading</strong></td>
<td></td>
</tr>
<tr>
<td>Lees, Slater, and Wyly, 2013, p. xv</td>
<td>“The transformation of a working class or vacant area of the central city into middle-class residential and/or commercial use.”</td>
</tr>
<tr>
<td>Smith, 1979</td>
<td>“Gentrification is a structural product of the land and housing markets. Capital flows where the rate of return is highest, and the movement of capital to the suburbs along with the continual depreciation of inner-city capital, eventually produces the rent gap. When this gap grows sufficiently large, rehabilitation (or for that matter, renewal) can begin to challenge the rates of return available elsewhere, and capital flows back.”</td>
</tr>
<tr>
<td><strong>1a. Socio-economic upgrading and displacement</strong></td>
<td></td>
</tr>
<tr>
<td>Glass, 1964, p. xvii</td>
<td>Working class housing or recently disinvested in houses were invaded and upgraded by the middle class. This process continues &quot;until all or most of the original working-class occupiers are displaced and the whole social character of the districts changed.&quot;</td>
</tr>
<tr>
<td><strong>1b. Socio-economic upgrading, displacement and racial dimensions of gentrification</strong></td>
<td></td>
</tr>
<tr>
<td>Goetz, 2011</td>
<td>Demographic transformations produced by gentrification are nearly as frequently racial as they are class-based. The predominant racial reality of gentrification has been one of White gentrifiers displacing low-income Black incumbents.</td>
</tr>
<tr>
<td><strong>2. Multi-level and stage model of gentrification</strong></td>
<td></td>
</tr>
<tr>
<td>Clay, 1979, p 57-60</td>
<td>American gentrified neighborhoods usually had older housing stock, working-class families, and some abandoned properties. Gentrification occurs in 4 stages, with stage 1 being pioneer gentrification where sweat equity and private capital is used, stage 2 where some displacement occurs and vacant housing decreases, stage 3 where a newer middle class resides in the neighborhood, continued displacement occurs, and an increasing number of investors rehabilitate the area, and stage 4 where more business and managerial professions come to the area, commercial activity occurs, along with rapid price and rent changes.</td>
</tr>
<tr>
<td>Hackworth and Smith, 2001; Lees et al., 2013, p. 173</td>
<td>Hackworth and Smith define 3 stages: 1. First wave gentrification occurs in select small neighborhoods, with investors eventually using the economic recession in the late 1970s to purchase devalorized properties; 2. Second stage gentrification which anchored and stabilized the gentrification process, and included economic and cultural processes within the neighborhood; 3. Third wave gentrification is characterized by the increased presence of corporate developers leading gentrification, the state and local government working with the private sector and facilitating gentrification, and finally the expansion of gentrification to more remote areas.</td>
</tr>
</tbody>
</table>
A conceptual framework transforms experiential knowledge, prior theory, and research into a system of constructs and presumed interrelationships among them that supports or informs one's research (Maxwell, 2013, p. 39; Miles and Huberman, 1994, p. 18). Additionally, conceptual frameworks help identify the most critical variables to include in research design and the ways in which they influence one another (Ravitch and Riggan, 2012, p. 6).

The majority of studies (11/14) conceptualized gentrification as socio-economic upgrading. Among these, three articles also included residential displacement as potentially part of the process of gentrification (Ding et al., 2016; Ding and Hwang; 2016; Gibbons and Barton, 2016) (Table 2). Two articles conceptualized gentrification as a political conflict (Betancur, 2009; Anguelovski, 2015). In these articles, gentrification is an unjust process where the right to land, ownership and power over key decisions is appropriated by new, predominately white residents with higher incomes. Two studies by the same authors identified gentrification as a staged process, implying outcomes may differ for individuals depending on the extent in which gentrification has advanced in the neighborhood (Ding et al., 2016; Ding and Hwang, 2016). Finally, Kreager identified gentrification as a staged process, with changes in crime being moderated at the most advanced stages of gentrification (2011).
3.2. Mechanisms linking gentrification and health

Social epidemiology’s increasing focus on causality and policy-related research to improve population health (translational social epidemiology) requires clarity and rigor around the logical propositions linking conceptualization of a modifiable exposure to mechanisms that link exposures to outcomes (Glymour and Spiegelman, 2014; Oakes and Andrade, 2014). The context of gentrification influences the operation of mechanisms; these mechanisms indicate how and why macrosocial factors, such as gentrification, impact population health (Ng and Muntaner, 2014). Identification of the mechanisms of gentrification influencing health is necessary to understand the various ways gentrification shapes population health and well-being and potential interventions. Mechanisms operate at various levels simultaneously with the causal relevance of each level determined by the conceptualization of the phenomenon of interest (Krieger, 2008). Content analysis identified the following mechanisms across studies (Table 2-2).
Thus far, we have reviewed the primary themes characterizing the way gentrification has been conceptualized in the literature; conceptualization generally indicates the mechanisms and levels by which gentrification influences a health outcome. Analysis of conceptualization, mechanisms, and levels articulated in each paper indicate that eight of the fourteen papers we reviewed provided explicit and logical linkages between their conceptualization of gentrification, and clearly identified mechanisms and their associated levels through which the exposure was related to the outcome (Table 3) (Anguelovski, 2015; Betancur, 2009; Desmond and Gershenson, 2017; Ding and Hwang, 2016; Ding et al., 2016; Smith et al., 2017; Linton et al., 2017; Kreager, b2011). For example, if gentrification is conceptualized as a process that changes neighborhood food resources, the outcome would be measured in terms of neighborhood sources of healthy food at the neighborhood level (Breyer and Voss-Andrae, 2013). Linton et al.,
articulate that gentrification, as a result of socio-economic upgrading, increases rental costs; as such, the authors assess how this shift in neighborhood attributes increases the odds of homelessness (2017).
<table>
<thead>
<tr>
<th>Author(s) and Year</th>
<th>Study Aim(s)</th>
<th>Conceptualization/Definition of Gentrification</th>
<th>Category of Conceptualization/Definition</th>
<th>Mechanism and Level</th>
<th>Articulation of Mechanisms Linking Exposure and Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abel and White, 2011</td>
<td>Examine uneven disbursement of Seattle’s sources of air toxic exposure and convergence of pollution risk and inequitable development in areas that experienced gentrification</td>
<td>Upward socioeconomic transformation of urban neighborhoods; this transformation is captured by income, housing values, education, and occupational levels.</td>
<td>Socio-economic upgrading</td>
<td>Neighborhoo d attributes (infrastructure)</td>
<td>The connection between the inequitable spatial distribution of air toxic producers and Seattle’s socio-economic strata is a socio-historical process.</td>
</tr>
<tr>
<td>Anguelovski, 2015</td>
<td>Socio-spatial patterns and exclusion are produced through decreasing access to resources and supermarket greenling, which are generally unwanted by local residents. Understand how these places establish new forms of exclusion and privilege.</td>
<td>Developers and investors redevelop properties for higher-income residents, making profits through rent gaps. Municipal leaders declare these formerly blighted neighborhoods as sites of revitalization and tourism.</td>
<td>Political Conflict</td>
<td>Sense of community/exclusion</td>
<td>Gentrification is a ‘mundane and chronic forms of injustice’ in the urban environment (Bickerstaff et al., 2009: 594). There is the production of new socio-spatial patterns and experiences of exclusion, transforming amenities into locally unwanted land uses (LULUS).</td>
</tr>
<tr>
<td>Betancur, 2009</td>
<td>Explore if the experience of gentrification of Latinos is one of invasion, succession, or forceful relocation.</td>
<td>Based on the study, gentrification is not a blind market process but one of exchange value-enhancing entities using resources and power to create tensions and fractions among residents.</td>
<td>Political Conflict</td>
<td>Sense of community/exclusion</td>
<td>Gentrification mandates residents to shift from community building and action to defending place, which results in a fragmentation of social fabrics.</td>
</tr>
<tr>
<td>Author(s) and Year</td>
<td>Study Aim(s)</td>
<td>Conceptualization/Definition of Gentrification</td>
<td>Category of Conceptualization/Definition</td>
<td>Mechanism and Level</td>
<td>Articulation of Mechanisms Linking Exposure and Outcome</td>
</tr>
<tr>
<td>--------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>Breyer and Voss-Andrae, 2013</td>
<td>Assess if food mirages (numerous food outlets but with high priced foods, preventing healthy food consumption among low-income residents) converge with gentrified areas</td>
<td>Neighborhoods experiencing redlining and disinvestment are now receiving more affluent residents with higher incomes, which decreases food affordability for low-income households.</td>
<td>Socio-economic upgrading</td>
<td>Individual health protective resources</td>
<td>Barriers to healthful diets is reliant on affordability of local stores, which is a function of income.</td>
</tr>
<tr>
<td>Desmond and Gershenson, 2017</td>
<td>Examine 3 mechanisms (discrimination, life shocks, concentrated disadvantage and gentrification, which is the focus on this matrix, and social isolation) that may be associated with disparities in eviction among low-income families.</td>
<td>Gentrification entails neighborhood revitalization with increased capital flows and population shifts to more affluent households; to attract these more affluent households, landlords may seek to evict lower-income populations.</td>
<td>Socio-economic upgrading/Displacement</td>
<td>Neighborhoo d attributes (economic)</td>
<td>Eviction among low-income populations can result from individual, neighborhood and social network mechanisms.</td>
</tr>
<tr>
<td>Author(s) and Year</td>
<td>Study Aim(s)</td>
<td>Conceptualization/Definition of Gentrification</td>
<td>Category of Conceptualization/Definition</td>
<td>Mechanism and Level</td>
<td>Articulation of Mechanisms Linking Exposure and Outcome</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------</td>
<td>-----------------------------------------------</td>
<td>------------------------------------------</td>
<td>---------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Ding et al., 2016</td>
<td>Examine mobility patterns based on stage of gentrification, which neighborhoods residents move to, if it differs for the most vulnerable, and time at which gentrification commenced in the neighborhood.</td>
<td>Socio-economic upgrading within central urban areas rather than across cities of previously low-income urban neighborhoods, whereby incoming residents are of a higher socio-economic status. This implies residential displacement, though evidence is inconclusive.</td>
<td>Socio-economic upgrading/Displacement/ and Stages of gentrification</td>
<td>Neighborhood attributes (economic)</td>
<td>“We conceptualize gentrification as the socioeconomic upgrading of a previously low-income, central city neighborhood, characterized by the influx of higher socioeconomic status residents and an increase in housing prices [implying residential displacement of long-term, often older or low-income, residents by younger and high-income residents]. This definition is consistent with most characterizations of gentrification. . Although some scholars define gentrification by racial turnover or displacement, several scholarly accounts of gentrification find that gentrification does not necessarily follow these patterns (e.g., Freeman, 2005; Pattillo, 2007)”</td>
</tr>
<tr>
<td>Author(s) and Year</td>
<td>Study Aim(s)</td>
<td>Conceptualization/Definition of Gentrification</td>
<td>Category of Conceptualization/Definition</td>
<td>Mechanism and Level</td>
<td>Articulation of Mechanisms Linking Exposure and Outcome</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------</td>
<td>-----------------------------------------------</td>
<td>------------------------------------------</td>
<td>---------------------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>Gibbons and Barton, 2016</td>
<td>Determine the relationship between gentrification and self-rated health. Does the relationship differ depending if gentrification results in an influx of white or black residents?</td>
<td>Gentrification reflects increasing affluence reflective of changes in infrastructure, housing cost and availability, resulting in possible displacement of less affluent residents.</td>
<td>Socio-economic upgrading/Displacement</td>
<td>Neighborhood attributes (economic)</td>
<td>Gentrification can inject additional resources which may enhance community health, there are concerns regarding the alignment between these new resources and the needs of the long-term residents that are often of a lower class and/or are racial/ethnic minorities. Furthermore, displacement and heightened stress are two other pathways that can influence the health of long-term residents.</td>
</tr>
<tr>
<td>Huynh and Marako, 2013</td>
<td>Assess the association between gentrification and preterm birth (PTB)</td>
<td>Gentrification entails economic and social changes that are a result of an influx of higher income residents and housing investment.</td>
<td>Socio-economic upgrading</td>
<td>Neighborhood attributes (economic); Individual health protective resources</td>
<td>Gentrification may influence health through neo-material pathways (material resources and opportunities) and through psychosocial pathways (physiological stress).</td>
</tr>
<tr>
<td>Author(s) and Year</td>
<td>Study Aim(s)</td>
<td>Conceptualization/Definition of Gentrification</td>
<td>Category of Conceptualization/Definition</td>
<td>Mechanism and Level</td>
<td>Articulation of Mechanisms Linking Exposure and Outcome</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------</td>
<td>-----------------------------------------------</td>
<td>------------------------------------------</td>
<td>-------------------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>Kreager, 2011</td>
<td>Examine the relationship between crime and gentrification in the city of Seattle in the 1980s and 1990s.</td>
<td>Authors distinguish gentrification from other forms of urban growth because “it applies only to urban neighborhoods that underwent a period of substantial economic decline.”</td>
<td>Urban Restructuring/Stage of Gentrification</td>
<td>Neighborhood attributes (economic and social)</td>
<td>Generally, social organization and human ecology perspectives identify gentrification as disruptive of social processes. However, a more aggressive, consolidated form of revitalization occurred in the late 1990s, and this surge of capital investments undermined conditions propelling crime (such as poverty) and increased more formal controls, such as policing and surveillance. As such, authors predict the relationship between gentrification and crime is curvilinear.</td>
</tr>
<tr>
<td>Lim et al., 2017</td>
<td>Compare rates of health care access and mental health status between those who remained in gentrifying neighborhoods and those who were displaced (individuals who moved from gentrifying to non-gentrifying areas).</td>
<td>Gentrification entails the revitalization of formerly deprived neighborhoods, resulting in an influx of residents with higher socioeconomic status.</td>
<td>Socio-economic upgrading</td>
<td>Neighborhood attributes (economic)</td>
<td>Displacement can lead to disrupted access in primary health care services and stress, leading to increased Emergency Department (ED) visits.</td>
</tr>
<tr>
<td>Author(s) and Year</td>
<td>Study Aim(s)</td>
<td>Conceptualization/Definition of Gentrification</td>
<td>Category of Conceptualization/Definition</td>
<td>Mechanism and Level</td>
<td>Articulation of Mechanisms Linking Exposure and Outcome</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------</td>
<td>-----------------------------------------------</td>
<td>------------------------------------------</td>
<td>-------------------</td>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td>Linton et al., 2017</td>
<td>Examine the association between local-level housing and economic conditions with homelessness among persons who inject drugs (PWID)</td>
<td>Gentrification changes the socioeconomic character of a neighborhood, starkly increasing rental costs, or reduction in low-income and affordable housing.</td>
<td>Socio-economic upgrading</td>
<td>Neighborhood attributes (economic)</td>
<td>Housing is a key social determinant of health; PWID are vulnerable to homelessness, and homelessness can result from place-based factors, such as unaffordable housing.</td>
</tr>
<tr>
<td>Smith et al., 2017</td>
<td>Examine the relationship between gentrification and older adults’ self-rated health and mental health, with a particular focus on those that are economically vulnerable.</td>
<td>Gentrification is a market process where in-migration of new, higher-income residents in former economically-deprived neighborhoods.</td>
<td>Socio-economic upgrading</td>
<td>Individual resources; Neighborhood attributes (economic)</td>
<td>Elderly may be displaced to low-income neighborhoods, however those who stay may gain additional services. The relationship between gentrification and displacement may be dependent on individual characteristics.</td>
</tr>
<tr>
<td>Whittle et al., 2015</td>
<td>Explore the experiences and structural drivers of food insecurity among people living with HIV/AIDS (PLWHA) in San Francisco.</td>
<td>In the Bay Area, gentrification is the process in which higher income households displace lower income residents, changing the character of the neighborhood (Kennedy and Leonard, 2001). Quality of life measures established by the City of San Francisco to attract wealth and tourists, the technology boom, and increasing efforts to attract industry into San Francisco, have enabled the private sector to shape the city,</td>
<td>Socio-economic upgrading</td>
<td>Political and economic institutions</td>
<td>Political and economic institutions can systematically cause harm and protect the health of groups of vulnerable individuals.</td>
</tr>
</tbody>
</table>
Anguelovski (2015) conceptualizes gentrification as a political conflict. He explicitly identifies the powerful elite and articulates their goal of shifting ownership of the community, from lower-income residents to outside sources of capital. This is illustrated by an explicit identification of investors developing properties for higher-income residents and municipal leaders labeling areas of reinvestment as “sites for revitalization and tourism” (Anguelovski, 2015). Framing gentrification as a political conflict, the author moves away from identifying socio-economic changes as a mechanism that influences the relationship between gentrification and health. Rather, conceptualization of gentrification as a political conflict incites a social justice framework and moves away from an objective epistemology. Because of this framing, he focuses on “new socio-spatial patterns and experiences of exclusion, transforming amenities into locally unwanted land uses (LULUS)” (Anguelovski, 2015). Therefore, community and exclusion are the factors tying gentrification to health. By extension, the level of interest is the community-level, which aligns with the study aim to understand how gentrifying places establish new forms of exclusion and privilege.

Ding et al., conceptualizes gentrification as socio-economic upgrading within central urban areas in previously low-income neighborhoods whereby incoming residents are of a higher socio-economic status (2016). The authors also clearly state that while this conceptualization implies displacement, evidence is inconclusive. Given this, mechanisms linking gentrification and mobility (rather than displacement via eviction for instance) relate to affordability of the neighborhood. Affordability, an economic mechanism at the neighborhood level then directly ties to their study aims which are to “Examine mobility patterns based on stage of gentrification, which neighborhoods residents move to, if it differs for the most vulnerable, and time at which gentrification commenced in the neighborhood” (Ding et al., 2016). Affordability is a continuous variable and can increase at a greater rate within advanced stages of gentrification when demand for housing and neighborhood resources exceeds supply. Therefore, Ding et al., in their research aims examine how a stage of gentrification, which alters affordability, moderates mobility (discussed in the subsequent section).

