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The Role of Neighborhoods and Ethnorace in Constructing Health-Related Disparities in California

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Silvia González

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ABSTRACT OF THE DISSERTATION

The Role of Neighborhoods and Ethnorace in Constructing Health-Related Disparities in California

by

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Doctor of Philosophy in Urban Planning

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Professor Paul M. Ong, Chair

In the face of global health, economic, and climate crises, scholars in the fields of urban planning and public health are converging again to study how the spatial context—the arrangement of neighborhoods and their characteristics—affects the health outcomes of residents. This dissertation consists of three essays—each based on alternative modeling approaches found in the literature—that examine the relationship between individual and

neighborhood characteristics and three health-related outcomes: cardiovascular disease, lifetime asthma, and walking. The neighborhood measures include demographic composition, economic position, the chemical environment, the human-made built environment, and access to neighborhood resources. I pay particular attention to the role of race and ethnicity (ethnorace) at the individual and neighborhood levels, which are both primary social determinants of health. Data for the outcomes of interest come from the 2013–2014 and 2015–2016 California Health Interview Survey. The data for the independent variables come from various sources, including the American Community Survey.

The first essay uses an ecological framework and aggregate data to assess the relationship between ZIP Code–level health-related outcomes and neighborhood contextual independent variables. I find that neighborhood's ethnorace is a better predictor of the prevalence of heart disease than it is for predicting walking and heart disease. Furthermore, while Latino neighborhoods experience inequalities that can lead to greater health risks, such as less primary care availability and significant disparities in income and education, these characteristics are not necessarily associated with a greater prevalence of heart disease and asthma. The second essay uses individual-level data to examine the strength of five types of independent variables (demographic, socioeconomic characteristics, medical insurance coverage, health behaviors, and comorbidity with other chronic diseases) in predicting walking, heart disease, and lifetime asthma. The findings show that an individual's ethnorace is a better predictor for asthma than the other dependent variables, and that as Latinos assimilate into American culture, the odds of lifetime asthma increase, as does the adoption of a more sedentary lifestyle. The third essay again uses individual-level data—this time with geographic identifiers that allow individual-level data to be matched with their respective neighborhood characteristics—to examine the multilevel relationship between individual-level outcomes of interest. The results show that ethnorace continues to be a more important predictor for heart disease than for the other outcomes of interest, and that patterns between assimilation and the odds of walking continue to hold true.

A significant finding across all essays is that neighborhood-effects are of secondary importance compared to more proximal individual and household-level effects, particularly for lifetime asthma and heart disease. These findings have implications for place-based interventions, as these alone may not lead to anticipated health benefits if they do not consider how to simultaneously incorporate programs and activities that address individual risk factors.

The dissertation of Silvia González is approved.

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Vita

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The Role of Neighborhoods and Ethnorace in Constructing Health-Related Disparities in California

Introduction

There is growing evidence that health-related disparities are not only determined by individual socioeconomic characteristics, health, and behaviors but also by the characteristics of the spatial context where people conduct their daily lives (Bronfenbrenner, 1977; Diez-Roux, 2001; Diez-Roux & Mair, 2010; Gee & Payne-Sturges, 2004; Jackson, 2003; Kawachi & Berkman, 2003). This dissertation uses data from the California Health Interview Survey (CHIS) to explore the spatial and individual-level factors associated with three health-related outcomes: the propensity of walking for leisure and transportation, lifetime asthma prevalence, and the prevalence of heart disease. I pay particular attention to the role of race and ethnicity (ethnorace) at the individual and neighborhood levels because both are primary social determinants of equity and health.

Further, I highlight how different factors influence outcomes for the Latino community relative to non-Latino whites. For instance, I focus on neighborhoods where Latinos and whites are segregated, that is they have a high level of coethnic living, to explore how living in racially homogenous neighborhoods may construct unique disparities. The comparison between the two groups is made because Latinos are a fast-growing segment of the population and have surpassed whites as the largest ethnoracial group in California (U.S. Census Bureau, 2019). However, most evidence on Latino health is from cross-sectional studies that offer national averages and obscure localized disparities and inequalities (Velasco-Mondragon et al., 2016).

I focus on the three factors because of the consensus among scholars that a positive relationship exists between walking and lower incidences of chronic respiratory and cardiovascular diseases, such as improved cardiorespiratory function, prevention of heart attacks, treatment of hypertension, rehabilitation after a heart attack, and other risk factors (Boone-Heinonen et al., 2009; Manley, 1996; Morris & Hardman, 1997; Murtagh et al., 2010). At the same time, mounting evidence implicates attributes of the spatial context, such as residential neighborhood resources, as a facilitator or barrier to walking (Giles-Corti & Donovan, 2002; Sallis et al., 2009; Taylor et al., 2007), as a trigger for asthma, asthma severity, and health care use (Guarnieri & Balmes, 2014; Zheng et al., 2015), and as associated with externalities linked to cardiovascular disease risks and outcomes (Koohsari et al., 2020; Malambo et al., 2016; Nieuwenhuijsen, 2018).