Another example of research with explicit logical linkages conceptualizes gentrification as urban restructuring and hypothesizes an association with crime (Kreager, 2011). Kreager stipulates gentrification is a process changing both population and property characteristics such as high-end residential development and improving an area’s real estate and local infrastructure. This study, then, includes context by identifying that gentrification became more aggressive in the late 1990s, and investments weakened conditions facilitating crime and increased formal controls (such as police surveillance).
As a form of urban restructuring, gentrification occurs at an inter-sectoral city-wide level where infrastructure development and real estate enhancement changes area-level characteristics transforming whole city blocks and not only individual properties over time. The key mechanism of interest therefore is neighborhood level capital investment on infrastructure, resulting from area-level shifts in crime. This study could have conceptualized gentrification as a process inducing individual level displacement of low-income households and replacement by those of a higher socio-economic status. With increased socio-economic status of residents, one may posit a reduction in crime. In this case, area level investment in infrastructure would not be the appropriate mechanism. Rather, gentrification would be conceptualized partly as a process of displacement, and thus mechanisms (potentially at the individual level) linking gentrification and displacement to crime would be appropriate.

The above examples describe cogent concordance of conceptualizations, mechanisms, and levels identified in research on gentrification and health. However, discordance and/or lack of clarity between these fundamental pieces for rigorous research are present in six studies. This discordance compromises the ability to further a more translational epidemiology – to move from science to policy development and community interventions (Abel and White, 2011; Gibbons and Barton, 2016; Whittle et al., 2015; Lim et al., 2017; Huynh and Marako, 2013; Breyer and Voss-Andrae, 2013).

As an example, Gibbons and Barton first conceptualize gentrification as socio-economic upgrading/displacement impacting self-rated health. Gentrification induces increasing affluence, changes in infrastructure which may or may not align with the needs of lower-income residents, and possible displacement thereby increasing stress. To understand how Gibbons and Barton’s logic informs their conceptualization, mechanisms and levels shaping the relationship between gentrification and health outcomes, one may ask: 1. Do new resources align with the needs of low-income residents and 2. Is displacement occurring in the area of interest? This may identify two potential mechanisms - meeting the resource needs of low-income populations and stress as a byproduct of individual displacement and potential loss of social networks; there is ambiguous articulation regarding the specific mechanisms they hypothesize will alter self-rated health. Therefore, findings will not point to specific mechanisms that must be altered to decrease the risk of gentrification compromising health and well-being. Through the viewpoint of translational epidemiology, would an intervention entail reduction of individual stress levels, or assisting local, long-term businesses in leveraging gentrification for capital stability while still serving resources most helpful for low-income residents, for example?
Another illustration of discordance between conceptualization and mechanisms identified in the research is one studying testing the association between gentrification and pre-term birth (Huynh and Marako, 2013). In this study, gentrification is conceptualized as socio-economic upgrading, resulting in higher income residents and housing investment. This may cause changes in neighborhood economic attributes by providing additional opportunities or material resources, while also potentially resulting in increased stress and susceptibility to disease. Therefore, any identified associations do not elucidate the most relevant mechanisms and causal connections linking gentrification and pre-term birth. In this case, a theoretical framework to identify what we know and assume would anchor firm hypotheses. For example, employing life course theory would lead to questions regarding length of time of exposure to gentrification, changes in material resources prior to and within the period of exposure, and distinctions between levels of exposure, timing and embodiment. This would then require a shift in mechanisms, measurements, and considerations of spatiotemporal scale.

### 3.3. Spatiotemporal considerations

Gentrification occurs across the community, city, regional and national scales; the question is to understand the simultaneous cross-level connections (Smith, 1996). Yet, as Hwang and Simpson point out, traditional data sources do not capture multi-level political and economic forces, such as private developers, public housing policies, and gentrification’s uneven nature within neighborhoods (2014). As such, we assessed to what extent articles incorporated multiple levels of spatial scales. Table 4 illustrates each studies’ spatial unit of analysis. Ten quantitative studies used census tracts as the unit of analysis (Abel and White, 2011; Breyer and Voss-Andrae, 2013; Desmond and Gershenson, 2017; Ding and Hwang, 2016; Ding et al., 2016; Gibbons and Barton, 2016; Kreager, 2011; Smith et al., 2017). One analyzed data at the zip code level (Linton, 2017) and the other used Public Use Microdata Area (PUMA) boundaries (n = 55, median population in each PUMA = 149,447) (Huynh and Marako, 2013). Two qualitative studies used study participant and author perceptions of place to identify gentrifying areas (Anguelovski, 2015; Betancur, 2009).

Studies of gentrification employing large areal units such as PUMA boundaries, will likely face the modifiable areal unit problem (MAUP) where artificial units of spatial reporting of continuous geographical phenomena results in artificial spatial patterns; this issue is akin to ecological fallacy (Heywood et al., p. 8; 1998). Aggregated values will vary depending on which boundaries we use. For example, analysis of data aggregated
at the county level will offer distinct conclusions in comparison to data collected at the census tract level. At smaller spatial scales, ranges or variations in data are more apparent. A larger spatial scale may obscure important extremes. Gentrification is often conceptualized as an uneven urban phenomenon. As such, larger areal units, such as PUMA boundaries and potentially census tracts, which range in population size between 1,800 and 8,000 individuals, with the optimal size being 4,000 individuals, may not capture the unevenness of gentrification. In early stage gentrifying areas, gentrification may not occur within a tract as a whole but on a block by block basis.

Moreover, all census tracts do not have the same probability of being gentrified. Those census tracts that are least likely to gentrify due to continued lack of investment and marginalization may be clustered. Being surrounded by multiple disinvested tracts may have distinct implications for residents than living close to clustered resource rich census tracts (Diez-Roux and Mair, 2010). This lack of independence, or spatial dependency between census tracts, may induce spillover effects beyond the imposed census tract boundaries and affect health outcomes (Diez Roux and Mair, 2010). None of the studies examined discussed spatial dependencies as a limitation in research or acknowledged the varying spatial contexts relevant to a process. The process of gentrification is not confined by US Census boundaries.

Regarding temporality, two issues require consideration – lack of time lag between exposure and outcome of interest and frequency of data collection on the health outcome. First, no time lag between exposure and outcome is generally implausible in social epidemiology (Blakely & Woodward, 2000). The challenge is to include in testable hypotheses explicit assumptions about plausible time intervals during which area influences on health are likely to manifest themselves in health outcomes. All quantitative studies examined in this review lacked an explicit articulation of the temporal relationship between gentrification and the outcome of interest (Macintyre et al, 2002). For example, Gibbons and Barton used 2008 self-rated health data while measuring the process of gentrification within the same time span – changes in measures in 2000 and 2005 – 2009, without including any lag time between exposure and outcome. Furthermore, inferences are challenging to assert given temporal bias (reverse causality) (Rothman et al., 2008, p. 97). If one is unclear if the exposure precedes the outcome, one may conclude for example that enhanced health outcomes of residents is a result of the capital infusion resulting from gentrification; conversely, it is also plausible that lower-income less healthy residents have been displaced.

Second, gentrification is a dynamic, uneven, process which occurs in stages (Clay, 1979,
To link these core tenants of the process of gentrification and research design, one should consider the following: 1. The number of times and interval length of outcome data; 2. Hypotheses regarding if gentrification is constant or accelerates at certain points in time. Health outcome data was collected and analyzed at only one point in time for all 12 quantitative studies. This may increase selection bias, which occurs when the subjects identified are not representative of the target population. For example, collecting data at only one point in time during the advanced stages of gentrification may capture residents who were not displaced for various reasons, such as homeownership and family support networks in the event of a crisis; these households may not be representative of the population, therefore distorting any measure of association. Furthermore, collecting outcome data at one point in time prohibits accounting for past effects of the process of gentrification on health and identification of an appropriate latency period.

Another form of bias, length time bias occurs when illnesses slowly progress and as such would not be captured if there is infrequent data collection. In the case of gentrification, a health outcome of interest that theoretically requires exposure over the life course is preterm birth (Lu et al., 2010). This outcome, employed by Huynh and Marako’s 2013 article was collected at one point in time, increasing the risk of misestimating of the relationship between gentrification and health.

Regarding hypotheses concerning intensity of gentrification over time, two studies explicitly mentioned the pace of gentrification, and hypothesized that gentrification accelerated in the 1990s (Ding et al., 2016; Kreager, 2011). As such, health outcomes may be more prevalent after the early 2000s but these differences were not captured. Averaging variables to include multiple points in time may obscure important ebbs and flows in the process of gentrification itself.
### Table 2-4 Temporal and spatial considerations and concordance with health outcomes

<table>
<thead>
<tr>
<th>Author(s) and Year</th>
<th>Study Aim(s)</th>
<th>Health Outcomes</th>
<th>Data on Timing of Exposure</th>
<th>Scale/Unit of Analysis</th>
<th>Key Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abel and White, 2011</td>
<td>Examine uneven disbursement of Seattle’s sources of air toxic exposure and convergence of pollution risk and inequitable development in areas that experienced gentrification.</td>
<td>Air toxic exposure risk measured from 1990 - 2007</td>
<td>Two timepoints: 1990 - 2000</td>
<td>Census Block Groups</td>
<td>Seattle’s riskiest cities in terms of air toxic exposure overlapped with area’s with increased minority populations and economic development; while this initially decreased in 2000, the relative exposure riskscape increased since one facility accounted for 95% of the exposure risk.</td>
</tr>
<tr>
<td>Anguelovski, 2015</td>
<td>Socio-spatial patterns and exclusion are produced through decreasing access to resources and supermarket greenling, which are generally unwanted by local residents. Understand how these places establish new forms of exclusion and privilege.</td>
<td>Socio-spatial patterns of exclusion from 2011 to 2014</td>
<td>Over time</td>
<td>Neighborhood</td>
<td>Jamaica Plain’s efforts to create a green livable community in addition to the arrive of wealthier and whiter residents by supporting Whole Foods, in fact excluded the neighborhood’s long-term residents and made Latino food practices and tradition invisible. Furthermore, displacement entailed not only economic terms, but political and cultural loss of Latino community power given schisms between Latino activists and officials. Whole Foods symbolizes green gentrification, which facilitates environmental inequities by reducing sources of inexpensive food and the creation of new socio-spatial inequalities.</td>
</tr>
<tr>
<td>Author(s) and Year</td>
<td>Study Aim(s)</td>
<td>Health Outcomes</td>
<td>Data on Timing of Exposure</td>
<td>Scale/Unit of Analysis</td>
<td>Key Findings</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------</td>
<td>-----------------</td>
<td>----------------------------</td>
<td>------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Betancur, 2009</td>
<td>Explore if the experience of gentrification of Latinos is one of invasion, succession, or forceful relocation.</td>
<td>Neighborhood based support and advancement over a period of 10 years</td>
<td>Over time</td>
<td>Neighborhood</td>
<td>Class and race dynamics contributed to an uneven playing field where exchange value rich groups with mobility and options clashed with resource poor residents. Residents then shifted from community building to community defense. Eventually, community fragmentation and disintegration ensued.</td>
</tr>
<tr>
<td>Breyer and Voss-Andrae, 2013</td>
<td>Assess if food mirages (numerous food outlets but with high priced foods, preventing healthy food consumption among low-income residents) converge with gentrified areas.</td>
<td>Decreasing access to healthy food; food prices were collected in 2011</td>
<td>Change between 2000 and 2010</td>
<td>140 census tracts in Portland</td>
<td>Food mirages are most extreme in Portland’s gentrifying neighborhoods. Spatial patterning of store prices is a critical piece of assessing the food environment, from the perspective of low-income households.</td>
</tr>
<tr>
<td>Desmond and Gershenson, 2017</td>
<td>Examine 3 mechanisms (discrimination, life shocks, concentrated disadvantage and gentrification, which is the focus on this matrix, and social isolation) that may be associated with disparities in eviction among low-income families.</td>
<td>Nature of inequality, housing instability among low-income renters; eviction data was drawn from 2009 - 2011</td>
<td>Two timepoints: 2000 and 2010</td>
<td>Census Tracts</td>
<td>There is no effect on eviction among renters residing in gentrifying neighborhoods; research should go beyond gentrification and include gentrifying or disadvantaged neighborhoods where most evictions take place.</td>
</tr>
<tr>
<td>Author(s) and Year</td>
<td>Study Aim(s)</td>
<td>Health Outcomes</td>
<td>Data on Timing of Exposure</td>
<td>Scale/Unit of Analysis</td>
<td>Key Findings</td>
</tr>
<tr>
<td>--------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>------------------------------------</td>
<td>------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Ding and Hwang, 2016</td>
<td>Examine the relationship between financial status changes and gentrification, in relation to mobility of residents and stage of gentrification.</td>
<td>Changes in financial health of residents; credit scores from 2002 - 2014</td>
<td>Change between 2000 and 2010</td>
<td>Census tracts</td>
<td>Overall, residents who are able to stay in gentrifying neighborhoods have improved credit scores, with increases greatest among those living in neighborhoods undergoing intense gentrification. This finding remains among less advantaged residents in gentrifying neighborhoods, though with a smaller magnitude of a positive association in comparison to more advantaged residents. Among those who move from a gentrifying neighborhood, the impact on their financial health varies depending on the quality if their new neighborhood; moving to a lower income neighborhood is negatively associated with financial health.</td>
</tr>
<tr>
<td>Ding et al., 2016</td>
<td>Examine mobility patterns based on stage of gentrification, which neighborhoods residents move to, if it differs for the most vulnerable, and time at which gentrification commenced in the neighborhood.</td>
<td>Residential mobility patterns from 2002 - 2014</td>
<td>1980, 1990, and 2000 and ACS estimates for 2009–2013</td>
<td>Census Tracts</td>
<td>Vulnerable residents are not more likely to move than their counterparts in non-gentrifying neighborhoods. Those who do move have a higher risk of downward mobility, particularly those moving from intensely gentrifying areas. Residents with higher credit scores in intensely gentrifying areas are no more likely to move to low-income neighborhoods compared to those from non-gentrifying low-income neighborhoods.</td>
</tr>
<tr>
<td>Author(s) and Year</td>
<td>Study Aim(s)</td>
<td>Health Outcomes</td>
<td>Data on Timing of Exposure</td>
<td>Scale/Unit of Analysis</td>
<td>Key Findings</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------</td>
<td>----------------------------</td>
<td>------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Gibbons and Barton, 2016</td>
<td>Determine the relationship between gentrification and self-rated health. Does the relationship differ depending if gentrification results in an influx of White or Black residents?</td>
<td>Self-rated Health measured in 2008</td>
<td>Two timepoints: 2000 and ACS estimates 2005 - 2009</td>
<td>Census Tracts</td>
<td>Gentrification had a marginal significant negative relationship with self-rated health. Blacks were 75% more likely to report poor/fair self-rated health than their counterparts in other neighborhoods. This may be a result of cultural displacement when upper-income Blacks relocate to a gentrifying area.</td>
</tr>
<tr>
<td>Huynh and Marako, 2013</td>
<td>Assess the association between gentrification and preterm birth (PTB).</td>
<td>Preterm birth from 2008 - 2010</td>
<td>Two timepoints: 1990 and ACS estimates 2005-2009</td>
<td>59 community districts</td>
<td>Overall, gentrification was not associated with preterm birth. However, very high gentrification was adversely associated with preterm birth for non-Hispanic Blacks but was a protective factor for non-Hispanic Whites.</td>
</tr>
<tr>
<td>Kreager, 2011</td>
<td>Examine the relationship between crime and gentrification in the city of Seattle in the 1980s and 1990s.</td>
<td>Crime, as measured by difference in crime indexes in 1990 (averaged across 1989–1991) and crime indexes measured in 2000 (averaged across the three years spanning 1999–2001)</td>
<td>Two timepoints: 1990 and 2000</td>
<td>Census Tracts</td>
<td>In the 1980s, increased investments were associated with increased crime. However, in the 1990s, crime decreased with “consolidated” gentrification. This curvilinear pattern indicates there is a tipping point in the process of gentrification, where eventually crime declines once a neighborhood is in more advanced stages of the process. As such, gentrification must be conceptualized as a temporal process.</td>
</tr>
<tr>
<td>Author(s) and Year</td>
<td>Study Aim(s)</td>
<td>Health Outcomes</td>
<td>Data on Timing of Exposure</td>
<td>Scale/Unit of Analysis</td>
<td>Key Findings</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------</td>
<td>-----------------</td>
<td>---------------------------</td>
<td>------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Lim et al., 2017</td>
<td>Compare rates of health care access and mental health status between those who remained in gentrifying neighborhoods and those who were displaced (individuals who moved from gentrifying to non-gentrifying areas).</td>
<td>ED visits and hospitalizations of recurring patients from 2006 - 2014</td>
<td>5 years post displacement for each individual</td>
<td>Neighborhoods were defined using Public Use Microdata Area (PUMA) boundaries (n = 55, median population in each PUMA = 149,447 according to 2014 ACS)</td>
<td>Displaced residents had a statistically significant higher rate of ED visits, hospitalizations, and mental health visits. Of note, sensitivity analysis showed rates of mental health-related visits were not different between residents of gentrifying areas and those of non-gentrifying areas.</td>
</tr>
<tr>
<td>Linton et al., 2017</td>
<td>Examine the association between local-level housing and economic conditions with homelessness among persons who inject drugs (PWID).</td>
<td>Homelessness within one year of 2009</td>
<td>Two timepoints; 1990 and 2009</td>
<td>Zip Code</td>
<td>The odds of homelessness increased by 17% with each SD increase in ZIP code-level gentrification.</td>
</tr>
<tr>
<td>Smith et al., 2017</td>
<td>Examine the relationship between gentrification and older adults’ self-rated health and mental health, with a particular focus on those that are economically vulnerable.</td>
<td>Self-rated health and mental health among elderly and economically vulnerable population in 2011</td>
<td>Two timepoints; 2000 and 2010</td>
<td>Census Tracts</td>
<td>While economically vulnerable older adults in gentrifying neighborhoods have better self-rated health than those in low-income neighborhoods, employing a matched pair design, with regard to mental health there were no statistically significant differences.</td>
</tr>
<tr>
<td>Author(s) and Year</td>
<td>Study Aim(s)</td>
<td>Health Outcomes</td>
<td>Data on Timing of Exposure</td>
<td>Scale/Unit of Analysis</td>
<td>Key Findings</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------</td>
<td>-----------------</td>
<td>---------------------------</td>
<td>-----------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Whittle et al., 2015</td>
<td>Explore the experiences and structural drivers of food insecurity among people living with HIV/AIDS (PLWHA) in San Francisco.</td>
<td>Food insecurity; qualitative data collected in 2014</td>
<td>One point in time in 2014</td>
<td>34 semi-structured interviews</td>
<td>Respondents cited poor quality and limited quantity of available food coupled with using a sizable portion income for rent. Food insecurity often was a result of the imbalance between rent payments and disability payments. Authors identify the following interventions: “(1) by protecting vulnerable populations from the market effects of urban regeneration, and (2) by helping state-dependent individuals to afford an adequate and sufficiently healthy diet.”</td>
</tr>
</tbody>
</table>
Anguelovski (2015) conceptualizes gentrification as a political conflict. He explicitly identifies the powerful elite and articulates their goal of shifting ownership of the community, from lower-income residents to outside sources of capital. This is illustrated by an explicit identification of investors developing properties for higher-income residents and municipal leaders labeling areas of reinvestment as “sites for revitalization and tourism” (Anguelovski, 2015). Framinggentrification as a political conflict, the author moves away from identifying socio-economic changes as a mechanism that influences the relationship between gentrification and health. Rather, conceptualization of gentrification as a political conflict incites a social justice framework and moves away from an objective epistemology. Because of this framing, he focuses on “new socio-spatial patterns and experiences of exclusion, transforming amenities into locally unwanted land uses (LULUS)” (Anguelovski, 2015). Therefore, community and exclusion are the factors tying gentrification to health. By extension, the level of interest is the community-level, which aligns with the study aim to understand how gentrifying places establish new forms of exclusion and privilege.