Yet despite the favorable relationship between walking, asthma, and cardiovascular health, there is a paucity in knowledge about the physical health and physical activity among Latinos compared to other groups (Ruiz et al., 2016). Further, there are unique barriers facing the Latino community that inhibit access to health-promoting resources relative to other ethnic groups. These barriers include persistent economic disparities, limited English literacy, undocumented legal status, and hazardous residential environments. Urban planners, therefore, can play an important role in improving the design of communities to lessen racial disparities and promote health.

The dissertation consists of three essays, each based on an alternative statistical modeling approach found in the literature, to examine the factors associated with the three outcomes of interest. Table I-1 describes these approaches and outlines the major benefits and limitations to each approach in the context of this dissertation research and the CHIS, more details are in the

"Generalized Research Design" section. The table also highlights the major methodological and empirical contributions of the dissertation, which are summarized next.

Table I-1: Dissertation Approach and Contributions

	Ecological Neighborhood	**Individual Level**	**Multi-level**
Major benefits to approach	-Cross-sectional data are readily available	- Microdata are readily available	-Connect individuals with neighborhood of residence
Major limitations to approach	-Cannot attribute neighborhood-level observations to individuals	-Ignores spatial or contextual effects -No geographical information	-No direct data access -Cost and length of time to access and analyze data
Methodological contribution	-Use unique neighborhood data in combination with CHIS -Consistent data across more than one outcome -Use California-specific data	-New specifications related to assimilation -Consistent data across more than one outcome	- Use unique neighborhood data connected with CHIS -Consistent data across more than one outcome -Use California-specific data
Empirical contributions	-Ethnorace is a better predictor for heart disease compared to asthma and walking	-Ethnorace is a better predictor for lifetime asthma -Assimilation is related to worse health-related outcomes	-Limited association between neighborhood characteristics and outcomes

The first essay titled "Neighborhood Influences on Health" applies an ecological approach using aggregated data at the ZIP Code level to model the linear relationship between the outcomes of interest and factors related to the sociodemographic and built environment characteristics, such as air pollution, transportation, and neighborhood resources. I find that neighborhood ethnorace is a better predictor of the prevalence of heart disease than it is for asthma or walking, with ethnorace explaining about 30% of the variation across neighborhoods. I also use decomposition analysis to examine the differences in walking and lifetime asthma in Latino and white neighborhoods to isolate the degree to which different factors play a role on the outcomes of interest. The most important dimension associated with lower walking levels in Latino neighborhoods relates to the built environment. Further, while Latino neighborhoods experience inequalities associated with greater health risks, such as less primary care availability and significant disparities in income and education, these are not necessarily related with the greater prevalence of heart disease and asthma. The findings suggest neighborhood-level interventions should be pursued to promote walking; and individual-level interventions alongside neighborhood policies and programs are need for asthma and heart disease prevention.

The second essay entitled "The Role of Individual Determinants in Constructing Health" uses individual-level logistic models to examine the relationship between the outcomes of interest (e.g., whether or not a person suffers from a disease) and demographic characteristics, economic position, comorbidity with other chronic diseases, behaviors that may affect health, and perceptions of neighborhood safety. This essay also examines the differences and similarities between white and Latino adults, and the length of time living in the United States, a proxy for assimilation. I find that individual ethnorace alone is a better predictor for the odds of having asthma than for walking and heart disease, yet the influence of race disappears after controlling for other factors. For Latinos, living a majority of their life in the United States decreases the odds of walking, which suggests that they assimilate into a more sedentary lifestyle. An area for further research is the positive correlation between assimilation and lifetime asthma, suggesting a loss of the immigrant health advantage or perhaps greater diagnoses. As with the ecological analysis in Essay 1, I find that while Latinos experience inequalities that pose health risks, these are not necessarily associated with a greater prevalence of heart disease and asthma. The findings have important implications for urban planning practice and placed-based approaches, as these approaches alone may not be sufficient to addressing disparities between Latinos and whites or improving health.

In the third essay, "Racialized Neighborhoods and Spatialized Disparities," I examine the factors beyond individual characteristics that influence disparities in health and walking outcomes. I use logistic models with individual and neighborhood-level predictors to test the relationship between individual-level outcomes (e.g., whether a person exercises regularly or not as the dependent variable) and spatial contextual dependent variables (e.g., proximity to transportation resources and health care providers). Like the previous essay, this essay also examines the differences and similarities between white and Latino adults, and the role of ethnoracial coliving. The results show that after accounting for neighborhood ethnorace, individual ethnorace is a better predictor for the prevalence of heart disease than for asthma or walking. Another key finding is related to ethnic coliving. While coethnic living does not predict walking for Latino adults, coethnic living is a significant predictor for white individuals. Assimilation continues to play a significant role in predicting walking and lifetime asthma for the Latino population. The findings from this essay confirm that neighborhood effects carry less weight relative to individual and household level factors. This is particularly true for health disease and asthma. The findings have implications for place-based interventions, as these alone may not lead to anticipated health benefits if they do not consider how to simultaneously incorporate programs and activities that address individual risk factors.