Ding et al., conceptualizes gentrification as socio-economic upgrading within central urban areas in previously low-income neighborhoods whereby incoming residents are of a higher socio-economic status (2016). The authors also clearly state that while this conceptualization implies displacement, evidence is inconclusive. Given this, mechanisms linking gentrification and mobility (rather than displacement via eviction for instance) relate to affordability of the neighborhood. Affordability, an economic mechanism at the neighborhood level then directly ties to their study aims which are to “examine mobility patterns based on stage of gentrification, which neighborhoods residents move to, if it differs for the most vulnerable, and time at which gentrification commenced in the neighborhood” (Ding et al., 2016). Affordability is a continuous variable and can increase at a greater rate within advanced stages of gentrification when demand for housing and neighborhood resources exceeds supply. Therefore, Ding et al., in their research aims examine how a stage of gentrification, which alters affordability, moderates mobility (discussed in the subsequent section).

Another example of research with explicit logical linkages conceptualizes gentrification as urban restructuring and hypothesizes an association with crime (Kreager, 2011). Kreager stipulates gentrification is a process changing both population and property characteristics such as high-end residential development and improving an area’s real estate and local infrastructure. This study then includes context by identifying that gentrification became more aggressive in the late 1990s, and investments weakened conditions facilitating crime and increased formal controls (such as police surveillance). As a form of urban restructuring, gentrification occurs at an inter-sectoral city-wide level.
where infrastructure development and real estate enhancement changes area-level characteristics transforming whole city blocks and not only individual properties over time. The key mechanism of interest therefore is neighborhood level capital investment on infrastructure, resulting from area-level shifts in crime. This study could have conceptualized gentrification as a process inducing individual level displacement of low-income households and replacement by those of a higher socio-economic status. With increased socio-economic status of residents, one may posit a reduction in crime. In this case, area level investment in infrastructure would not be the appropriate mechanism. Rather, gentrification would be conceptualized partly as a process of displacement, and thus mechanisms (potentially at the individual level) linking gentrification and displacement to crime would be appropriate.

The above examples describe cogent concordance of conceptualizations, mechanisms, and levels identified in research on gentrification and health. However, discordance and/or lack of clarity between these fundamental pieces for rigorous research are present in six studies. This discordance compromises the ability to further a more translational epidemiology – to move from science to policy development and community interventions (Abel and White, 2011; Gibbons and Barton, 2016; Whittle et al., 2015; Lim et al., 2017; Huynh and Marako, 2013; Breyer and Voss-Andrae, 2013).

As an example, Gibbons and Barton first conceptualize gentrification as socio-economic upgrading/displacement impacting self-rated health. Gentrification induces increasing affluence, changes in infrastructure which may or may not align with the needs of lower-income residents, and possible displacement thereby increasing stress. To understand how Gibbons and Barton’s logic informs their conceptualization, mechanisms and levels shaping the relationship between gentrification and health outcomes, one may ask: 1. Do new resources align with the needs of low-income residents and 2. Is displacement occurring in the area of interest? This may identify two potential mechanisms - meeting the resource needs of low-income populations and stress as a byproduct of individual displacement and potential loss of social networks; there is ambiguous articulation regarding the specific mechanisms they hypothesize will alter self-rated health. Therefore, findings will not point to specific mechanisms that must be altered to decrease the risk of gentrification compromising health and well-being. Through the viewpoint of translational epidemiology, would an intervention entail reduction of individual stress levels, or assisting local, long-term businesses in leveraging gentrification for capital stability while still serving resources most helpful for low-income residents, for example?

Another illustration of discordance between conceptualization and mechanisms
identified in the research is one studying testing the association between gentrification and pre-term birth (Huynh and Marako, 2013). In this study, gentrification is conceptualized as socio-economic upgrading, resulting in higher income residents and housing investment. This may cause changes in neighborhood economic attributes by providing additional opportunities or material resources, while also potentially resulting in increased stress and susceptibility to disease. Therefore, any identified associations do not elucidate the most relevant mechanisms and causal connections linking gentrification and pre-term birth. In this case, a theoretical framework to identify what we know and assume would anchor firm hypotheses. For example, employing life course theory would lead to questions regarding length of time of exposure to gentrification, changes in material resources prior to and within the period of exposure, and distinctions between levels of exposure, timing and embodiment. This would then require a shift in mechanisms, measurements, and considerations of spatiotemporal scale.

4. Discussion

Jones defined health equity as: “the [active] assurance of optimal conditions for all people. This can be achieved by “valuing everyone equally, rectifying historic inequities and distributing resources according to need” (2016). Efforts to reduce health equity and gentrification as a class-based process have propelled research on the relationship between gentrification and health. This is the first systematic view, to our knowledge, which provides an account of the conceptualization of current research related to gentrification and health, mechanisms identified across studies, and the extent in which spatiotemporal considerations are made.

We identify research gaps and points for methodological and conceptual strengthening, which in the long-run may inform policy development and implementation. With regard to the conceptualization of gentrification, the majority of studies incorporated socio-economic upgrading as the defining feature of gentrification. As such, research limits the ways in which gentrification may influence health and well-being of both individuals and their communities by focusing on demographic shifts or flows of capital. The power dynamics inherent in gentrification, the differential valuing of individuals based on class and race as signified by levels of investment over time, in addition to threats to community, are clouded. This prevents identification of who is responsible if negative health impacts are associated with gentrification, and the potential points of intervention.

Furthermore, explicit logic linking conceptualization of gentrification and the mechanisms linking gentrification with the outcome of interest are evident in eight of
fourteen papers. Theory can provide a framework through which to articulate a clear logical sequence of propositions and connections. It can also inform appropriate time intervals in which to capture health outcome data that takes into account the lag time and length time of a health outcome, to ensure data will theoretically capture any changes to a specific health outcome as a result of gentrification. However, none of the papers included in this study described a theoretical proposition anchoring the research.

The literature is sorely lacking in integrating spatiotemporal considerations into frameworks and research design. Relying only on census tracts for a spatiotemporal measure of exposure to gentrification calls into question whether census tracts are the causally relevant geographic area. Increasingly large areas as sites of research contribute to the decontextualization of the process of gentrification. Explicit discussion of the spillover effects of gentrification and spatial dependence among census tracts as a result of the process also obscures the health effects of living in a clustered resource rich or resource poor area. Kwan refers to as the Uncertain Geographic Context Problem (UGCoP), which arises when there is “the spatial uncertainty in the actual areas that exert contextual influences on the individuals being studied and the temporal uncertainty in the timing and duration in which individuals experienced these contextual influences” (2012). While these are complex methodological problems, a discussion regarding limitations resulting from and potential methods to account for spatial dependencies and fixed spatial contexts is warranted.

To begin to overcome these challenges, we propose using an ecosocial lens as a starting point for elucidating a clear conceptual framework reflecting the operationalization of gentrification chosen by the authors, identifying relevant mechanisms, levels and scales for inquiry. Analyzing each study with an ecosocial lens allows for an explicit articulation of mechanisms linking exposures and outcomes, assumptions being made, and gaps in the research (Krieger, 2001). The first two components of ecosocial theory, embodiment and pathways to embodiment are reflected in Huynh and Maroko’s study assessing the association between pre-term birth and gentrification. Embodiment is the incorporation into the body of the material and social world in which we live. Pathways to embodiment helps us understand what variables (such as economic or social conditions) facilitate embodiment. Incorporating the biologic, material and social world conceptually to ground their research, they link over 126,000 births in New York City to a measure of gentrification at the community district level; and found an association between pre-term birth among blacks living in districts with a high level of gentrification. Level of gentrification was measured using census data on area income and area education level. Among whites, a high level of gentrification was inversely associated with preterm birth. This study provides data framing gentrification as an environmental factor that gets
under the skin, triggering negative health outcomes across various levels, such as individual stress and susceptibility in addition to neighborhood level changes in material resources.

The third component of the theory is cumulative interplay between exposure, susceptibility, and resistance functions across levels. As one example, Anguelovski’s study identified levels of power structures which shape socio-spatial patterns identifying new forms of exclusion (2015). Loss of inexpensive food represented power imbalances and loss and cultural dismissal of minority groups. In this case, the exposure of gentrification changes susceptibility through reducing access to resources, while also at the community level altering the strength and advocacy networks of long-term residents.

Regarding accountability and agency, one must consider a set of historical factors pertinent to urban history and power dynamics that may be reinforced as a result of gentrification. These factors include federal, state, and local government policies such as segregation, redlining, urban renewal, planned shrinkage/catastrophic disinvestment, deindustrialization, mass criminalization, HOPE VI, and the foreclosure crisis, which resulted in the serial forced displacement of African Americans. None of the studies integrated analyses with macro-level historical factors. It is these macro-level historical factors that shape the resiliency or susceptibility of neighborhoods. For instance, both redlining and foreclosure crises have shaped the structural conditions of urban neighborhoods (Hernandez, 2009).

This review has limitations. We conceptualized health and well-being broadly, aiming to include as many articles as possible. Although we used a combination of search strategies to find published articles that met our eligibility criteria, it is possible that our search strategy missed some articles that would have been eligible. For example, while some articles concerning gentrification may include outcomes related to violent crime, they may not conceptually link and articulate crime as related to health and well-being. Thus, these studies would be excluded from search results. Furthermore, only one author conducted the literature search and identified eligible studies. Therefore, we did not calculate a reliability score assessing consistency of study selection between two independent reviewers.

5. Conclusions

Research on gentrification however can pave the way to developing a process for understanding complex macrosocial phenomena. As Brown-Saracino aptly declares: Most crucially, we ought to better position ourselves to study empirically and speak
theoretically to linkages between gentrification and broader processes of neighborhood change, such as those pertaining to the bifurcation of wealth and poverty. This will encourage us to think more deliberately about gentrification as an instance of classical “neighborhood succession,” as well as about broader shifts in cities’ economic bases and in class structure (2016).

Debates may ensue regarding whether gentrification is a powerful force in cities, or one that does not lead to displacement. Others may contend it is unstoppable and the structural changes necessary for health equity are impossible to attain. Irrespective of its strength as a determinant of urban poverty, conceptual clarity, clear linkages to mechanisms, and intentional research design that responds to the methodological challenges of understanding neighborhood change and city and regional transformation are necessary to move from research to undertaking health equity. Cities are systems within regional, national, housing, and individual level webs which simultaneously influence one another across sectors, social groups, and power structures. It is by wrestling with this complexity that we will move from medical advancements for individuals to understanding how to advance population level health equity.
References


46

Chapter 3 Gentrification and its Role in Exacerbating Health Inequities: An Exploratory Study Based in Alameda County, California

1. Introduction

The neighborhood effects literature is predicated on the thesis that “where you live affects your life chances” (Slater, 2013). What then happens to the life chances of individuals living in neighborhoods experiencing change? One macro-level force inducing neighborhood change is gentrification. Gentrification is a process in which formerly declining, under-resourced neighborhoods experience reinvestment and in-migration of increasingly affluent new residents; this process is dynamic, uneven, occurs in stages, and has distinct drivers depending on context (Maloutas, 2012; Kerstein, 1990; Clay, 1989; Helms, 2003; Hochstenback and van Gent, 2015; Hwang and Sampson, 2014). Gentrification inducing reinvestment and socio-demographic shifts can influence the distribution and spatial patterning of health risk and protective factors within neighborhoods. Yet there is a dearth of understanding regarding the relationship between macro-level changes such as gentrification and health inequities.

Neighborhood effects research has focused primarily on whether neighborhoods matter for health and the isolation of place effects on health (Oakes et al., 2015; Sharkey and Faber, 2014). Recent studies have focused on neighborhood socioeconomic status and relative deprivation and a broad spectrum of health outcomes. A few illustrative outcomes of focus include cardiovascular disease (Roux-Diez et al., 2001; Mujahid et al., 2017), physical activity (Boone-Heinonen et al., 2011), obesity (Mobley, et al., 2006), mental health (Graif et. al, 2016; Leventhal and Brooks-Gunn, 2003), and self-rated health (Subramanian, et al., 2006; Subramanyam et al., 2009).

However, an exclusive focus on neighborhood level factors limits understanding on how the neighborhood is shaped by multi-level influences. Following calls for rethinking research on neighborhood effects, this paper uses the exposure of gentrification, which innately is not one that is measured only at the contextual (place) or compositional (people) level. It is a social force that is manifested in both the contextual and compositional levels, working at scales where stages of gentrification can be clustered, influencing both intra-neighborhood and intra-city inequities.
The overarching goal of this study is to examine the extent in which gentrification mitigates, maintains, or exacerbates health inequities in the context of Alameda County, California. We accomplish this by using the measure of preventable mortality per census tract as an indicator of health inequities. We assess preventable mortality among census tracts experiencing particular stages of gentrification and upgrading. Here we differentiate gentrification and upgrading. Gentrification is a process where formerly disinvested neighborhoods are now experiencing socio-economic change. This is contrast to upgrading of medium/high income census tracts, which have experienced consistent and additional capital investment and continued socio-demographic shifts with residents of increasing affluence (Landis, 2016; Maloutas, 2012). In the proceeding section, we expound on research linking health and place, and further describe the potential pathways through which gentrification may influence preventable mortality. Then, we review the conceptual linkages between gentrification, fundamental cause theory, and operationalization of the outcome of interest - preventable mortality.

1.1. Neighborhoods, Health, and Gentrification

Neighborhoods are a geographically bound area providing access to health-relevant resources (Bernard, et. al., 2007) The spatial patterning of health suggests place or neighborhood level effects is a critical nexus point of socio-economic, physical, and biological health risk and protective factors (Curtis and Jones, 1998; Auchincloss and Diez-Roux, 2008; Diez-Roux, 2001).

While scholars in the 1980s and 1990s focused on urban concentrated poverty, during this same period concentrated wealth and income rose (Watson, 2009; Wheeler and Jeunesse, 2008). Following the Great Recession, the largest metropolitan areas in the United States grew more rapidly than their suburbs for the first time in nearly a century (Frey, 2012). Cities are now experiencing increased urban in-migration and resulting capital flows, enhanced power of local level institutions as a result of governance shifting from state and federal entities and widening inequality (Chetty et. al., 2016; Katz and Nowak, 2018).

Through a social determinants of health perspective, socio-economic factors such as income, wealth and education are critical factors shaping a range of health outcomes (Braveman and Gottlieb, 2014; Adler et. al., 2016) Therefore, increasing socio-economic inequity can plausibly lead to health inequities.

Gentrification can shape a neighborhood’s key resources and opportunities. The changes may be differentially experienced based on the socio-demographic characteristics of residents and the stage of gentrification currently being experienced in
a neighborhood. For example, a long-term resident who is a homeowner living in a neighborhood with advanced gentrification will experience increased wealth and potentially income from new renters. However, a low-income individual that is experiencing the same stage may be displaced or suffer a loss of health-protective social networks. Those in the most advanced stages may lose social networks and experience loss of inexpensive, basic goods as a result of businesses catering to the more affluent customers and changes in community services. Reflecting the process of gentrification, we refrain from conceptualizing gentrification as a dichotomous factor which either is or is not present within an area. Employing stages of gentrification acknowledges the uneven intensity, differential impacts of these changes, and identification for future intervention.

Therefore, this paper employs 4 stages of gentrification (Zuk, 2015). The first stage includes tracts that are not undergoing any socio-economic shifts. The second stage includes those at risk of gentrification where prior disinvestment occurred but may be prone to investment as a result of location, quality of the housing stock, or accessibility to transit (Chapple and Zuk, 2016). The third stage includes tracts that are experiencing a decline of low-income in-migration and experiencing population or economic growth. The fourth stage includes those tracts that have been gentrifying since the 1990s or starting in the 2000s, where as a result of demand and supply side characteristics such as local markets, new resident preferences, government policies, and capital investments, the actual rental income of a property is closely aligned to the potential income of a property (Shaw, 2005; Lees, 2000). In this most advanced stage, there is a fundamental shift in resources catering to the more affluent, newer residents and transferring of power and community institutions from low-income long-term residents to the incoming residents gentrifying the neighborhood.

1.2. Gentrification in Alameda County, Fundamental Cause Theory, and Preventable Mortality

This paper focuses on gentrification occurring in the rapidly changing context of Alameda County, California, part of the Bay Area metropolitan region. This area is a prime case study site given its economic growth, increasing inequity, and gentrification processes shaping the distribution of fundamental resources shaping health outcomes. The Bay Area has grown at a faster rate than the United State or California between 2010 – 2014 and Alameda County in particular has experienced substantial economic and demographic urban transformation (ABAG, 2015). For example, the median rent has increased by 29%, a median-priced single-family home increased from $447,970 to $895,000 in the past five years and a household of four with an income of $80,400 is classified as low-income (Plan Bay Area, Alameda County, 2017; California Association of
Realtors, 2017; HUD 2017). These data illustrating wealth concentration are juxtaposed with additional indicators of decreasing opportunity for the lower and middle class. For instance, since 2008 investments in affordable housing in Alameda County were reduced by $115 million annually, a 74% reduction and lowest-income renters spend 56% of their income on rent (California Housing Partnership, 2016). There are also significant disparities within Alameda County. For example, in terms of children living in poverty within the city of Oakland, 43% of children in the portion of Oakland south of Fruitvale live in poverty while in Northeast Oakland, 6% of children live in poverty (United Way Bay Area, 2017). In Alameda County, people living in the lowest poverty neighborhoods on average live six years longer than residents of high poverty neighborhoods (Alameda County Public Health Department, 2011).

Despite changes in diseases, technology, and interventions, fundamental cause theory posits that some causes maintain health inequities, based on who has access to these new resources (Phelan and Link, 2005; Link and Phelan, 1995). Those who possess flexible resources are better positioned to leverage health-promoting resources and innovations, can minimize the risks and consequences of disease, prolong life and well-being, and prevent mortality. These flexible resources are inherent in neighborhoods; hence changes in neighborhood resources can alter the ability of residents to develop and access flexible resources, thereby perpetuating or limiting health inequities. Conceivably, changes to physical, social, political, and economic environments, resulting from gentrification, can alter access to these flexible resources, potentially increasing (for some) or decreasing (perhaps for others) rates of preventable mortality.

Preventable mortality is defined as a cause of death that could be averted by controlling or managing disease or facilitating access to critical preventative care. For example, mortality from several preventable causes of mortality, such as death from diabetes, influenza, and tuberculosis, can be attenuated through access to knowledge sources and social connections – both key flexible resources, according to fundamental cause theory.

When defining preventable mortality in the context of gentrification, one must consider the attributes of the exposure. First, given that gentrification is a longitudinal process, it is important to consider the necessary length of time of the exposure of interest to reasonably influence the disease development of preventable causes of mortality. Gentrification accelerated in the early 2000s, and as such causes of preventable mortality that could be altered within ten years is necessary. In addition, one must consider whether illness can be treated, controlled, or prevented as a result of changes to the neighborhood social, economic, or physical environment which result from gentrification. Third, new technological advances or resources necessary to prevent
mortality must be conceivably available as a result of gentrification. For instance, while participation in a clinical trial may deem a cause of death preventable, participation itself is generally not strongly related to gentrification. Hence, causes of preventable mortality, within the context of gentrification, is a cause of death of an individual under 65 year of age which meet the following criteria: 1. Limited time necessary for exposure to result in death (less than 10 years); 2. Easily treatable or acuity is quickly modifiable; 3. Resources necessary for modification are plausible within the context of gentrification. Preventable causes of death for this study include Tuberculosis, Syphilis, HIV/AIDS, Influenza, Pneumonia, Chronic Lower Respiratory Illness, Suicide and Diabetes. A complete list of all causes of death classified by Alameda County Public Health Department and identification of which are preventable or non-preventable is listed in Appendix 1.

These preventable causes of death are indeed distinct. However, they are all modifiable through flexible resources (knowledge, money, power, prestige), altered in the context of gentrification at the individual level, and also shaped and being shaped by neighborhood physical, economic and social resources, which together are embodied. For example, the built environment has been linked to drug overdose, and conceivably changes to the built environment as a result of gentrification serve as a protective of risk factor. Control of diabetes can also be enhanced by access to healthier food options or impeded by deteriorating social connections that facilitated consistent care and healthier food.

Taken together, neighborhoods influence health outcomes, and during times of macro-level change such as the process of gentrification, resources within these neighborhoods are altered in phases, influencing the health of individuals most vulnerable to shifts in flexible resources. Based on fundamental cause theory, one indicator of health inequity during times of change is preventable mortality. Gentrification as a process can lead to distinct hypotheses on preventable mortality. For example, because of its long-term nature, one can expect a limited change in preventable mortality during the early stages of the process. This in turn may lead to a spike in preventable mortality in census tracts that are experiencing most advanced stages of gentrification.

Therefore, this paper will answer the following a priori hypotheses. We hypothesize there an association between stages of gentrification and preventable mortality, where rates of preventable mortality increase as stages of gentrification become more advanced. During these more advanced stages, health protective resources shift toward meeting the needs of the newer, more affluent residents, who hold increasing power and control of neighborhood development. Our second hypothesis is that more
advanced gentrification census tracts within Alameda County increases the risk of preventable mortality in comparison to low-income non-gentrifying census tracts. Conversely, because medium/high income census tracts did not experience historical disinvestment, further upgrading through additional capital and increasingly affluent residents reduces the risk of preventable mortality.

2. Methods

This ecological analysis uses census tracts as the unit of analysis. This level of analysis is appropriate for two reasons. First, the exposure of interest, gentrification, is a group-level construct and not sufficiently captured by individual-level variables; therefore, ecological designs are appropriate when examining group interventions on group outcomes (Morgenstern, 1995).

We use all-cause mortality data from 2005 – 2013, the only period of data which was available at time of analysis, from the Alameda County Public Health Department. These data were geo-coded based on address of last residence for each deceased individual.

2.1. Construction of Independent Variable: Gentrification

Gentrification has been measured in a variety of ways, many of which assume a standard set of indicators of gentrification across distinct contexts.1 However, this study

1 There are several methodologies for measuring the stages or process of gentrification of census tracts across income levels. A widely accepted measure is the Freeman method, which uses three indicators to identify gentrifying neighborhoods for a defined period: an increase in median home sales, an increase in education attainment and identification of neighborhoods with a median income below that of its metropolitan area (Freeman, 2005). The Landis method captures neighborhood socioeconomic change by identifying census tracts with a two or more-decile change in the median household income over time (Landis, 2016). The Regional Early Warning System incorporates more variables and identifies a greater number of census tracts experiencing gentrification throughout the Bay Area and greater variability of stages of gentrification (Sohn, 2017). Generally, the census tracts that are classified by Freeman and Landis as gentrifying are also classified as such by the Regional Early Warning System. However, in areas experiencing recent rezoning and growth, the methodologies provide distinct results. For example, within the West Berkeley, Emeryville, and West Oakland area the Regional Early Warning System indicates advanced gentrification of a large portion of the area. This in fact reflects the re-zoning efforts catalyzing residential, manufacturing, retail and office development. Yet, this growth is not reflected in maps of gentrification based on Landis’ measure, given its focus on changes in income of the population over time. As another illustration of the Early Warning System’s ability to identify changing urban census tracts, a comparison of the methodologies for the area of San Francisco again shows differentiation. Specifically, the eastern portion of San Francisco which includes the Mission District and South of Market (SoMA) has undergone a transformation expanding housing and light industrial use, reflected in the relatively large area identified as experiencing advanced gentrification. In contrast, Freeman’s methodology, as a result of the few variables included in the measure which focus on demographic and housing, omits several census tracts in the Mission District and SoMa, masking the process of gentrification (Sohn, 2017).
acknowledges the heterogeneity of place and the resultant myriad ways gentrification can shape urban areas. Therefore, as a starting point for identifying the universe of potential indicators of gentrification relevant to Alameda County, we used the Regional Early Warning System for Displacement (REWS), developed by UC Berkeley’s Center for Community Innovation (CCI) to predict stages of gentrification in the Bay Area.²

The REWS measure of gentrification includes a plethora of indicators capturing market conditions, vulnerable populations, and demographics. However, this may induce multicollinearity resulting in unstable parameters and exclude critical confounding variables from the regression model, such as racial demographics. Therefore, the REWS measure was used as a training data set to build a random forest prediction algorithm.

Random forest was utilized to select the most minimal and relevant features of the construct of gentrification. The random forest approach uses random bootstrap samples of both the variables and the census tracts to generate decision trees. Each variable in a decision tree (also referred to as a node) has a distribution; a threshold is determined within the observed distribution to optimize the probability of correctly classifying the census tract to a particular stage of gentrification. Once a tree is built to a desired depth, the process is repeated to build a forest of decision trees. These trees allow for a more stable and accurate prediction of stage of gentrification. Random forests are considered a highly accurate prediction technique that can handle a large number of input variables without overfitting, are non-parametric, and are relatively robust to outliers and noise (Louppe, 2014; Touw et al., 2013).

Using the R package ‘varSelRF’ allowed backwards elimination to aggressively reduce the set of variables selected by iteratively fitting random forest and discarding variables of the smallest importance. Random forest identified the following variables listed in Table 3-1 as most critical for prediction and classification of stages of gentrification for timepoint 1 (2013). Using these indicators, gentrification was measured for each census tract in the year 2000; we extracted corresponding timepoints from US Census 1980,

² To ascertain the validity of the REWS construct, we analyzed distributional information, examined correlations and compared findings with theory. All indicators generally had a normal distribution. Furthermore, correlations between each subset of type of indicator (vulnerable populations, demographics, and housing market conditions) were consistent with the theoretical relationship between the two variables tested for correlation. The REWS measure was consistent with local knowledge of the various stages of gentrification in the Bay Area (ground-truthing) in comparison to other widely used measures, developed by Freeman (2005) and Landis (2016).
1990, and 2000. To adjust for changes in population as a result of merging or dividing census tracts between the 2000 and 2010 census, areal and population interpolation. We used the Longitudinal Tract Database by Brown University to link the 2000 census tracts with the 2010 equivalent. This method was developed and validated by Brown University to correctly standardize the population; it has been shown to perform better resulting in less error in comparison to methods using only areal interpolation (Logan, 2013).

These data were publicly provided by CCI, as extracted by the US Census 1990, 2000 and ACS 2009 – 2013. With regard to timepoint 0 (2000), we extracted corresponding timepoints from US Census 1980, 1990, and 2000. Regarding the median-income variable, only income distribution parameters were available; following Galster et al., pareto interpolation was used to determine the proportion of individuals that are below the income group of interest (2008).

**Table 3-1 Variables for measurement of the construct gentrification based on random forest**

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Adults (25+) with college degree (%, 1980)</td>
<td>Adults (25+) with college degree (%, 1990)</td>
</tr>
<tr>
<td>Low-income households (%, 1990)</td>
<td>Low-income households (%, 2000);</td>
</tr>
<tr>
<td>Low-income households (%, 2000)</td>
<td>Low-income households (%, 2013);</td>
</tr>
<tr>
<td>Low-income households (%, 1980)</td>
<td>Low-income households (%, 1990);</td>
</tr>
<tr>
<td>Median household income (1990)</td>
<td>Median household income (2000);</td>
</tr>
<tr>
<td>Housing units in pre-1950 buildings (%, 2000)</td>
<td>Housing units in pre-1950 buildings (%, 2013)</td>
</tr>
<tr>
<td>Renter households (%, 1990)</td>
<td>Renter households (%, 2000)</td>
</tr>
</tbody>
</table>

For consistency with the REWS measure, first census tracts were identified as low-income or medium to high/income. Low-income census tracts were defined as those where the share of low-income households (households that had an income below 80% of the county median) was greater than 39 percent, the Bay Area regional median in 2013.

Low-income tracts were categorized into one of the following gentrification stages: 1a. Not losing low-income (LI) households or are at the very early stages of gentrification; 2a. At risk of gentrification; 3a. Undergoing displacement/at risk of displacement and 4a. Experiencing advanced gentrification. Medium/high income (MHI) census tracts were
classified into the following: 1a. Not losing LI households or very early stages of displacement; 2a. At risk of displacement; 3a. Undergoing displacement; and 4a. Advanced exclusion. Medium/high census tracts are referred to as being upgraded rather than gentrified given gentrification takes place in areas newly in demand and historically under-resourced and disinvested.

To avoid biasing the prediction toward the most common stage (see Table 3-2 for the number of census tracts in each category based on REWS) balanced subsampling was executed, preventing misclassification. This allowed for identifying the most important variables to include in our classifier. We then compared our classification of census tracts based on the with the classification of census tracts based on the REWS classifier, which is the full data set. We reached 70% concordance with the REWS identified stages of gentrification for each tract. This is a solid concordance, given their measure accounts for Bay Area regional trends, thus obscuring smaller scale or county-level key attributes.

Table 3-2 Sample size: number of low-income (LI) census tracts by stage of gentrification in 2010 and number of medium/high (MHI) census tracts by stage of upgrading

<table>
<thead>
<tr>
<th>Stage of Gentrification</th>
<th>Number of Census Tracts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a. LI - Not losing LI households or very early stages of displacement</td>
<td>60</td>
</tr>
<tr>
<td>2a. LI - At risk of gentrification or displacement</td>
<td>49</td>
</tr>
<tr>
<td>3a. LI - Undergoing displacement</td>
<td>37</td>
</tr>
<tr>
<td>4a. LI - Advanced gentrification</td>
<td>38</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stage of Upgrading</th>
<th>Number of Census Tracts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1b. MHI - Not losing LI households or very early stages of displacement</td>
<td>105</td>
</tr>
<tr>
<td>2b. MHI - At risk of displacement</td>
<td>31</td>
</tr>
<tr>
<td>3b. MHI - Undergoing displacement</td>
<td>34</td>
</tr>
<tr>
<td>4b. MHI - Advanced exclusion</td>
<td>23</td>
</tr>
</tbody>
</table>

2.2. Construction of Outcome Variable: Preventable Mortality

Preventable mortality was measured using all-cause mortality data for timepoint 0 from 2005 – 2008 to assess the relationship with stage of gentrification at 2000. Preventable mortality data for timepoint 1 from 2009 – 2013 was then used to examine the
association with stage of gentrification at point 2013.

To identify the causes of death that are preventable or non-preventable, a systematic search of literature was conducted to extract the causes of death most consistently deemed preventable in peer-reviewed literature. 38 studies including preventable mortality as the outcome of interest were identified. For those with specific causes of death classified as preventable, frequency tables were generated to assess the diseases most commonly deemed as a preventable cause of mortality. Based on this review, breast cancer, lung cancer and hypertensive and cerebrovascular diseases have the highest frequency across all studies observed across time and countries.

Preventable mortality, within the context of gentrification, is a cause of death of an individual under 65 year of age that meets the following criteria: 1. Limited time necessary for exposure to result in death (less than 10 years); 2. Easily treatable or acuity is quickly modifiable; 3. Resources necessary for modification or treatment could be enhanced within the context of gentrification. Appendix 1 includes a complete list of preventable and non-preventable causes of death.

2.3. Census Tract Level Covariates

Four covariates for two points in time are included in the model to control for factors that are associated with both the independent and dependent variables. Given that the measurement of the process of gentrification required 10 variables, per random forest (described in the previous section), covariates were limited. The United States Census 2000 was used for timepoint 0 and the American Community Survey 2008 – 2013 was used for timepoint 1. Median age of the residents of the census tract is included in the model given differences in age between census tracts can confound the relationship between gentrification and preventable mortality; research on gentrification indicates that young adults and families are more likely to move to a gentrifying area (Shaw and Sullivan, 2011; Moos, 2016; Billingham, 2018).

The second covariate is the percent of individuals who identify as white. Individuals of color are disproportionately impacted by the process of gentrification as a result of urban economic forces and power differentials. Interpersonal and institutional racism as a result of gentrification may increase for individuals of color with an increasing percent of individuals identifying as White residing in and shaping organizations and community resources in their neighborhood. Research has found a relationship between racism and poor health, as measured by mental illness, blood pressure, and leukocyte telomere length Experiences of racism (Williams, 1999); (Krieger and Sidney, 1996); (Nuru-Jeter et al., 2009); (Chae et. al., 2014). Multiple minority racial and ethnic categories were not
used as covariates to avoid obscuring the relationship between the experience of certain racial groups in gentrifying areas given California’s multiethnic composition.

The third covariate included is the percent of vacant units in a census tract. Higher rates of vacancy may signal disinvestment in neighborhood resources. Vacancy may also shape the pace of gentrification at the neighborhood or block level.

Finally, gentrification often propels displacement in the long-run. The concern therefore is: are the results of this analysis a result of changing demographics therefore research actually captures the health outcomes of new, higher-income residents? Duration of residence in the census tract was employed to control for the likelihood that incoming residents with greater economic means and education levels are healthier. Furthermore, tracts with a higher percent of newer residents also indicate the process of gentrification, therefore mitigating our ability to understand the relationship between long-term residents in gentrifying tracts and preventable mortality. To control for these factors given we do not have longitudinal data on the residence of each individual, we used the percent of residents that moved into their housing unit on or before 1980 (for timepoint 0) and in 1990 or earlier (for timepoint 1). Sensitivity analysis found including the variables percent of residents that moved into their housing unit in 1990 (for timepoint 0) and in 2000 (for timepoint 1) did not alter results.

2.4. Statistical Analysis

Our overall objective was to examine the relationship between rates of preventable mortality in Alameda County and gentrification. First, we developed crude rates of preventable mortality at the county level for 2005 – 2013. Individuals in the study population were not selected randomly and differences in demographic characteristics between tracts prohibit comparisons between tracts; hence, model based direct adjustment was employed (Rosenbaum, 1987); (Roalfe, et. al., 2008). To conduct direct adjustment, age, sex and minority status stratum-specific rates of the reference population was applied to the study population. Alameda County was selected as the reference population instead of using the state of California, as each entity has distinct demographic differences. For example, as of 2016, 73% of California residents identified as white alone, while 51% of Alameda County residents identified as white alone (US Census, 2016).

One risk with direct standardization is the unreliability of estimates, particularly given the large variability in weights and small cell counts in this data set. Directly standardized rates (finding a confidence interval for a weighted sum of Poisson parameters) assumes a normal distribution. Obtaining confidence intervals may result in
a negative number for the lower confidence limit and provide unstable results (Swift, 1995). To avoid this, one can approximate exact confidence intervals (Fay and Feur, 1997). As such, we used the R package ‘epitools’ to calculate exact confidence intervals, which has been shown to be a conservative approach (Fay and Feur, 1997; Aragon, 2017).

We used a generalized linear mixed model with a random intercept for census tract, which accounts for the lack of independence of census tract measurements over time (timepoint 0 and timepoint 1) both with regard to repeated measures of stage of gentrification and repeated measures of preventable mortality rates. Given overdispersion, we used a negative binomial distribution. Our model was the following:

\[
\log(\lambda_{ij}) = (\beta_0 + \beta_0i) + \beta_1A_{ij} + \beta_2W_{ij}
\]

Here \(\lambda_{ij}\) is the average rate of preventable mortality directly standardized for race, age, and sex for CT \(i\) at time \(j = 1, 2\), \(A_{ij}\) is the gentrification status of census tract \(i\) at time \(j\), and \(W_{ij}\) is the set of confounders for census tract \(i\) at time \(j\). We assume a normal distribution of the random effect.

First, we modeled the relationship between the standardized rates of preventable morality and all stages of gentrification controlling for covariates that were not used in the outcome standardization (tenure and vacancy). Then, we examined whether the risk of preventable mortality differs between low-income non/minimally gentrifying census tracts (stages 1a – 2a) and gentrifying census tracts (stages 3a and 4a) and between medium/high income census tracts experiencing no or minimal upgrading (stages 1b and 2b) and those experiencing further upgrading (stages 3b and 4b). We calculated incidence rate ratios (IRRs) by exponentiating standardized betas. All analyses were conducted in R. The statistical significance was set a priori at \(p<.10\).