The essays overlap in three important aspects. First, the essays use the same primary data source: the CHIS. The CHIS is the nation's largest state health survey, which has been conducted in two-year cycles since 2001 (UCLA Center for Health Policy Research, 2020). Three versions of the survey are available to researchers: the AskCHIS neighborhood edition published online at the ZIP Code level, microlevel data in the public-use files (PUFs), and microlevel data in the confidential files. The AskCHIS data are used in the ecological statistical models for the first essay. The PUFs files are used for the second essay; however, a key limitation of the PUFs data is that they do not contain geographic identifiers and many variables are suppressed or recoded as categorical. The confidential files are used for the multilevel (individual and neighborhood) models in the third essay.

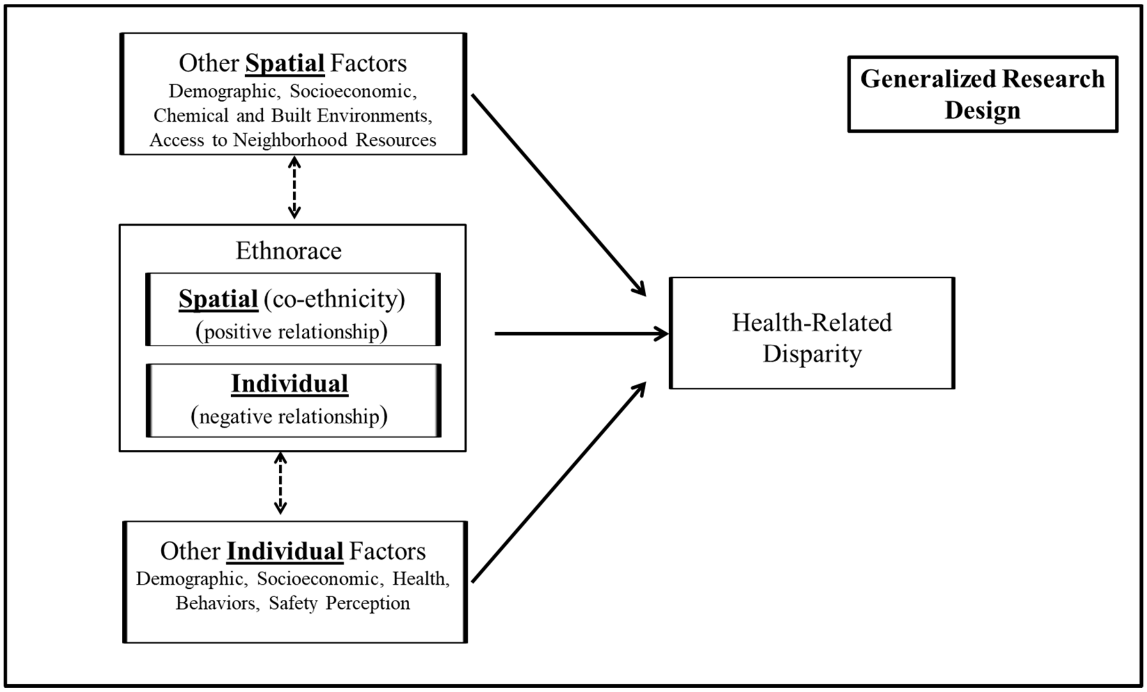
In addition to the CHIS data, two of the essays use unique neighborhood contextual indicators developed by Ong et al. (2018) and Ong et al. (2020) for the California Air Resources Board (CARB) and the California Department of Transportation (Caltrans). These indicators were developed at the census-tract level as part of two statewide monitoring systems that will assist state agencies in tracking their progress toward achieving sustainable community goals and examining the relationship between transportation resources and health-related outcomes. These indicators underwent extensive assessments and evaluations. In Essay 3, I utilize indicators obtained directly from the monitoring system. In Essay 1, I use the underlying data used to construct the indicators in the monitoring system to create ZIP Code level measures to match the geographical resolution of the AskCHIS dataset.

The third overlap among the essays is the relationship between the outcomes of interest to race and ethnicity (ethnorace), which operates both at the individual and spatial levels (Ong & González, 2019), as well as other predictors. The patterns of lifetime asthma, walking, and heart disease vary greatly according to population and location (cites). This heterogeneity, along with differing methodologies, likely contribute to the mixed picture of these outcomes. A contribution of this research is the consistency in methodology, data source, location, and population. This consistency is particularly important to inform a unified and comprehensive framework to assess Latino health in the United States that goes beyond individual determinants of health (Velasco-Mondragon et al., 2016). Further, this consistency allows for a comparison of the influence of ethnorace at both the individual and neighborhood level, and a better understanding of how and by how much racialized spaces matter. These are the questions at the heart of this dissertation research.