3. Results

3.1. Descriptive Statistics: Preventable Mortality Over Time

Within our study period of 2005 – 2013, 7,206 individuals died of a preventable cause. Table 3-3 illustrates the total number by year and by cause of mortality. Unintentional injuries were the leading cause of preventable mortality in Alameda County in 2013 and overall between 2005 – 2013. Risks for unintentional injury, per the Centers for Disease Control and Prevention, “include lack of seatbelt use, lack of motorcycle helmet use, unsafe consumer products, drug and alcohol use (including prescription drug misuse), exposure to occupational hazards, and unsafe home and community environments”
(2014). After a decrease from 296 to 211 deaths (almost 30%), deaths from unintentional injuries increased to 274. Suicide generally increased over time, from 82 in 2005 to 120 in 2013. Homicide resulted in 124 deaths in 2005, with a peak at 2008 (158). Homicides gradually decreased (except in 2012); 2013 had the lowest number of homicides in Alameda County since 2005. Deaths from Diabetes Mellitus and Chronic Lower Respiratory Disease remained relatively stable, with a slight increase in 2007 and 2008 and a subsequent decrease in the following years. Finally, while deaths from Viral Hepatitis increased from 18 in 2005 to 38 in 2013, deaths as a result from HIV, as expected given medical advances, decreased from 61 to 25 (55%).

Table 3-3 Count of non-preventable causes of death (in order of highest value as of 2013)

<table>
<thead>
<tr>
<th>Non-Preventable Causes of Death</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Total by Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unintentional Injuries</td>
<td>296</td>
<td>311</td>
<td>299</td>
<td>286</td>
<td>241</td>
<td>211</td>
<td>246</td>
<td>226</td>
<td>274</td>
<td>2390</td>
</tr>
<tr>
<td>Suicide</td>
<td>82</td>
<td>69</td>
<td>118</td>
<td>105</td>
<td>113</td>
<td>106</td>
<td>103</td>
<td>120</td>
<td>920</td>
<td></td>
</tr>
<tr>
<td>Homicide</td>
<td>124</td>
<td>169</td>
<td>145</td>
<td>158</td>
<td>126</td>
<td>124</td>
<td>120</td>
<td>136</td>
<td>103</td>
<td>1205</td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td>82</td>
<td>74</td>
<td>80</td>
<td>105</td>
<td>76</td>
<td>71</td>
<td>87</td>
<td>110</td>
<td>85</td>
<td>770</td>
</tr>
<tr>
<td>Chronic Lower Respiratory Diseases</td>
<td>49</td>
<td>63</td>
<td>61</td>
<td>70</td>
<td>60</td>
<td>49</td>
<td>61</td>
<td>65</td>
<td>51</td>
<td>529</td>
</tr>
<tr>
<td>Influenza &amp; Pneumonia</td>
<td>35</td>
<td>24</td>
<td>28</td>
<td>47</td>
<td>48</td>
<td>32</td>
<td>35</td>
<td>26</td>
<td>40</td>
<td>315</td>
</tr>
<tr>
<td>Viral Hepatitis</td>
<td>18</td>
<td>34</td>
<td>33</td>
<td>40</td>
<td>36</td>
<td>34</td>
<td>41</td>
<td>38</td>
<td>41</td>
<td>312</td>
</tr>
<tr>
<td>Essential Hypertension &amp; Hypertensive Renal Disease</td>
<td>26</td>
<td>34</td>
<td>28</td>
<td>25</td>
<td>30</td>
<td>31</td>
<td>27</td>
<td>36</td>
<td>34</td>
<td>271</td>
</tr>
<tr>
<td>HIV Disease</td>
<td>61</td>
<td>62</td>
<td>50</td>
<td>36</td>
<td>37</td>
<td>29</td>
<td>26</td>
<td>33</td>
<td>25</td>
<td>359</td>
</tr>
<tr>
<td>Nutritional Deficiencies</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>6</td>
<td>19</td>
</tr>
<tr>
<td>Pregnancy, Childbirth &amp; the Puerperium</td>
<td>8</td>
<td>6</td>
<td>2</td>
<td>1</td>
<td>6</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>39</td>
</tr>
<tr>
<td>Anemias</td>
<td>5</td>
<td>3</td>
<td>6</td>
<td>6</td>
<td>3</td>
<td>5</td>
<td>6</td>
<td>8</td>
<td>3</td>
<td>45</td>
</tr>
<tr>
<td>Acute Bronchitis &amp; Bronchiolitis</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Meningitis</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>TB</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>Meningococcal Infection</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Salmonella Infections</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Total by Year</td>
<td>793</td>
<td>849</td>
<td>856</td>
<td>884</td>
<td>779</td>
<td>701</td>
<td>756</td>
<td>796</td>
<td>792</td>
<td>7206</td>
</tr>
</tbody>
</table>

Concerning our first research question on the rates of preventable mortality over time, we hypothesized that rates increased in a linear fashion over time. Data showed a curvilinear trend, demonstrating shifts in preventable mortality rates (Figure 3-1).
2005 the rate for Alameda County was 6.64 deaths per 10,000 individuals. The slope slightly increased between 2005 – 2008 to 7.24 preventable deaths per 10,000 individuals. However, the rate decreased to 4.93 preventable deaths per 10,000 individuals in 2010. In 2012, the rate increased to 5.5 deaths per 10,000 individuals and again slightly decreased to 5.46 preventable deaths per 10,000 individuals.

**Figure 3-1 Preventable mortality rates over time for alameda county (2005 – 2013)**

In addition, to ensure rates at the county-level were not driven by low-income census tracts, we compared preventable mortality rates for 189 low-income census tracts and 165 medium/high income census tracts (Figure 3-2). We confirmed that while rates are higher in low-income census tracts and the negative slope is larger between 2008 – 2010, stratifying by income exhibited a similar curvilinear trend.
3.2. Regression Analyses

Next, we examined if there was an association between stages of gentrification and preventable mortality in low-income census tracts. In our naïve model (Table 3-4), we found that census tracts are statistically significantly associated with preventable mortality. We then examined confidence intervals for each slope to assess differences in preventable mortality rates by census tract. The confidence intervals for stage 2a (Undergoing displacement) and stage 4a (Advanced gentrification analysis) slightly overlapped, indicating the rates for these two levels are not quite statistically significantly different from one another (Table 3-4).
The statistical significance between preventable mortality and gentrification justified additional multilevel modeling to account for potential confounding variables. We tested our first hypothesis, to examine the association between increasing rates of preventable mortality and increasing stages of gentrification, by employing a generalized linear mixed effects model. We compared preventable mortality rates between stages of gentrification among low-income census tracts. Compared to census tracts experiencing advanced gentrification (stage 4a), stage 1a census tracts experienced a nearly 25\% lower rate of preventable mortality ($\text{IRR} = \exp(-0.29327) = 0.7458$). Additionally, stage 3a census tracts had a nearly 30\% lower rate of preventable mortality than stage 4a tracts ($\text{IRR} = \exp(-0.32945)$ (Table 4). These differences are statistically significant when adjusting for tenure and vacancy. The only low-income census tracts that appear to have a standardized preventable mortality rate higher than the stage 4a classification are those in stage 2a. Therefore, we cannot declare a positive linear relationship between preventable mortality and increasing stages of gentrification and we reject our first hypothesis.

|                | Estimate | SE  | Pr(>|z|) | CI (lower bound) | CI (upper bound) |
|----------------|----------|-----|---------|------------------|------------------|
| 1a. LI - At risk of gentrification or displacement | 3.80     | 0.13| 0.00    | 3.59             | 4.01             |
| 2a. LI - Not losing LI households or very early stages of displacement | 3.17     | 0.12| 0.00    | 2.97             | 3.38             |
| 3a. LI - Undergoing displacement | 1.88     | 0.14| 0.00    | 1.65             | 2.11             |
| 4a. LI - Advanced gentrification | 2.86     | 0.13| 0.00    | 2.64             | 3.08             |

Table 3-4 Quasipoisson regression model testing association between gentrification and preventable mortality
### Table 3-5 Association between stages of gentrification and preventable mortality

|                          | Estimate | Std. Error | z value | PR(>|z|) |
|--------------------------|----------|------------|---------|----------|
| Intercept (LI - Advanced gentrification) (4a) | 2.27     | 0.08       | 25.43   | < 2e-16 *** |
| LI - Not losing LI households or very early stages of displacement (1a) | 0.29     | 0.12       | 0.18    | 0.002**   |
| LI - At risk of gentrification or displacement (2a) | 0.05     | 0.11       | 1.67    | 0.10      |
| LI - Undergoing displacement (3a) | -0.33    | 0.13       | -0.51   | 0.001**   |
| MHI - Advanced exclusion (4b) | -1.6     | 0.20       | -7.06   | 1.63E-12 *** |
| MHI - At risk of displacement (1b) | -0.94    | 0.15       | -6.35   | 2.14E-10 *** |
| MHI - Not losing LI (2b) households or very early stages of displacement | -1.24    | 0.12       | -9.33   | < 2e-16 *** |
| MHI - Undergoing displacement (3b) | -1.07    | 0.16       | -6.39   | 1.7E-10 *** |
| Vacant                   |          |            |         | < 9.56e-06*** |
| Tenure                   |          |            |         |           |

***p < .001  **p < .01 *p < .05
Next, gentrification is temporally uneven; one may expect minimal changes in the first two stages of gentrification, and accelerated effects in census tracts with more advanced stages of gentrification. Therefore, we examine if there is a greater risk of preventable risk among gentrifying low-income census tracts in comparison to all other census tracts in Alameda County. In addition, we extend this analysis to medium/high income census tracts that have not experienced disinvestment but are experiencing capital investment and demographic changes (hence the use of the term upgrading since a precondition for gentrification is disinvestment). We assess if there is an increased risk of preventable mortality between medium/high income non/minimally upgrading census tracts and all other census tracts.

| Table 3-6 Association between Stages of Gentrification and Preventable Mortality |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|
|                                 | Estimate \( \exp(\beta) \) | Std. Error \( \text{SE}(\beta) \) | \( z \) value | \( PR(>|z|) \) |
| Intercept – Low-income Non-Gentrifying | 14.81 | 1.19 | 15.62 | < 2e-16 *** |
| Low-Income Gentrifying | 1.15 | 1.05 | 2.97 | .0029** |
| Medium/High Income Upgrading | .77 | 1.07 | -3.38 | .0007*** |
| Median Age | .98 | 1.00 | -4.35 | 1.35e-05*** |
| White | .34 | 1.14 | -8.3 | < 2e-16*** |
| Vacant | 6.83 | 1.73 | 3.5 | .000*** |
| Tenure | 1.97 | 1.20 | 3.65 | .000*** |

As shown in Table 3-6, the incidence rate ratio comparing low-income gentrifying census tracts to all non-gentrifying census tracts was observed to be 1.15, denoting an increase in incidence rates of 15%. In contrast, medium/high income upgrading census tracts have an incidence rate ratio of .77 when compared to all non-gentrifying census tracts.
tracts, denoting a decrease in incidence rates of 23%. In essence, gentrification is a risk factor in low-income census tracts but is a protective factor in medium/high income non-upgrading census tracts. This provides evidence in favor of the hypothesis that gentrification has a detrimental effect on low-income census tract.

4. Discussion

Using geo-coded all-cause mortality data from Alameda County Public Health Department and categorizing specific causes of death as preventable within the context of gentrification, two major findings are the following: 1. Gentrification is a risk factor for preventable mortality among low-income census tracts experiencing gentrification in comparison to those low-income tracts that are not being gentrified; 2. Upgrading is a protective factor among medium/high income census tracts, in comparison to non-upgrading tracts. In other words, when medium/high income census tracts experience changes similar to low-income census tracts, preventable mortality declines in those neighborhoods. Thus, neighborhood changes are not intrinsically positive or negative, but their effect depends on the neighborhood context prior to those changes. When assessing the influence of the macro-level force of gentrification within formerly disinvested areas, rather than gentrification itself as influencing preventable mortality, the history of disinvestment that precipitated and possibly facilitated gentrification positioned the tract to experience gentrification and deleterious health consequences, at the ecological level.

Our findings identified decreasing rates of preventable mortality until 2008, when there was a slight increase of rates in Alameda County. Fluctuations in preventable mortality rates in Alameda County may be related to the Great Recession which began in 2008 in addition to increasing inequity. Yet, these macro-level factors are related to gentrification itself. The foreclosure crisis in Alameda County precipitated massive private sector development, and the affordable housing crisis drove private and public-sector investment into formerly underserved, relatively inexpensive neighborhoods (Urban Strategies Council, 2012).

This study indicates gentrification can be exacerbating health inequity. The inverse effects of gentrification and upgrading can signal continued exacerbation of health inequity over time. Reduced risk of preventable mortality within middle/high income census tracts experiencing upgrading could be conceived as the effect of historical investment in institutions, organizations, and populations within these communities. In turn, gentrification is part of a broader continuum of social and economic change.

Traditionally, scholarship on gentrification has focused on the underlying structure of
g gentrification with tensions between gentrification as a form of control and appropriation and gentrification as a method for deconcentrating poverty (Zukin, 1987; Chaskin and Joseph, 2012). Most recently, gentrification scholars have urged constraint in employing the term gentrification to a broad set of social and economic changes along with examining gentrification within the broader urban landscape of neighborhood change, poverty and segregation (Hwang, 2016; Brown-Saracino and Rumpf, 2011). This research is an attempt to focus on locally relevant constructs of gentrification using data specific to Alameda County. Furthermore, our findings reify that gentrification and health must be understood through the histories of neighborhood context. Gentrification among low-income census tracts or upgrading in the case of medium/high-income census tracts influences the spatial patterning of health equity.

To our knowledge, this is the first study concerning gentrification and health that measures preventable mortality; other studies have used violence or low-birth weight as their outcome of interest (Huynh, et al., 2014; Barton, 2016). While epidemiology focuses on a clinical classification of disease, leaders in social epidemiology have emphasized the value in classifying types or sets of diseases. Marmot et. al found a similar risk of death across a range of diseases, regardless of employment grade (1984). Similarly, Syme argued for examining characteristics for a set of diseases; he employs the example of social support to illustrate the importance of studying this concept in relation to a set of diseases (1996). Finally, Cassel suggests there are classes of environmental factors that alter resistance and affect host susceptibility, thereby emphasizing a predisposing factor of disease rather than a disease specific etiology (1976).

Thus, the argument for identifying sets of diseases is persuasive, documented over three decades. Yet, how do we create these categories of diseases in a way that develops interventions and assesses health inequity? This paper proposes a process that incorporates the level of exposure necessary for the illness to occur (individual, meso, macro), the timeframe in which the exposure can catalyze change at the appropriate level, and an assessment of which causes of mortality can be associated with changes in exposure within the identified timeframe of interest. Ultimately, identifying characteristics of the disease itself will help us identify causes of preventable death within a certain social and economic context and develop interventions across multiple diseases.

Furthermore, measurement generally consists of a limited number of variables. Complicating current efforts to describe gentrification and measure the process are the varied definitions for gentrification. The range in definitions includes social, political and
economic forces across individual, community and regional contexts. Yet, as Hwang and Simpson point out, traditional data sources do not capture multi-level political and economic forces, such as private developers, public housing policies, and gentrification’s uneven nature within neighborhoods (2014). In addition, the social (social cohesion, social capital, etc.) and environmental (built environment, physical surroundings, violence, etc.) mechanisms and the interaction between residents and these changing facets of the community also are generally not captured. REWS attempts to more robustly use data aligned with theory and forces of gentrification; for example, the indicators included represent access to employment (indicating inner-city reinvestment), proportion of older housing stock (which has been associated with gentrification), and both changes in home sale price and value (capturing rehabilitation and reinvestment). This typology captures major forces and impacts of gentrification based on the literature. However, future additional measurement should also capture multi-level social, political, and physical changes, and how those are experienced by residents.

4.1. Limitations

This study is not without limitations. Given constraints in available data, a time lag for preventable mortality at timepoint 2 was not possible; as such there is overlap between our exposure and outcome of interest. Furthermore, this was an ecological level analysis. As with any phenomena involving potential displacement, we ran the risk of capturing deaths of generally healthier individuals who in fact are gentrifying these areas. Yet, if we were capturing gentrifiers, gentrification would be a protective factor rather than a risk factor in low-income census tracts.

In addition, an indicator of disinvestment, a precondition required for census tracts to be classified as gentrifying, is low-income level. Low-income tracts were those with more than 39% of households with an income of 80% of the county median in 2013, which was almost $60,000 in 2013 (US Census, 2018). Reduced risk of preventable mortality within middle/high income census tracts experiencing upgrading could be conceived as the effect of historical investment in institutions, organizations, and populations within these communities. Or, given the thriving economic context of the Bay Area and rampant revitalization of neighborhoods, at the household level, some vulnerable could be living in medium/high income census tracts and experiencing either the deleterious effects of exclusion or the health-protective factors of stronger neighborhood institutions, social cohesion, and additional physical and economic resources. Additional research may suggest more robust measures of disinvestment for identifying census tracts that could be gentrifying.

Several assumptions concerning the measure of gentrification warrant further
examination. We assume the REWS classification of four stages of gentrification for low-income and medium/high income census tracts is a valid source of measurement for training the data to complete the random forest algorithm. However, preliminary assessment of clustering of the variables included in the construct indicated two stages of gentrification may be a more meaningful categorization. This may explain why our first model examining four stages of gentrification and preventable mortality was not significant.

Furthermore, public health’s model of a dose-response relationship may need reconsideration when attempting to understand macro socio-structural forces. Distinct stages may lead to various kinds of “doses” that individuals can be differentially exposed to during the process of gentrification. These doses can vary in terms of intensity and type (physical changes verses economic changes for example). Hence, obtaining a more nuanced understanding of who is differentially impacted, under what circumstances, and the mechanisms behind the relationship between gentrification and preventable mortality may depend on qualitative methods to elucidate these findings.

5. Conclusions

This paper suggests gentrification is in fact exacerbating urban health inequity between low-income census tracts. The main differences between gentrification and upgrading is the income baseline and histories of disinvestment. One may posit that disinvestment in urban neighborhoods is a byproduct of institutional and interpersonal racism. Future research may conceptualize gentrification as outcome of historical processes of disinvestment that ultimately shape place and health over the life course of a neighborhood. Furthermore, understanding the psychosocial and biological mechanisms resulting in the embodiment of urban change is necessary to identify timing and content of future interventions. Together, this may shed light on how to inject communities with capital in a manner that rejuvenates under resourced communities explicitly for those long-term residents that are generally marginalized and disenfranchised living in the formerly neglected urban core.
References


Williams, David R. 1999. “Race, Socioeconomic Status, and Health The Added Effects of


Chapter 4 From Risky Places to Complex Experiences of Place and Health in Gentrifying West Oakland, California

1. Introduction

“If gentrification were a movie character he would be both a villain and knight in shining armor, welcomed by some and feared and loathed by others, and even dreaded and welcomed at the same time by the same people” (Freeman, 2011, p. 60).

As Freeman so aptly describes, the effects of gentrification, in which formerly declining, under-resourced neighborhoods experience capital reinvestment and in-migration of increasingly affluent new residents, are not homogenous. For some, this macro-level force improves public services, neighborhood aesthetics, quality of housing, and increases community safety. For others, it catalyzes displacement and contributes to a loss of health protective social networks and supports (Freeman and Braconi, 2004; Keels and Burdick, 2013). Hence, gentrification can either reduce or even deepen health inequities. Understanding how neighborhoods shape health inequities is stymied by several limitations of current research. Three limitations relevant to this study are: a limited number of investigations into the effects of gentrification and health from the perspective of long-term residents, the assumption that neighborhoods provide uniform exposures to its residents, and treating neighborhoods as static entities (Frohlich et al., 2001; Kingsley, et al., 2014, p.347; Sharkey and Faber, 2014). In an effort to address these limitations, this research uses qualitative data, which is uniquely suited to developing hypotheses, identifying underlying mechanisms explaining quantitative findings, and probing the heterogeneous effects of gentrification across subpopulations (Small and Feldman, 2012, p. 69). Building from previous research findings in this dissertation which showed gentrification is a risk factor for increased preventable mortality rates in gentrifying low-income census tracts in comparison to low-income non/minimally gentrifying census tracts, the aim of this research is to illuminate the mechanisms through which gentrification influences preventable mortality among long-term residents, and who and under what circumstances does gentrification become a
protective or deleterious health factor.

We use two census tracts in Alameda County with similar socio-demographic profiles and levels of gentrification, but significantly different levels of preventable mortality. By comparing the two areas, it allows us to explore how, for whom, and the mechanisms contributing to each site’s distinct rates of preventable mortality. In comparison to neighborhood effects research, which has focused on whether neighborhoods matter for health, our understanding of how neighborhoods impact health may be enhanced by focusing on the various mechanisms and levels through which neighborhood resources impact health and the heterogeneous effects these may have on individuals and communities (Small, 2012, p. 76). Mechanisms are wide-ranging and can include social mechanisms (social networks, collective socialization, social cohesion and control, and relative deprivation), environmental mechanisms (exposure to violence, physical surroundings, and the built environment), geographical mechanisms (access to job opportunities, transport, and other public services), and institutional mechanisms (private, non-profit and public organizations and other private actors that shape access to fresh food, liquor, and drug markets) (Small, 2012, p. 73).

Three main themes (or mechanisms) contributing to differential preventable mortality rates were community resources, social support, and inclusion/exclusion. Interpretation of this data suggests these mechanisms were experienced differently within each census tract, at multiple scales, and shaped how neighborhoods are resilient toward or susceptible to the effects of gentrification - reifying the importance of understanding the life course of a neighborhood rather than focusing on gentrification. In the following section, we expound on considerations of context, scale and change in the neighborhood effects literature and will conclude with a description of the case study sites and guiding research questions.

1.1. Considerations of context, scale and change in the neighborhood effects literature

Social, spatial and temporal patterning of neighborhoods can reflect and reinforce health inequities for residents, as “near things are more related than distant things” (Tobler, 1970, p. 236). Research increasingly is investigating how gentrification alters the physical, social, political, and economic environments of neighborhoods, altering both the composition and context of a neighborhood. Rather than focusing on identifying the “independent” effects of context and composition, this research uses a relational perspective to better understand the symbiotic relationship between place (context) and people (composition) (Cummins, 2007). This symbiotic relationship is especially relevant when exploring new research paths, such as how large-scale or macro-level forces shape
health (Galea and Link, 2013; Ng and Muntaner, 2013; O’Campo, 2003). These macro-
level forces range from economic conditions and early childhood family and educational
context to political economic systems and globalization (Glymour 2013). Research has a
tendency to control for social locations or view them as additive rather than reinforcing
one another in a multiplicative manner. An example of such an interaction is the
exposure of neighborhood deprivation, which is strongly correlated with various poor
health outcomes. The primary cause of neighborhood deprivation is residential racial
segregation, propelled by macro-level forces such as redlining and gentrification,
resulting in neighborhoods patterned by race, ethnicity and class (Williams and Collins,
2001). By focusing on gentrification as a case study, it helps to explore methods for
examining socio-economic forces as root outcomes of health inequities.

By studying context through the effects of macro-level forces such as median income or
poverty rates, epidemiologists assume these variables influence disease outcomes in
uniform ways across place and groups of populations (Frohlich, et al., 2001). However, a
deeper understanding of “where, when, why, and for whom residential contexts matter
is necessary (Sharkey, 2013). The same neighborhood can be experienced by different
residents in distinct ways, based on their length of time in the neighborhood, how they
spend their time, and which spaces they use in the neighborhood (Sharkey, 2014).
Therefore, a more flexible measurement of neighborhood contexts and an assumption
of heterogeneous responses to the residential environment is required (Sharkey, 2014).
Qualitative methodologies capturing the experiences of residents are well-suited to
move away from telling the tale of risky places and understanding the “wide range of
subtle and complex ways in which place or context matters for health” (Smith and
Easterlow, 2005).

In addition to the dearth of research on the influence of macro-level forces on health
and narrow conceptualization of context, one key challenge in the neighborhood effects
literature is the proclivity to measure neighborhoods in a static manner. This gap is
critical since gentrification itself is increasingly conceptualized as a type of
neighborhood change. Gentrification is an extended process and in its early phases,
gentrification may not even displace long-term residents. Gentrification may in fact alter
key health protective resources in a neighborhood for all residents, or new resources
may be developed explicitly for new, higher-income residents. Illustrative research
questions necessitating the conceptualization of neighborhoods as a changing entity
include: Does reinvestment in urban places that are now politically and economically
desirable produce resources that meet the needs of the widest range of potential users,
including long-term lower-income residents of these gentrifying neighborhoods? Or do
these shifts result in a loss of key resources most critical to the health and well-being of
urban, lower-income populations who are able to maintain residence in these changing areas? Therefore understanding how and to what extent neighborhoods change is critical to identifying trajectories of health and well-being for the most vulnerable populations. To illustrate how the concept of change alters research questions, Sharkey states: "Understanding how characteristics of neighborhoods affect children and families may not be adequate to understanding how a change in the neighborhood may affect children.

1.2. Application of Fundamental Cause Theory and Ecosocial Theory, Neighborhood Change, and Preventable Mortality

This research is guided by Fundamental Cause Theory (Link and Phelan, 1995) and Ecosocial Theory (Krieger, 2001). Link and Phelan argue that socioeconomic status, like other fundamental causes, regulates one’s ability to avert disease and death through a range of flexible resources including money, knowledge, power and social connections (1995). These flexible resources are inherent in neighborhoods; hence changes in neighborhood resources can alter the ability of residents to develop and access flexible resources, thereby perpetuating or limiting health inequities.

Whereas fundamental causes focuses attention on individual level flexible resources, Ecosocial Theory pays special attention to the “societal and ecologic context, the life course, levels of analysis, and the interrelationships between various forms of inequality” (Krieger, 2014, pg. 48). Based on ecosocial theory, it is plausible that changes in neighborhood conditions not only shift resources, but “get under the skin” or are embodied in ways that perpetuate or perhaps even increase inequities. Recent studies have uncovered associations between various biological markers and poor neighborhood conditions, where environments get under the skin by altering biological processes and affecting human development, health and well-being (Herztman and Boyce, 2010). Given this line of research, one can hypothesize that shifts in the environment for long-term residents may influence exposures that can serve as protective or risk factors, thereby impacting health.

Fundamental cause theory’s focus on individual level resources and ecosocial theory’s incorporation of multiple levels of analysis over the life course, allows for conceptually linking individual level flexible resources to subsequent neighborhood level resources across the life course of both the neighborhood and its residents. We suggest that in addition to flexible resources being obtained and employed at the individual level, these resources are also transferred and aggregated at the community level, particularly during the process of gentrification. For example, enhanced knowledge and power at the individual level can, through social connections, advance advocacy efforts for
additional public services. Thus, in this case, the individual knowledge transferred to others can incite contextual change that may benefit the health of both the individuals and the overall neighborhood to advance change and resiliency. These contextual changes may result in differential social or biological exposures and in turn be incorporated biologically by residents (Krieger, 2005) (Figure IV-1).

Flexible resources provide avenues to avert death, and one’s attainment, agency and ability to use these individual and neighborhood resources influences how these conditions are embodied, shaping susceptibility and vulnerability to disease. This interaction then shapes the pathways to opportunities and health protective factors over the life course. As a result of how gentrification alters flexible resources and vulnerability to disease, different rates of preventable mortality may be a result for residents that are experiencing gentrification.

**Figure 4-1 Linking fundamental cause theory and ecosocial theory**

To identify the causes of death that are a preventable or non-preventable, a systematic search of literature was conducted to extract the causes of death most consistently deemed preventable in peer-reviewed literature. 38 studies including preventable mortality as the outcome of interest were identified. For those with specific causes of death classified as preventable, frequency tables were generated to assess the most common diseases deemed as a preventable cause of mortality. A summary of
preventable causes identified in these articles are shown in Appendix 1. Based on this review, breast cancer, lung cancer and hypertensive, and cerebrovascular diseases have the highest frequency across all studies observed across time and countries.

However, gentrification is a longitudinal process. As such, one must consider the length of time required for the exposure to change health outcomes. Thus, those causes that are modifiable as a result of a few years of an individual being exposed and/or are easily treatable or likely to quickly respond to treatment are deemed as preventable for this study. Preventable causes of death for this study include Tuberculosis, Syphilis, HIV/AIDS, Influenza, Pneumonia, Chronic Lower Respiratory Illness, Suicide, and Diabetes.

These preventable causes of death are distinct but are all modifiable through flexible resources (knowledge, money, power, prestige) and shaped by neighborhood physical, economic and social resources, which together can be embodied, leading to health inequities. For example, access to and knowledge of Antiretroviral Therapy to suppress the HIV virus can be altered (both positively and negatively) by shifts in social connections and economic resources at the neighborhood level.

We define preventable mortality, within the context of gentrification, as a cause of death of an individual under 65 year of age that meets the following criteria: 1. Limited time necessary for exposure to result in death (less than 10 years); 2. Easily treatable or acuity is quickly modifiable; 3. Resources necessary for modification are plausible within the context of gentrification.

The process of gentrification is dynamic, uneven, and occurs in stages. (Clay, 1989; Helms, 2003; Hochstenback and van Gent, 2015; Hwang and Sampson, 2014; Kerstein, 1990; Maloutas, 2011). Therefore, the effects of gentrification can be heterogeneous. Some argue gentrification improves public services, neighborhood aesthetics, quality of housing, and increases community safety. As such, gentrification can be considered a solution for urban poverty ‘providing the tax base, rub-off work ethic, and political effectiveness of a middle class, and in the process improves the quality of life for all of a community’s residents. It is the rising tide that lifts all boats’ (Duany 2001, p.7). On the other hand, gentrification can result in social, cultural, and political displacement, where new residents develop their own institutions or supersede leadership in existing organizations, such as religious, academic, or governmental institutions. These heterogenous effects may all be experienced by residents simultaneously.

In response to opportunities to extend the literature on neighborhood effects, this research conceptualizes neighborhoods as non-static entities, considers socio-structural
forces influencing neighborhoods, and embraces heterogenous responses to context. This research is guided by the following questions:

1. How do long-term residents perceive the ways in which neighborhood attributes contribute to disparate preventable causes of death?

2. How do long-term resident experiences illuminate the mechanisms that may contribute to disparate preventable causes of death?

1.3. Selection of Case Study Sites

The case study sites in West Oakland, California are experiencing a similar stage of gentrification and have comparable socio-demographic profiles but have two distinct rates of preventable mortality. These two census tracts are identified in this study as 4018 and 4022 (Figure 4-2). As illustrated in Table 4-1, they have similar socio-economic characteristics. Based on data from University of California, Berkeley’s Urban Displacement Project, they are also experiencing the same stage of gentrification (ongoing gentrification/displacement).

Figure 4-2 Geographic location of census tracts

Table 4-1 Socio-demographic profile of census tracts
<table>
<thead>
<tr>
<th>Census Tract</th>
<th>4018</th>
<th>4022</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population 1990</td>
<td>1857</td>
<td>2097</td>
</tr>
<tr>
<td>Population 2000</td>
<td>1953</td>
<td>2559</td>
</tr>
<tr>
<td>Population 2013</td>
<td>2112</td>
<td>2505</td>
</tr>
<tr>
<td>Percent low income households (1990)</td>
<td>76%</td>
<td>83%</td>
</tr>
<tr>
<td>Percent low income households (2000)</td>
<td>76%</td>
<td>68%</td>
</tr>
<tr>
<td>Percent low income households (09-2013)</td>
<td>74%</td>
<td>63%</td>
</tr>
<tr>
<td>% of adults (25+) with college degree or more (1990)</td>
<td>5%</td>
<td>7%</td>
</tr>
<tr>
<td>% of adults (25+) with college degree or more (2000)</td>
<td>11%</td>
<td>15%</td>
</tr>
<tr>
<td>% of adults (25+) with college degree or more (2013)</td>
<td>30%</td>
<td>24%</td>
</tr>
<tr>
<td>% renter (1990)</td>
<td>79%</td>
<td>73%</td>
</tr>
<tr>
<td>% renter (2000)</td>
<td>81%</td>
<td>70%</td>
</tr>
<tr>
<td>% renter (2013)</td>
<td>84%</td>
<td>70%</td>
</tr>
<tr>
<td>% non-hispanic white (1990)</td>
<td>4%</td>
<td>8%</td>
</tr>
<tr>
<td>% non-hispanic white (2000)</td>
<td>3%</td>
<td>10%</td>
</tr>
<tr>
<td>% non-hispanic white (2013)</td>
<td>23%</td>
<td>17%</td>
</tr>
<tr>
<td>% growth in college educated adult population (1990-2000)</td>
<td>5%</td>
<td>8%</td>
</tr>
<tr>
<td>% growth in college educated adult population (2000-2013)</td>
<td>19%</td>
<td>9%</td>
</tr>
<tr>
<td>Median Household Income 1990</td>
<td>$ 17,985</td>
<td>$ 22,850</td>
</tr>
<tr>
<td>Median Household Income 2000</td>
<td>$ 25,724</td>
<td>$ 44,860</td>
</tr>
<tr>
<td>Median Household Income 2013</td>
<td>$ 30,449</td>
<td>$ 36,600</td>
</tr>
</tbody>
</table>

After accounting for differences in age, sex, and race between census tracts, census tract 4018 had a higher rate of preventable mortality in comparison to census tract 4022, particularly in 2013. For example, tract 4018 has the highest rate in Alameda County, while tract 4022 is consistently about average for the county.
Identifying two divergent trends in neighboring census tracts experiencing similar stages of gentrification allows us to explore the features of the environment that are related to differential health outcomes. Thus, following Small’s recommendation to “use heterogeneity in responses to neighborhood poverty as the starting point rather than [something] to ignore....” (Small, 2004, p.176; Small and Feldman, 2012, p.73).

Figure 4-3 Preventable mortality rates by census tract (per 10,000 individuals)

An earlier study in this dissertation found that gentrification is associated with increased rates of preventable mortality among low-income gentrifying census tracts in comparison to low-income non-gentrifying census tracts (Figure V-3). Hence, comparing long-term resident perceptions and experiences in two census tracts undergoing gentrification with varying rates of preventable mortality allows for an exploration into the mechanisms that might be triggering increased rates of preventable mortality.

2. Methods

2.1. Setting

Three features of West Oakland include a rich African-American history, poor health and high poverty as a result of decades of disinvestment and poor environmental conditions,
and current government and investor-led efforts to revitalize the neighborhood. The Black Panther Party for Self Defense in the 1960s was founded in West Oakland. There was a sense of pride and meaning behind the fact that the African American struggle against structural inequalities and exploitation that fueled the Panthers arose in West and North Oakland. The remnants of black pride that fed the souls of those in the black triangle, between West and North Oakland and South Berkeley, persists. In Postwar Oakland, West Oakland was a port of entry for African American migrants. Racial segregation was deeply embedded in Oakland. Self, in his book *American Babylon: Race and the Struggle for Postwar Oakland*, cites one interviewee who stated, “There’s very little difference between segregation here in California and the blatant things that go on in the South” (Self, 1995, p. 50).

Currently, West Oakland has the highest asthma hospitalization rates in the county, a life expectancy that is 6.6 years less than in Alameda County, and five decades of high poverty (CAPE, 2018). However, efforts to revitalize the neighborhood have led to the passage of a West Oakland Specific Plan, which “will be a tool for supporting, attracting and developing commercial and industrial enterprises to provide jobs and services needed by the West Oakland community and the city of Oakland at large” (City of Oakland, 2014). To meet these goals, it would facilitate the development of select vacant or underutilized commercial and industrial properties by tackling issues such as land use, economic conditions, infrastructure, transportation and safety deficiencies. Activists organized against the plan, given fears for the plan increasing gentrification in West Oakland and displacing low-income residents.

Adding to the complexity of space contestation in West Oakland, the community has the highest rates of foreclosure in Alameda County, with a rate of notices of default over 30 percent in West Oakland. According to Urban Strategies Council, between 2007 and 2011, 42 percent of the 10,508 homes in Oakland were purchased by real estate investors. One investor alone, Community Fund LLC, purchased 307 foreclosed homes and apartment buildings, which underscores external capital investments relevant to gentrification (2012).

### 2.2 Philosophies Guiding Design and Analysis

Within an interpretive epistemology, intersectionality and critical race theory are two key philosophies that guide this research design and analysis. Employing an intersectional lens is not an exercise in including additional variables but grounds research in the experiences of classes of people “where systems of race, gender and class converge, criticizing a rigidly top-down social and political order from the perspective of the bottom up” (Crenshaw, 1991). This knowledge building thus centers on the lives of
women and other oppressed groups and incorporates a feminist’s view of emotion as a legitimate source of knowledge, establishes collaborative and non-exploitative relationships, and conducts research that is transformative.