Generalized Research Design

In the following section, I describe the generalized conceptual approach utilized to examine the impact of the spatial context on health disparities. The starting point is the multilevel framework used in Ong and González (2019) to study how the urban spatial structure in Los Angeles independently produces and reproduces socioeconomic inequality in the areas of housing, employment, and education, even after accounting for a rich set of individual factors (Ong & González, 2019). Figure I-1 shows the generalized research design for the dissertation. On the right side of the figure is the outcome of interest, health-related disparities. Within this framework, health-related disparities are the product of multilevel factors related to individual characteristics and spatial neighborhood-level factors shown on the left. The multilevel framework allows for the use of both individual- and neighborhood-level constructs to examine how these factors are related to health outcomes, as well as the extent to which the variability in both factors are explained by factors defined at both levels (Diez-Roux, 2003).

Figure I-1: Generalized Research Design



Source: Adapted from **Ong and González (2019)**.

These factors have two characteristics that influence outcomes: aspatial and spatial characteristics. For the purpose of this framework, the term "aspatial" denotes factors for which the geographic context is an epiphenomenon with no role in influencing the interactions and processes shaping an outcome, such as an individual's race. To some extent, individual characteristics are modified by elements of the spatial world. One example of these interactions is racial residential segregation, a form of spatial stratification. Segregation results when individuals share social and economic environments on the basis of ethnorace and class (Borjas, 1998) as a result of larger structural factors and racial prejudices of others.

Amongst the various forces that scholars have argued lead to segregation patterns are individual voluntary choices (Schelling, 1969) and racial prejudices (Bobo & Zubrinsky, 1996). These individual characteristics interact with processes such as economic segregation, stemming from the mismatch between housing and residential location (Kain, 1968), as well as institutional mechanisms that create segregated neighborhood amenities, such as transportation resources, schools, and businesses, and have kept minority ethnoracial groups out of certain neighborhoods. Examples of institutional mechanisms are racial restrictive covenants and discriminatory spatial redlining practices by creditors, who deny loans on the basis of race that lead to the hypersegregation of black Americans (Massey & Denton, 1993). Ongoing institutional mechanisms include exclusionary zoning practices. These institutional practices are shaped by aspatial characteristics (e.g., racial prejudices) that are then applied to the spatial world and have spatial consequences.

Path dependency is another mechanism that may create segregated spaces and spatial disparities. Path dependency is a theoretical concept developed in economics to argue that economic outcomes evolve as a consequence of previous outcomes, rather than merely current circumstances (Arthur, 1989; David, 1985; North, 1990). For instance, immigrants often initially settle in gateway cities (Singer, 2004) where they can find localized relevant resources such as lower-paid, unskilled labor (Waldinger, 1996) with lower barriers to employment (Portes & Rumbaut, 2014), hence concentrating individuals in racialized spaces where other disparities may exist. Establishing the causal links and mechanisms between aspatial and spatial factors is a methodological challenge associated with this and other multilevel frameworks. Instead, the focus of the dissertation is to describe the relationship between individual-level and neighborhood-level aspects.

A key component of the framework used by Ong and González (2019) to examine spatialized economic disparities is race and ethnicity (ethnorace). Ethnorace operates at two levels: individual and spatial. For the purpose of this research, ethnorace has no biological or genetic basis but is a construct created and shaped by social, economic, and political conflict in the diverse American society (Omi & Winant, 2014). While newer studies on human genetics identify potential underlying differences in asthma and cardiovascular outcomes due to the biological traits of ancestry, there are no clear relationships to ethnorace (Yudell et al., 2016).

As a social construct, at the individual level, ethnorace is experienced by people being treated differently because of the color of their skin. At the spatial level, race is experienced through the structures in which people are embedded and within which they live their daily lives. I refer to these as racialized spaces. The clearest example of a racialized space is a segregated neighborhood resulting from discriminatory real estate practices as discussed previously. Other examples of racialized spaces include ethnic enclaves where, to some degree, there is voluntary coethnic living (Logan et al., 2002) because these spaces offer culturally relevant resources (e.g., Vallejo, 2012).

Studies show a relationship between residential segregation and health outcomes (Kramer & Hogue, 2009; Neutens, 2015; Williams & Collins, 2001; Yankauer, 1950). Living in segregated spaces is often linked to negative outcomes as these spaces may limit access to health-promoting resources as a result of historical resource deprivation, underinvestment, and marginalization (U.S. Institute of Medicine, 2012). While both ethnic enclaves and residential segregation denote a concentration of an ethnoracial group, the mechanisms that lead to either the formation or maintenance of these spaces may differ or occur simultaneously. As a result, social outcomes in these neighborhoods may be heterogeneous. For example, some studies have documented the health (Walton, 2012), educational (Zhou & Kim, 2006), social mobility (Vallejo, 2012), and wealth-protection benefits associated with middle- and high-income ethnic enclaves (Lee, 2018).