Critical race theory is also instrumental in informing analysis. Where critical theory is oriented toward critiquing and changing society as a whole, critical race theory centers on social inequities arising from institutional racism, sexism, and their interactive effects (Thomas, 1999). This is relevant to the case of gentrification, with the inflow of young white residents and the high rates of foreclosure interacting, emphasizing, and igniting tensions of belonging and ownership in a place.

2.3. Recruitment and subject population

The author was immersed in the setting, as she lived in tract 4018 for 5 years, thereby facilitating recruitment. The author and her team of two undergraduate assistants employed a multi-pronged recruitment strategy, consisting of direct recruitment of individuals while walking within tracts 4018 and 4022, posting and distributing flyers at community events, churches, and local organizations, as well as snowball sampling. The recruitment materials invited anyone who lived in the neighborhood for at least eight years to participate in an in-depth and walking interview to discuss their neighborhood and how it affects their health and well-being. This wording was broad, as we did not want to confine our interview to the gentrification process and assume its importance to residents.

We conducted purposive sampling, a type of non-probability sampling where a deliberate choice of an informant is made due to the qualities the informant possesses (Creswell, 2003). We prioritized a diverse set of participants given the exploratory nature of this study. Individuals had networks in the neighborhood through involvement in local institutions or schools or based on residing in the area for an extensive period. This sampling method allows us to capture residents whom have experienced the phenomenon of gentrification in addition to other forms of change throughout time (Creswell, 2003).

2.4. Data Collection Procedures

This paper utilizes data from in-depth semi-structured interviews with residents. A semi-structured interview guide consisted of three sections. The first section consisted of broad questions concerning their history in the area and asked about specific places they spend time in, as well as their relationships with fellow residents. The second section asked more specifically about their experiences and impressions of physical and population change within the neighborhood, the aspects of the neighborhood that
facilitate or impede their well-being, and how those have changed over time. The third section includes questions on their views concerning the future of the neighborhood. Interviews lasted for approximately 2 hours and all participants received a US $30 gift card. All interviews were recorded and transcribed. 2.5 Data Analysis Procedures

There is a dearth of theoretical frameworks and research on the relationship between gentrification and health. Given this, grounded theory was employed in order to help generate a theory of gentrification and health that is “grounded in data from participants who have experienced the process” (Creswell, 2012; Strauss et al., 1998). Given that grounded theory was our analytical approach, during coding we were open to any theoretical possibilities that are represented in the data (Charmaz, 2014).

Using MAXQDA, a software for qualitative and mixed methods research, two coders wrote memos after each interview and developed preliminary codes based on analysis of four interviews. The memos served as notes concerning preliminary analysis of the interview. Open coding with gerunds was used to become familiar and interact with the data, remain open, and identify data segments and as many concepts as possible (Charmaz, 2014, p. 121). Next, through focused coding, the most significant/frequent early codes were used to categorize data and to create categories of the open codes (Charmaz, 2014, p. 138). Focused codes were used in subsequent interviews and we collaboratively developed a codebook; two coders applied this codebook to three interviews. We discussed inconsistencies in coding and developed definitions and examples for each code. The codebook was revised one additional time and we applied this final codebook to the 10 interviews. Patterns were determined, identifying co-occurrence, order, and triangulation (LeCompte, 2000). Individual case findings were then merged and themes across cases were elucidated (Stake, 2013, p. 29).

2.5. Ethics

All participants were provided a written consent form and the interviewer provided a verbal overview of the form. This study was approved by the Institutional Review Board of UC Berkeley.

3. Results

The subject population included individuals that have resided in one of the target census tracts for at least eight years. This captured residents who have experienced the phenomenon of gentrification in addition to other forms of change precipitated by economic recession and urban disinvestment throughout time. Five individuals lived in each of the census tracts and we aimed to have similar demographic profiles for each of the tracts. Individuals ranged in age from 20 – 73 and all identified as Black except for
one individual, who identified as white. Recruitment and interviews were conducted between July of 2017 and January of 2018. Participant pseudonyms, age, race/ethnicity, census tract of residence, and length of time in that tract are shown in Table 2. To further protect anonymity, we have altered the age by ± 2 – 3 years. Emergent themes across these two case study sites are described below.

Table 4-2 Participant characteristics

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Census Tract</th>
<th>Age*</th>
<th>Sex</th>
<th>Length of time in Neighborhood (years)</th>
<th>Self-Identified Race</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marcus</td>
<td>4018</td>
<td>26</td>
<td>M</td>
<td>16</td>
<td>Black and Native American</td>
</tr>
<tr>
<td>Ralph</td>
<td>4018</td>
<td>31</td>
<td>M</td>
<td>10</td>
<td>Black</td>
</tr>
<tr>
<td>Linda</td>
<td>4018</td>
<td>52</td>
<td>F</td>
<td>31</td>
<td>Black</td>
</tr>
<tr>
<td>David</td>
<td>4018</td>
<td>42</td>
<td>M</td>
<td>39</td>
<td>White</td>
</tr>
<tr>
<td>Sherry</td>
<td>4018</td>
<td>38</td>
<td>F</td>
<td>9</td>
<td>Black</td>
</tr>
<tr>
<td>Bryan</td>
<td>4022</td>
<td>30</td>
<td>M</td>
<td>28</td>
<td>Black</td>
</tr>
<tr>
<td>Robert</td>
<td>4022</td>
<td>68</td>
<td>M</td>
<td>27</td>
<td>Black</td>
</tr>
<tr>
<td>Gerald</td>
<td>4022</td>
<td>69</td>
<td>M</td>
<td>66</td>
<td>Black</td>
</tr>
<tr>
<td>Rose</td>
<td>4022</td>
<td>71</td>
<td>F</td>
<td>15</td>
<td>Black</td>
</tr>
<tr>
<td>Maxine</td>
<td>4022</td>
<td>36</td>
<td>F</td>
<td>9</td>
<td>Black</td>
</tr>
</tbody>
</table>

There were three main themes (or mechanisms) contributing to differential preventable mortality rates including community resources, social support, and inclusion/exclusion, which are described below.

3.1. Community Resources: Provision and Obliteration

One line of inquiry focused on changes to community physical, economic, and social resources. While gentrification was a possible force that incited this change, residents challenged this perspective. The provision of resources over time in tract 4022 and the
obliteration of resources in 4018 was evident from the interviews. Residents in tract 4022 generally discussed the strength of community resources in their neighborhood, including long-standing organizations and local institutions. For example, Maxine identified a local church which provides clothing, food, and Christmas gifts, and discussed how she used one community organization for assistance with her electricity bill:

“They called the PG&E company, they looked at my bill and said oh we can take care of this, and my bill was like 500 and something, almost 600 dollars and it was like, we take care of this we got this and I was like what? And then they talked to the lady at the PG&E company, not the lady who answered the phone but the manager, they talked to her - the supervisor. . . everything worked out perfectly oh my goodness. If you would have been a fly on the wall you would have been amazed too. I promise you. Every was perfectly that day, I was thinking they wasn’t gonna help me. I was like nah they’re not gonna help me.”

Maxine, a single mother of three children, was able to rely on organizations located two blocks from her home during a time of crisis. In addition to her confidence in community organizations, she also readily expressed the strength and richness of the local school.

In census tract 4018, Sherry, also a single mother of three children, mentioned the strengths of the local school and insisted on showing us the school, sharing its pedagogical strengths, and showing us active classrooms filled with a diverse set of students learning and engaged. However, community resources or safety nets were generally not mentioned among residents in tract 4018.

This omission was emphasized by Marcus, a 26-year-old male also living in census tract 4018. When asked about past critical resources for the neighborhood, he stated:

“The best store, the best example I have is Hendrix. I don’t know his name, all I know that there is a man call Hendrix, he is a Caucasian man, maybe Jewish but he was like a good man. He used to sell things for pretty reasonable prices like candy, toilet paper, food. He used to do a lot of stuff for the community but when I came back his store was closed. I remember he used to hold breakfast programs every Saturday but haven’t seen one.”

Furthermore, residents in 4018 hold extraordinary respect and pride for the history of the neighborhood. It’s richness and legacy within the African-American community is not overshadowed by the history of disinvestment within the neighborhood. Instead,
recounting its history is used as a call to action to use current strengths in the neighborhood and its inherent resiliency. For example, Ralph notes:

“There’s Esthers. It’s the bar down the street the old club, old blues club, only club for African Americans to be in while Oakland was popping. We’re not doing anything with this shit. People will just buy this shit and run it straight down into the ground. This shit was a theater, my mother is a fucking theater director, that shit could be black owned but they’re not doing anything with it. That place is a fire hazard if anything else and people are living in it like it’s a house.”

Residents in both tracts discussed losses to the area, such as a 99 cents store that provided inexpensive food and household items and the closing of the Boys and Girls Club approximately five years ago. However, residents in 4018 focused on the demise of organizations and services, eliminating any sense of opportunity, particularly for children.

Generally, female residents and older residents of 4022 expressed confidence in the neighborhood. While some lamented the demise of cultural institutions, many embraced changes. However, the experience for younger male black residents is somewhat tempered in tract 4022 and is very much a source of anxiety for younger male Black residents in tract 4018. In the next section, we discuss methods of overt and covert inclusion and exclusion among residents.

3.2. Inclusion/Exclusion: Connection and Division

Four residents in 4022 expressed acceptance of neighborhood change and placed an emphasis on increased safety and physical changes. Generally residents in 4022 held great hope for the area, interpreting interest from San Francisco residents as a sign of possibility:

“For sure, definitely, this neighborhood is a diamond in the rough. And for sure, in the future, definitely, it’s going to shine bright. I mean, already it attracts San Francisco, and San Francisco is the most biggest, corporation rich, very rich, I mean, if it attracts them, yeah, oh yes. Oh yes.”

Beyond physical changes and feelings of hope, new connections were made and welcomed by residents in tract 4022. For example, Gerald, a 69-year-old formerly homeless gentleman who is living in a friend’s house embraced change:

“Its a great neighborhood, especially with those people coming a lot of people coming and buying up property and people selling their houses and stuff. And
it's gonna be ok. . . . Some of the people coming over... it is really expensive but we used to call this the hood and the hood is where you don’t find nothing but blacks. And for the last few years we see the change coming in cause you see a mixture now and its changing the neighborhood because the hood people don’t hang out like they used to you know they’re not all in the streets its getting to be civilized they’re getting civilized now but it has changed but this is for the good. I think it’s good and nobody bothers anything and nobody is scared to walk the streets.”

Gerald has deep roots in the community, multiple support systems spanning both new, younger, white residents and older black families living on his block. In contrast, Bryan, a 30-year-old male who grew up in the neighborhood has experienced exclusion and anger regarding the lack of integration and dissimilar values and social norms among new residents.

“When you’re able to buy a house up in a neighborhood that you’re not from and there’s already a certain way, don’t come to that neighborhood trynna change shit because you came and bought a house in this neighborhood. No, people is not about to change for you. You gonna have to change to fit into that community that you moved in to. That’s the thing that I think she’s (a next door neighbor) not trynna do. I just think she should move, that’s how I feel. She put the front on like she a cool person, but she do that type of stuff to a family that is barely getting by…. it’s a family across the street from her, barely making it and just trying to be the little decent family they are. They just had a little newborn baby with Down syndrome. The dad work doing two jobs and stuff to try and take care of medical bills for the baby and stuff, and the lady, gets irritated by their dog be barking all the time. They stay exactly across the street. So she try to get to they landlord to try have them evicted because the noise from the dog and all that shit. Excuse my language.”

Similar feelings of exclusion were felt with almost all residents in tract 4018. Exclusion occurred in a variety of forms, ranging from not acknowledging someone’s presence, exclusion from community activities, and a sense of surveillance. These experiences are punctuated by physical changes the tract experienced, such as the construction of an above-ground rail line which is so loud that it hinders conversation outside, and the construction of a post office, which resulted in the eminent domain of hundreds of homes in the tract. These governmental actions placed the tract on a life course of marginality. This is experienced at the individual level via alienation from current neighborhood opportunities for long-term residents. When Marcus was discussing how
the community has changed, he underscored a lack of belonging and alignment with resident needs and community opportunities:

“I’ve been down the street and I seen it a dance studio down the street but when I walked in it and tried to volunteer and just help out it kind of seemed like the dance studio wasn’t for me or for people like me as in people who grew up in the neighborhood you know its for other people.”

Beyond exclusion of community resources, the right to housing and efforts of displacement were a recurring theme among residents in 4018. Changes in the neighborhood were not just local but in fact reflected regional economics. Ralph, a 31-year-old black male discussed economic challenges, which were also linked to concerns around changing racial demographics and power.

“All I see is tech people coming, Frisco is getting too over populated with tech and what the Silicon Valley people now they trying to push the natives of Oakland out of Oakland so they can have the better stuff, so they can make Oakland, either Oakland again. Technically Oakland was 75 percent dominated by blacks and now its 45 percent Caucasian at this point in time. They kicking us out for less than nothing, just to build a condo so they can give it to tech people from Frisco or Silicon Valley. We barely got parking down here.”

Federal policies have also shaped safety within housing projects and housing access. One participant noted the privatization of a local housing project, which resulted in rehabilitation of the inner courtyards of the project. Instead of open spaces, rehabilitation efforts created corridors within the inner area. Therefore, instead of drug distribution being contained and controlled within the project, it drove drug distribution to the outskirts of the housing project, leading to increased violence and turf wars in the subsequent years. As such, tract 4018 is seen as a site for gentrification and redevelopment- increasing housing construction and broader revitalization plans championed by local government and new residents, which in turn make existing residents feel invisible. Further illustrating limitations of federal policies to enhance housing access, which has been shown to facilitate health and well-being, Linda pointed out the following:

“They’re pushing us out. It’s hard to find a house on Section 8 with a voucher in Oakland because they won’t take it. You have to move out to Sacramento, Stockton, Antioch because this stuff in Oakland is just too expensive.”
This experience was also accompanied by an increased sense of surveillance of younger black men. While Marcus noted the community is safer, he also stipulates that it is safer for a subset of the population:

“It is safer, which is good. But at the same time, when gentrification, the more it gets gentrified the more safer it becomes for white people or people of non-color compared to people of color cuz once it’s like 20% black people they’re going to start targeting most black people, like what are you doing here? Or like why are you out here? The police is going to do that because they’re going to see us as a problem you know what I’m saying I don’t know its just a lot of shit.”

3.3. Social Support: Networks and Solitude

Reflecting positive residential experiences of neighborhood change and community resources, residents of tract 4022 also expressed ample support systems within the community. These systems became relevant in everyday occurrences and during crises. For example, Maxine relied on her neighbors to watch her children while she sought weekly mental health services and Gerald’s new neighbors, a group of young, white individuals, looked after him and visited him in the hospital after a series of heart attacks. Bryan also discussed receiving counsel from a neighbor, and the importance of that connection for helping him handle conflict:

“That’s why you wanna have a connection with your neighbors and that’s in your community. It was actually a few times where I had talked to an older neighbor who lived down the street before he moved to North Carolina. I considered him almost like another grandpa and I was going to really mess this dude up behind doing something to one of my family members. He was just talking to me about not to even do it and the person they gone open they eyes and realize the shit’s not working and stuff and they gone just let it be, walk away from it. Talking to him about that and stuff, I was really glad that I did that cause the person would have been gone and I probably would have been gone too.”

In contrast, in tract 4018, a history of social connections was discussed in detail, but current sources of support were lacking. Two residents noted that while drugs permeated the neighborhood, it was still a strong, historical neighborhood. Linda expressed nostalgia for the order imposed by drug dealers, and the opportunities they afforded residents; for example, one weekend they brought all the children in the community to Disneyland and provided new clothing and spending money. Marcus also discussed the strong influence and sense of pride in the neighborhood stemming from the leadership of the Black Panthers, despite the well-known drug infestation of the
neighborhood within that period, in addition to block parties and a general familiarity with knowing people in the neighborhood.

While it may seem a recent decline in drug use and increased sense of safety would provide a greater sense of social connections, long-term residents in 4018 increasingly experienced lack of social cohesion. Marcus noted the following experiences:

“I'm not trying to be racist, but this is going to come out completely racist, white people in particularly are going to be more stuck-up to black people compared to when I was growing up they wanted to be friendly because you know, these are your neighbors. You don't want to piss them off because you might be scared cuz they might run in your house or something like that you know what I'm saying. I've been noticing this lately working at the cafe saying hi to people you getting a lot more stuck-up people lot of more coders that come from San Francisco or not coders, tech people who come from San Francisco who don't really care about nothing but themselves. Or that's not accurate cuz I don't know that but don't really care about don't really care to stop and say hi to you, don't really like you see in their personality how they walk right past you with their nose up in the air.”

In essence, the sense of community and social support was still a relevant construct within tract 4022. However, in tract 4018 there was nostalgia for the past community, an emphasis on moderating one’s presence in the community, and seeking more solitude for survival rather than connection. Previous experiences of place, in this case longing for the past and feelings of loss of neighborhood ownership shape current experiences and meanings extracted from current neighborhood change processes.

4. Discussion

Within a larger mixed-methods study, we identified an increased rate of preventable mortality among low-income gentrifying census tracts in comparison to low-income non-gentrifying census tracts. Often socio-demographic characteristics or exposure to macro-level processes are theorized to explain health inequities. However, this study sought to understand the neighborhood attributes that can account for these differences and how residents’ experience with gentrification is distinct among similar census tracts. This allows for proposing potential mechanisms underlying the links between neighborhood processes, such as gentrification and disparities in preventable mortality.

We provide preliminary evidence of the potential mechanisms that influence distinct
rates of preventable mortality. Three main mechanisms were revealed in this study: community resources, inclusion/exclusion, and social support. Varying levels of these factors for each of the case study sites contributed to increased susceptibility and vulnerability to disease in the case of tract 4018 and protective health factors in the case of tract 4022.

As previously discussed, Ecosocial and Fundamental Cause Theory conceptually guided this study. Individual level flexible resources, such as shared knowledge and support, were identified among residents living in tract 4022. Community resources over the life course of residents provided these flexible resources (such as key organizations providing support during a crisis) but conversely, the absence of these community resources, as seen in tract 4018, neglected the obtainment and use of key flexible resources. Furthermore, the embodiment of psychosocial factors, such as exclusion and isolation experienced by residents in tract 4018, or presence of social support, which in one case enabled one respondent in tract 4022 to seek mental health services, may contribute to differential rates of preventable mortality.

Analyses of this data showed that an exclusive focus on the process of gentrification obscures critical mechanisms that influence health. The mechanisms mentioned by participants were rarely linked to processes of gentrification. In fact, most respondents did not discuss gentrification without prompting from the interviewer toward the end of the interview. Instead, to identify how, for whom, and under what circumstances do macro-level processes influence health, we recommend the following considerations when illuminating the relationship between place and health. First, respondents reified the importance of multiple geographic scales influencing the relationship between gentrification and health, ranging from one-on-one relationships to acknowledging the regional processes that shape neighborhoods and opportunities for residents. Furthermore, respondents did not focus on the process of gentrification within the past eight years but discussed the entire life course of the neighborhood. Finally, experiences of the neighborhood are influenced by gender, race and age; essentially, who you are helps determine the kinds of experiences you will be afforded within your context.

### 4.1. Multiple scales of influence

Analysis of preventable mortality rates over time in Alameda County illustrate spatial trends, where rates were concentrated in urban areas in 2005, and slowly broadened to include suburban areas (Figure V-4). These health trends are reflected in residential accounts of excluding predominately low-income, minority, long-term residents from housing in the urban core and a migration to areas including Antioch, Stockton and Sacramento. These trends reify the spatial inequities in health and point to potential
policy changes, which shift resources from urban to suburban areas.

Analyses of these data suggest that understanding health within the neighborhood context, in addition to interaction with city and regional inter-related forces, is necessary to identify potential policy interventions. As Macintyre and Easterlow pointed out in 2005, “There is a sense in which this [spatial health divide] amounts to a rather conventional, even mildly outdated geography (how environments affect health . . . ).” Instead, understanding context of neighborhoods through space (a grid or dimension which contains items), place (social and physical attributes with meaning) and time may facilitate our understanding of the processes contributing to health variation (Agnew, 2011, p. 318; Curtis and Jones, 1998).

**Figure 4-4: Standardized preventable mortality rates, 2005 and 2013**

![Standardized preventable mortality rates, 2005 and 2013](image)

**4.2. Life course of neighborhoods**

The process of gentrification is one point in an intricate timeline of neighborhood and individual level processes and history. As a result, gentrification can be conceptualized as part of a broader process of neighborhood change that bifurcates wealth and poverty (Brown-Saracino, 2016). Understanding the historical forces shaping a neighborhood as both discrete and interacting mechanisms facilitates a deeper understanding of the extent in which a neighborhood will be resilient to or succumb to gentrification. For
example, despite the forces of gentrification, tract 4022 retained strong organizations and social support networks, even with the influx of new, more affluent residents. In comparison, demise of organizations in tract 4018 set the stage for increased neighborhood vulnerability to both disease and macro-level processes that exacerbate inequity. In essence, the history of place shapes the health of place at later time points, such as when a neighborhood is undergoing gentrification. Neighborhoods are not static entities, yet they also hold persistent qualities (Lekkas et al., 2017). For example, while the foreclose crisis in 2008 and a history of eminent domain in census tract 4018 are two processes, they may interact via gentrification. In this case, a destruction of homes for the construction of a major post office precipitated urban disinvestment in the area and this legacy interacts with properties experiencing foreclosure, further depreciating home values, reducing services for the long-term residents, and reshaping neighborhood attributes for a wealthier population. Loss of organizations, sense of place, control, and inclusion in the years leading to gentrification increased the susceptibility to poor health outcomes within tract 4018. Indeed, this aligns with the life course notion of “chains of risk” (Lekkas et al., 2017).

4.3. Who you are matters

Interviews also indicate a mechanism that alters the influence gentrification has on the health and well-being of long-term residents are personal characteristics – particularly age, gender, family composition, and race. Young black men in the context of a tract experiencing loss of organizational resources and social cohesion indicated loss of power, agency, and ownership of their community. For young black men, gentrification implies the “creation of racially separate, disparate but embedded urban social worlds as a shift in the racial landscape” (Lees, 2016). In contrast, women with children were able to seize upon community resources that persisted despite of gentrification, and access new or enhanced community resources and attributes, such as thriving schools and enhanced safety, for their children.

4.4. Limitations

These findings should be understood considering the study’s limitations. The small sample size provides potential mechanisms for further exploration. The data in future publications can be analyzed with the results from walking interviews with the same population, therefore facilitating triangulation of results. In addition, the data collected was cross-sectional, therefore we could not capture how these experiences and interpretations changed over the life course of both the individual and the neighborhood. Finally, these results are specific to the context of West Oakland within the larger regional processes of the Bay Area. Therefore, these results are not
generalizable. Nevertheless, detailed qualitative data underscore the importance of the perspective of long-term, lower-income residents, shedding light on the historical structures of marginalization in census tracts, cities, and regions that are still relevant in current urban processes.

5. Conclusions

This study underscores the importance of embracing heterogenous neighborhoods as sites of inquiry. Generally, epidemiology has focused on identifying risk factors. However, questions concerning why risk factors affect the neighborhoods or populations that they do is of primary importance (Krieger, 1994). This consideration then refocuses attention on the inter-related scales of influence on urban health, the life histories of neighborhoods and chains of risk, and the importance of structural processes that alter the availability and ability of individuals to access health protective resources. Identifying the links between the extent of the dose of the exposure of gentrification to preventable causes of death allows for a clearer identification of policy and action to eliminate health inequities.

References


Arcaya, Mariana C., Reginald D. Tucker-Seeley, Rockli Kim, Alina Schnake-Mahl, Marvin


Galea, Sandro, and Bruce G Link. n.d. “Commentary Six Paths for the Future of Social

Roading With Social Epidemiology--Exploration, Causation, Translation.” American

Determinants of Urban Housing Renovation.” Journal of Urban Economics 54 (3).

Hertzman, Clyde, and Tom Boyce. 2010. “How Experience Gets under the Skin to Create
Gradients in Developmental Health.” Annual Review of Public Health 31. Annual Reviews:
329–47.

Processes: Variegating Causes of Neighbourhood Change.” Environment and Planning A:


Taylor & Francis: 146–54.

Lees, Loretta. 2016. “Gentrification, Race, and Ethnicity: Towards a Global Research


Tashakkori, Abbas, and Charles Teddlie. 2010. Sage Handbook of Mixed Methods in

Chapter 5 Conclusions

1. Summary and Future Directions

This dissertation is an effort to move away from telling the tale of risky places and understanding the “wide range of subtle and complex ways in which place or context matters for health” (Smith and Easterlow, 2005). To assess if and how research reflects the complexity of place and health in the context of gentrification, results of a systematic analysis of mixed methods research related to gentrification and health and well-being were presented in Chapter 2. Analyses of these studies uncovered a limited incorporation of explicit theoretical frameworks, a focus on conceptualizing gentrification mainly as a form of socio-economic upgrading, and an incomplete consideration of casually relevant spatiotemporal scale. We suggested that using ecosocial theory can provide a framework through which to systematically guide future research design, methods, and analysis on gentrification and health.

In Chapter 3, we quantitatively analyze the relationship between gentrification and preventable mortality in low-income census tracts in addition to upgrading (which is distinct from gentrification given these tracts did not experience prior disinvestment) and preventable mortality among medium/high income census tracts. Analyses show increases in preventable mortality was not associated with each increased stage of gentrification or upgrading. When attempting to account for uneven intensity of gentrification and upgrading between earlier and later stages we find the following: 1. Gentrifying low-income census tracts in comparison to all other non/minimally gentrifying census tracts have a preventable mortality incidence rate ratio of 1.15; 2. Medium/high census tracts experiencing further upgrading in comparison to all other non/minimally upgrading census tracts have a .77 incidence rate ratio. Gentrification is a risk factor for increased preventable mortality rates in gentrifying low-income census tracts and a protective factor for medium/high income tracts. Gentrification is a process that is differentially experienced based on the both the stage of the gentrification process and the socio-economic status of the census tract.

Finally, in Chapter 4, we discovered three main themes (or mechanisms) contributing to differential preventable mortality rates among census tracts with similar stages of
gentrification and socio-demographic profiles. These were community resources, social support, and inclusion/exclusion. Generally, residents in the tract with an average preventable mortality rate experienced thriving community resources, sources of social support, and inclusion within the community. In contrast, residents in the tract with the highest preventable mortality rate in the county discussed the closing of key community resources and feelings of isolation, exclusion, and loss of power.

As investigators continue to explore macro-social factors and their influence on health inequities, this research provides three key lessons and recommendations. First, conceptual clarity, a focus on identifying underlying mechanisms, and identifying the most relevant spatial and temporal scales is required of any rigorous and policy relevant research focused on continually changing and uneven macro-social factors. Second, theory guiding conceptualization and mechanisms linking the exposure and outcome along with syndemic theory can facilitate more contextually relevant research. This would enable measurement of constructs to more accurately account for changes in context and composition across multiple scales and categories of exposures reflecting the clustering of and interactions between diseases and poor health influenced by similar mechanisms. This would also facilitate linking research on gentrification with broader processes and consequences of neighborhood change (Brown-Saracino, 2016). Third, with a heterogenous exposure such as gentrification we can only expect how it is experienced to likewise be heterogenous; thus, in-depth interviews and other novel research methods linking experience with place may be beneficial for understanding for whom and under what circumstances does gentrification affect health. To be sure, research providing guidance on polices should give “precise insights into who is affected and how, in different settings, it provides a scalpel for policies rather than the current hatchet.” (Sen, 2009).
References


Appendix 1:

Data in Regional Early Warning System for Displacement (REWS) developed by UC Berkeley’s Center for Community Innovation (CCI) and Variables Used for Training Set

<table>
<thead>
<tr>
<th>Type of Indicator</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factors Contributing to Gentrification</td>
<td>Housing units in pre-1950 buildings (%, 2013)</td>
</tr>
<tr>
<td>Factors Contributing to Gentrification</td>
<td>Employment density: jobs per square mile (2011)</td>
</tr>
<tr>
<td>Factors Contributing to Gentrification</td>
<td>Gentrified between 2000 and 2013</td>
</tr>
<tr>
<td>Factors Contributing to Gentrification</td>
<td>Percent Living within Half Mile of Major Transit Stop (2012)</td>
</tr>
<tr>
<td>Vulnerable Populations</td>
<td>Change in LI households w/ low rent burden (#, 2000-2013)</td>
</tr>
<tr>
<td>Vulnerable Populations</td>
<td>Change in low-income households (#, 2000-2013)</td>
</tr>
<tr>
<td>Vulnerable Populations</td>
<td>Change in % low-income in-migration (2009-2013)</td>
</tr>
<tr>
<td>Vulnerable Populations</td>
<td>Low-income households (%, 1990)</td>
</tr>
<tr>
<td>Vulnerable Populations</td>
<td>Low-income households (%, 2000)</td>
</tr>
<tr>
<td>Vulnerable Populations</td>
<td>Low-income households (%, 2013) (%, 2011)</td>
</tr>
<tr>
<td>Vulnerable Populations</td>
<td>Renter households (%, 1990)</td>
</tr>
<tr>
<td>Vulnerable Populations</td>
<td>Renter households (%, 2000)</td>
</tr>
<tr>
<td>Vulnerable Populations</td>
<td>Renter households (%, 2013) (%, 2011)</td>
</tr>
<tr>
<td>Vulnerable Populations</td>
<td>Non-white population (%, 1990)</td>
</tr>
<tr>
<td>Vulnerable Populations</td>
<td>Non-white population (%, 2000)</td>
</tr>
<tr>
<td>Vulnerable Populations</td>
<td>Non-white population (%, 2013) (%, 2011)</td>
</tr>
<tr>
<td>Demographics</td>
<td>Population growth (%, 2000-2013)</td>
</tr>
<tr>
<td>Demographics</td>
<td>Vote Registration (2002)</td>
</tr>
<tr>
<td>Demographics</td>
<td>Adults (25+) with college degree (%, 1990)</td>
</tr>
<tr>
<td>Demographics</td>
<td>Adults (25+) with college degree (%, 2000)</td>
</tr>
<tr>
<td>Demographics</td>
<td>Adults (25+) with college degree (%, 2013) (% 2011)</td>
</tr>
<tr>
<td>Demographics</td>
<td>Change in college-educated adult population (%, 1990-2000)</td>
</tr>
<tr>
<td>Demographics</td>
<td>Change in college-educated adult population (%, 2000-2013)</td>
</tr>
<tr>
<td>Demographics</td>
<td>Median household income (1990)</td>
</tr>
<tr>
<td>Demographics</td>
<td>Median household income (2000)</td>
</tr>
<tr>
<td>Type of Indicator</td>
<td>Indicator</td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Demographics</td>
<td>Median household income (2013) (2011)</td>
</tr>
<tr>
<td>Demographics</td>
<td>Change in median household income (%, 1990-2000)</td>
</tr>
<tr>
<td>Demographics</td>
<td>Change in median household income (%, 2000-2013)</td>
</tr>
<tr>
<td>Demographics</td>
<td>Low-income in-migration (%, 2013)</td>
</tr>
<tr>
<td>Housing Market Conditions</td>
<td>Change in median home sale price (%, 2000-2013)</td>
</tr>
<tr>
<td>Housing Market Conditions</td>
<td>Change in rent (%)</td>
</tr>
<tr>
<td>Housing Market Conditions</td>
<td>New market-rate units (#, 2000-2013)</td>
</tr>
<tr>
<td>Housing Market Conditions</td>
<td>Market-rate units as % of new building (1990-2000)</td>
</tr>
<tr>
<td>Housing Market Conditions</td>
<td>Market-rate units as % of new building (2000-2013)</td>
</tr>
<tr>
<td>Housing Market Conditions</td>
<td>Change in median home sale price (%, 1990-2000)</td>
</tr>
<tr>
<td>Housing Market Conditions</td>
<td>Change in median home sale price (%, 2000-2013)</td>
</tr>
<tr>
<td>Housing Market Conditions</td>
<td>Change in median home value (%)</td>
</tr>
<tr>
<td>Housing Market Conditions</td>
<td>Change in median home value (%)</td>
</tr>
<tr>
<td>Housing Market Conditions</td>
<td>Gentrified between 1990 and 2000</td>
</tr>
</tbody>
</table>
Appendix 2: Classification of Preventable and Non-Preventable Causes of Death

<table>
<thead>
<tr>
<th>Cause of Death</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Septicemia</td>
<td>Non-Preventable</td>
</tr>
<tr>
<td>Malignant Neoplasms (Cancer)</td>
<td>Non-Preventable</td>
</tr>
<tr>
<td>In situ, Benign, Unknown &amp; Unspecified Neoplasms</td>
<td>Non-Preventable</td>
</tr>
<tr>
<td>Parkinson’s Disease</td>
<td>Non-Preventable</td>
</tr>
<tr>
<td>Alzheimer’s Disease</td>
<td>Non-Preventable</td>
</tr>
<tr>
<td>Diseases of Heart</td>
<td>Non-Preventable</td>
</tr>
<tr>
<td>Atherosclerosis</td>
<td>Non-Preventable</td>
</tr>
<tr>
<td>Aortic Aneurysm</td>
<td>Non-Preventable</td>
</tr>
<tr>
<td>Pneumonitis due to Solids &amp; Liquids</td>
<td>Non-Preventable</td>
</tr>
<tr>
<td>Diseases of Appendix</td>
<td>Non-Preventable</td>
</tr>
<tr>
<td>Cholelithiasis &amp; Gallbladder Disorders</td>
<td>Non-Preventable</td>
</tr>
<tr>
<td>Nephritis, Nephrotic Syndrome &amp; Nephrosis</td>
<td>Non-Preventable</td>
</tr>
<tr>
<td>Renal Tubulo-Interstitial Diseases (Infections of Kidney)</td>
<td>Non-Preventable</td>
</tr>
<tr>
<td>Hyperplasia of Prostate</td>
<td>Non-Preventable</td>
</tr>
<tr>
<td>Congenital Malformations &amp; Chromosomal</td>
<td>Non-Preventable</td>
</tr>
<tr>
<td>Legal Intervention</td>
<td>Non-Preventable</td>
</tr>
<tr>
<td>All Other</td>
<td>Non-Preventable</td>
</tr>
<tr>
<td>Stroke (Cerebrovascular Disease)</td>
<td>Non-Preventable</td>
</tr>
<tr>
<td>Pneumoconioses &amp; Chemical Effects</td>
<td>Non-Preventable</td>
</tr>
<tr>
<td>Peptic Ulcer</td>
<td>Non-Preventable</td>
</tr>
<tr>
<td>Hernia</td>
<td>Non-Preventable</td>
</tr>
<tr>
<td>Chronic Liver Disease &amp; Cirrhosis</td>
<td>Non-Preventable</td>
</tr>
<tr>
<td>Inflammatory Diseases of Female Pelvic</td>
<td>Non-Preventable</td>
</tr>
<tr>
<td>Complications of Medical &amp; Surgical Care</td>
<td>Non-Preventable</td>
</tr>
<tr>
<td>Salmonella Infections</td>
<td>Preventable</td>
</tr>
<tr>
<td>TB</td>
<td>Preventable</td>
</tr>
<tr>
<td>Meningococcal Infection</td>
<td>Preventable</td>
</tr>
<tr>
<td>Syphilis</td>
<td>Preventable</td>
</tr>
<tr>
<td>Viral Hepatitis</td>
<td>Preventable</td>
</tr>
<tr>
<td>HIV Disease</td>
<td>Preventable</td>
</tr>
<tr>
<td>Malaria</td>
<td>Preventable</td>
</tr>
<tr>
<td>Anemias</td>
<td>Preventable</td>
</tr>
<tr>
<td><strong>Cause of Death</strong></td>
<td><strong>Status</strong></td>
</tr>
<tr>
<td>--------------------------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td>Preventable</td>
</tr>
<tr>
<td>Nutritional Deficiencies</td>
<td>Preventable</td>
</tr>
<tr>
<td>Meningitis</td>
<td>Preventable</td>
</tr>
<tr>
<td>Essential Hypertension &amp; Hypertensive Renal Disease</td>
<td>Preventable</td>
</tr>
<tr>
<td>Influenza &amp; Pneumonia</td>
<td>Preventable</td>
</tr>
<tr>
<td>Acute Bronchitis &amp; Bronchiolitis</td>
<td>Preventable</td>
</tr>
<tr>
<td>Chronic Lower Respiratory Diseases</td>
<td>Preventable</td>
</tr>
<tr>
<td>Pregnancy, Childbirth &amp; the Puerperium</td>
<td>Preventable</td>
</tr>
<tr>
<td>Unintentional Injuries</td>
<td>Preventable</td>
</tr>
<tr>
<td>Suicide</td>
<td>Preventable</td>
</tr>
<tr>
<td>Homicide</td>
<td>Preventable</td>
</tr>
</tbody>
</table>