Another component of the conceptual framework is access to neighborhood amenities and resources. The term "access" is complex and multifaceted, but for the dissertation research I focus on "geographic access," which has been a focal point of scholarly attention in recent years in public health (Neutens, 2015). Spatial disparities in access to health care resources has been underexamined in the public health literature (Bell et al., 2013). Scholars have argued that spatial disparities in health care access may be a symptom of de jure racial segregation that led to de facto segregated neighborhood amenities since the 1960s civil rights movements (Vaughan Sarrazin et al., 2009). The products of less geographic accessibility to health care facilities are disparities in the utilization and outcomes of care (Vaughan Sarrazin et al., 2009).

Geographic accessibility is an important aspect of the broader "health care access" literature, as increased distance to heath care services results in reduced utilization of the health care system (Haynes, 2013; Hiscock et al., 2008), which has direct consequences for health outcomes. Geographic access, in turn, is mediated by transportation resources (Taylor & Ong, 1995). While (in)accessibility to transportation services and resources is cited as a key obstacle to providing health care to residents of low-income communities (Silver et al., 2012), few studies demonstrate a comprehensive model that includes controls for medical care access, transportation resources, as well as individual and neighborhood characteristics. Due to limitations to accessing the geographic information available in the CHIS confidential data, this dissertation research relied on the simplest and most widely used measure of access: the "container" approach, or the number of facilities within a given geographic "container" such as a ZIP Code Tabulation Areas (ZCTAs) or census tract. I also included a limited set of neighborhood-level measures related to transportation resources, including the presence of private and public transportation.

Limitations to this study include ecological fallacy, endogeneity, and simultaneity of contextual factors. For instance, as Coker et al. (2016) note, “Statistical models to assess the health effects from pollutant mixtures remain limited, due to problems of collinearity between pollutants and area-level covariates, and increases in covariate dimensionality” (p. 1). Self-selection bias is another limitation of this research approach (Zick et al., 2013). For instance, individuals who want to walk more may move to places that are more walkable (Boone□ Heinonen et al., 2009; Cao et al., 2009; Handy et al., 2006). These limitations are well known in the neighborhood effects literature (Diez-Roux, 2004; Sampson et al., 2002), and scholars have proposed a variety of methods to address these limitations (Harding, 2003; Oakes, 2004), a key challenge is finding the necessary data. For example, longitudinal data with exogenous shocks are the gold standard (unexpected and unplanned changes that are not associated with self-selection), but these data are scarce. In the end, this scholarly work is intended to make progress toward understanding ethnoracial health-related disparities and disparities in the Latino community within the confines of less than ideal data, under certain conditions and assumptions. However, as scholars have argued, the results from the methodological approach used in the dissertation is still useful in the broader process of drawing causal inference (Diez-Roux, 2004) and hypothesis generation to identify new areas of research and plausible relationships.

Data Sources

The primary data source for this dissertation is the CHIS. CHIS is the nation’s largest state health survey, with about 40,000 households and roughly 20,000 adults and 1,900 children under the age of 18 participating in the survey—responding to questions on hundreds of health topics such as health status and perception of neighborhood cohesion. The survey is administered by the Center for Health Policy Research at UCLA, in collaboration with the California

Department of Public Health and the Department of Health Care Services, by telephone using a random-digit-dialing frame (land and cellphone lines) and a supplemental surname list frame to ensure it is representative of the state's population. The CHIS surveys are conducted in all 58 counties, and the spatially stratified methodology provides a large enough sample to examine differences among racial and ethnic groups at small geographies, particularly in urban areas and for subpopulations that it oversamples.

As previously mentioned, there are three versions of the survey available to researchers: AskCHIS neighborhood edition published online at the ZIP Code level, microlevel data in the PUFs, and confidential microlevel data. The 2013–2014 AskCHIS data are used for the first essay using an ecological statistical approach, as it was the latest year available at the time of data collection and analysis. As of December 2020, there are 2015–2016 estimates available. Pooled annual PUFs (2015 and 2016) are used for the second essay on individual determinants to facilitate future updates to the analysis in Essay 1

The last version of the CHIS data are the confidential files accessible physically only at the Data Access Center (DAC). These confidential files include detailed geographic identifiers. In the third essay, I pooled 2015 and 2016 microdata that connects the neighborhood context to an individual's neighborhood (census tract). A challenge with using the confidential data is that researchers are not provided direct access to the data. Instead, researchers must go through an application process, which includes designating and justifying the variables they will use. Once a project is approved, researchers are assigned a statistician who runs the analyses and provides the outputs only. The cost and the length of time it took to complete this process limited the number of exploratory statistical analyses I could conduct.

The dissertation also utilized unique neighborhood contextual measures developed by Ong et al. (2018) and Ong et al. (2020) for Caltrans and CARB, respectively, in collaboration with the Center for Neighborhood Knowledge (CNK) at UCLA. The data will be published and made accessible to the public in the fall of 2020. The indicators were developed as part of two statewide monitoring systems that will assist state agencies in tracking progress toward achieving sustainable community goals and in examining the relationship between transportation resources and health-related outcomes. The indicators were developed through a rigorous methodology that included a literature review to ground the empirical work, extensive assessments and evaluations of data sources and methods, and expert input through a stakeholder advisory board.

I utilized indicators from these statewide monitoring systems or the underlying data used to create them as contextual variables in Essays 1 and 3. In the first essay, I used information on park access. The indicator was allocated from the census tract to the ZCTA using spatial areal weights. A key limitation with this approach is that spatial weights assume data are evenly distributed. As such, when possible, I replicated or modified the methodology utilized by Ong et al. (date) and used it at the ZCTA level for the first essay. I also used underlying data about the location of vehicle, bike, and pedestrian collisions and primary care doctors. For the third essay, I used census-tract indicators directly from both monitoring systems without modifications and include additional information on clunker vehicles as a proxy for limited private transportation options. I used spatial allocation factors to allocate tract data from the ZCTA for the first essay, a process that could introduce new sources of statistical error such as over- or underestimating an effect. As such, I opted to use the census tract as the unit of analysis in the third essay because much of the contextual data are at the census tract. More details are provided in the “Data and Methodology” section of each essay.

I also used neighborhood contextual data from the 2013–2014 American Community Survey (ACS), CalEnviroScreen 3.0 (CES), and CalAdapt. The ACS is an ongoing survey conducted by the U.S. Bureau of the Census. The survey is a premiere source of vital information on households and individuals. The ACS samples about 2.5% of the population annually, and information is released in two period estimates (one-year and five-year) and in two formats (aggregated summary statistics and public-use microdata). I aggregated the five-year estimates at the ZCTA level for the first essay and at the census-tract level for the last essay. Only the five-year estimates are available for geographies with a population of less than 20,000, such as ZCTAs and tracts.

CES is a state-funded publicly available dataset maintained by the California Environmental Protection Agency's (CalEPA) Office of Environmental Health Hazard Assessment (California Environmental Protection Agency, 2017). CES is an important environmental justice tool that has been instrumental in planning practice in three areas. First, it identifies disadvantaged communities across California to allocate funding. Second, it has been instrumental in prioritizing areas for targeted enforcement actions. Third, it has assisted CalEPA with planning community engagement and outreach efforts focused on disadvantaged communities disproportionately burdened by environmental hazards (Murphy et al., 2018). Similarly, CalAdapt is an important source of environmental information for state agencies and researchers. The tool provides annual localized downscaled climate projections for temperature and precipitation, including extreme heat days. Both CES and CalAdapt are available at the census-tract level.

Essay 1: Neighborhood Influences on Health-Related Disparities

Abstract

Previous studies show a positive association between neighborhood environments and health-related outcomes. In this essay, I use ecological linear regression models to examine neighborhood influences on neighborhood-level walking, lifetime asthma, and heart disease. The study also examines the role of ethnorace and compares the factors that lead to disparities between Latino and white neighborhoods. The results show that neighborhood ethnorace is a better predictor of the prevalence of heart disease than it is for asthma or walking. In addition, in Latino neighborhoods the built environment characteristics of the neighborhood have the strongest association with lower walking levels. Further, while Latino neighborhoods experience inequalities that can lead to greater health risks, such as the lower availability of primary care and significant disparities in income and education, these characteristics are not necessarily associated with a greater prevalence of heart disease and asthma. The findings suggest neighborhood-level interventions should be pursued to promote walking; and individual-level interventions alongside neighborhood policies and programs are need for asthma and heart disease prevention.

1. Introduction

There is growing evidence indicating health-related outcomes are associated with the characteristics of the spatial context where people conduct their daily lives, independent of the circumstances of individuals (Bronfenbrenner, 1977; Diez-Roux, 2001; Diez-Roux & Mair, 2010; Gee & Payne-Sturges, 2004; Jackson, 2003; Kawachi & Berkman, 2003). Further, there are theoretical grounds for believing ecological neighborhood-level studies provide commentary insights to other methodological approaches that examine the processes that affect health and create health disparities (Kawachi & Berkman, 2003b). For instance, the widening income divide between the rich and the poor mirrored by class and racial segregation have led to diverging residential environments (Kawachi & Berkman, 2003b; Massey, 1996) and disparities in the allocation of quality, quantity, and diversity of neighborhood resources and institutions to address community needs (Wilson, 1987). This study applies an ecological approach to study how neighborhood characteristics intersect with ethnorace to influence neighborhood-level walking, lifetime asthma, and heart disease. The essay pays special attention to disparities between Latino and white neighborhoods to address the relative paucity of research on health-related outcomes in Latino neighborhoods.

I use aggregated data at the ZIP Code level from the AskCHIS Neighborhood Edition as a proxy for neighborhoods. I model the relationship between neighborhood characteristics and outcomes for adults 18 years and older using standard descriptive, bivariate, and multivariate linear regression models (ordinary least squares or OLS). I use fully segmented linear models and decomposition analyses to explore which neighborhood characteristics play a significant role in Latino neighborhoods compared to white neighborhoods. The purpose is to document which residential neighborhood characteristics influence disparities between Latino and white neighborhoods. Latino and white neighborhoods are defined as areas with high coliving where at least 75% of the population is of the same ethnorace.

Walking is defined by AskCHIS as “respondents 18+ who walked for transportation or leisure for at least 150 minutes in the past week” (UCLA Center for Health Policy Research, 2020c). The walking threshold is a commonly used proxy for meeting physical activity guidelines of 150 minutes a week for American adults (U.S. Department of Health and Human Services, 2012). The measure for heart disease prevalence is derived by AskCHIS from affirmative answers to the question "Has a doctor ever told you that you have any kind of heart disease?" Likewise, yes responses to the question "Has a doctor ever told you that you have asthma?" were used by AskCHIS to derive lifetime asthma estimates.

For the statistical analysis, I focus on five groups of variables: (1) demographic composition, (2) economic position, (3) the chemical environment (air pollution and extreme heat days), (4) the human-made built environment, and (5) accessibility to neighborhood resources. The following section provides a short description of these dimensions and the rationale for their inclusion. A more detailed discussion of the empirical measures can be found in the "Data and Methodology" section.

Results indicate that neighborhood ethnorace is a better predictor for the prevalence of heart disease than for asthma or walking, with ethnorace explaining about 30% of the variation in neighborhood-level rates of heart disease. The most important dimension associated with less walking in Latino neighborhoods relates to the built environment. Further, while Latino neighborhoods experience inequalities that can lead to greater health risks, such as less primary care availability and significant disparities in income and education, these are not necessarily associated with the greater prevalence of heart disease and asthma.

2. Conceptual Approach

This essay focuses on the spatial environment, which I define as the residential neighborhood, and is represented in the top left quadrant of Figure I-1 in the "Generalized Research Design" section of the dissertation. There are many theories and models proposed in the literature to explain inequalities in health and health-related outcomes. Traditional models in the public health literature emphasize individual characteristics and behaviors as key determinants (Lukes, 1970). In contrast to individual models, scholars have increasingly accepted and embraced ecological perspectives as significant determinants of health and health-enhancing behavior. The ecological model is a multilevel framework that recognizes the interactive nature between the characteristics of individuals and their surrounding environments as underlying factors for human development (Bronfenbrenner, 1977). In the ecological approach, the environment includes not only the immediate residential setting but also the larger social contexts, both formal and informal, such as institutions and social networks, respectively (Bronfenbrenner, 1977).

Since the ecological model and theory were formalized in the 1980s for human development, they have been applied to health-related outcomes and expanded to include other factors. For instance, the social ecological perspective hypothesizes that physical activity is determined by the intersection of social, personal, environmental, and policy-related factors (Giles-Corti & Donovan, 2002; Spence & Lee, 2003). Similarly, the social determinants of health framework applies a holistic approach to improve health and also encompasses traditional policies and interventions geared at changing individual behavior and considers the sensitivity of health to the social environment (Wilkinson & Marmot, 2003). Literature reviews by researchers from the planning field also recommend the use of the social ecological model widely used in health behavior research (Handy, 2005; Lee & Moudon, 2004).

The inclusion of space as a determinant of health and health-related behaviors in these models has led to a growing body of public health literature documenting a relationship between residential neighborhood characteristics and health outcomes (Diez Roux, 2001; Diez Roux & Mair, 2010; Gee & Payne-Sturges, 2004; Kawachi & Berkman, 2003), including the neighborhood's demographic and socioeconomic context, chemical environment, and built environment. The built environment consists of the places and spaces created or modified by people, including neighborhood resources such as parks, transportation systems, and walkable streets. A substantial body of urban-planning literature documents a positive association between the built environment and walking as it relates to health. This includes social benefits such as opportunities for social cohesion and mental health benefits like reduced stressed, particularly for older populations (Levy-Storms et al., 2018).

2.1 Neighborhood Demographic Composition

I divided demographic composition into three types of variables that scholars show to be associated with the outcomes of interest: (1) ethnoracial composition, which is the primary independent variable of interest, (2) foreign-born status, and (3) age dependency ratios. These variables produced problems of multicollinearity and endogeneity; to reduce multicollinearity, I developed parsimonious models with a limited set of key variables. More details on these measures are provided in the "Data and Methodology" section of this essay. For the reasons that I discuss in the following text, I hypothesize that neighborhood ethnorace and living in a Latino neighborhood will be negatively associated with the outcomes of interest and contribute to variations in the amount of walking, lifetime asthma, and heart disease observed across the different neighborhoods types.

Studies show conflicting findings with respect to ethnoracial variations in walking based on the measures used to assess walking, trip purpose, and neighborhood location within a city. For instance, there is considerable evidence that racial and ethnic minorities live more sedentary lifestyles compared to their white counterparts, with Latinos being more inactive than other racial groups (Marshall et al., 2007; Neighbors et al., 2008). However, the transportation planning literature suggests that Latino immigrants walk more than whites for the commute to work (Contrino & McGuckin, 2009) in part because they use public transit at higher rates

(Blumenberg & Shiki, 2007; Myers, 2001), a transportation mode that in turn is correlated with greater physical activity (Durand et al., 2016). These patterns are due in part because immigrant jobs and homes are often concentrated in immigrant enclaves that are said to promote more walking (Rojas, 2012) and compact commuting (Myers, 2001). Further, one national study shows immigrants living in immigrant neighborhoods are more likely to walk than U.S.-born residents (Blumenberg, Smart, et al., 2018). In the public health literature, the evidence is mixed in regard to walking for leisure compared to walking for transport (Babey et al., 2018; Paul et al., 2015). Given the mixed picture for Latinos as a homogenous group, I also considered foreign-born status as nativity influences residential location choices (Massey & Denton, 1985) and, in turn, residential location determines neighborhood resources and amenity availability.

The incidence and prevalence of asthma vary greatly according to population and location. This heterogeneity, along with differing methodologies to study asthma (e.g., lifetime asthma vs. current asthma, prevalence vs. morbidity, adults vs. children), likely contribute to the mixed picture of asthma in the United States identified by Anandan et al. (2010) in their systematic literature review. For instance, black adults are disproportionately affected by lifetime asthma relative to white adults/individuals, even after controlling for socioeconomic status (SES) (Moorman et al., 2012). However, not all communities of color are affected equally. One study documents asthma prevalence is lowest among Asian and Latino adults, and highest among black and Native Americans but asthma-related problems and medical care utilization is higher amongst Latinos and Native Americans (Gorman & Chu, 2009). Nonetheless, there are documented racial and ethnic variations (Moorman et al., 2012). Given the evidence, I assume that lifetime asthma for adults would be lower in Latino neighborhoods compared to whites. This could be the result of a variety of reasons, including lower levels of diagnoses due to limited access health care services and the high percentage of immigrants, particularly the undocumented who have the worst access and utilization patterns (Ortega et al., 2018). The concentration of workers in low-wage sectors, such as retail and services, may also play a role as these sectors provide limited health benefits (Ong, Pech, González, et al., 2020). Another reason is that Latino immigrants, being overall younger than other ethnoracial groups, have less disease and are in better health, a contradictory pattern referred to as the Latino health paradox, which is documented in several review articles (Franzini et al., 2001; Palloni & Morenoff, 2006). Further, the broader literature that shows immigrants are in better health when they arrival to the United States compared to their American counterparts, but this health advantage erodes over time.

Ethnoracial differences in cardiovascular disease, the catchall phrase for a variety of disorders of the heart and blood vessels, are also well documented (Havranek et al., 2015; Mensah et al., 2005). In general, there are racial disparities in the prevalence, morbidity, and mortality associated with cardiovascular disease and the major risk factors with which these are associated. Further, amongst the most significantly and adversely affected groups are blacks and Latinos, in particular Mexican Americans and Americans with low socioeconomic status (Mensah et al., 2005; Sharma et al., 2004). There is also evidence that independent of an individual's race, neighborhood ethnoracial composition and segregation are driving forces behind health disparities and cardiovascular health (Kershaw et al., 2015; U.S. Institute of Medicine, 2012). For Latinos, despite increased risk factors and greater socioeconomic disadvantage, most studies show they are less likely to have heart disease and less likely to die from heart disease compared to whites, known as the "Hispanic or Latino Paradox" (Leigh et al., 2016). Given this evidence, I assumed cardiovascular health is better in Latino neighborhoods relative to comparable white neighborhoods.

Age dependency ratios represent how much pressure a local economy faces in supporting its "nonproductive" populations. The estimates assume the population in these age groups does not work, while all those in ages 18 to 64 do work. I included age dependency to capture the effects of age in a neighborhood. Within the context of the local economy, age may influence employment status, which is correlated with more walking, but active forms of travel are significantly lower among children and seniors (Pucher et al., 2011). As such, I anticipated that high child or senior dependency would be negatively associated with physical activity of caretakers and the elderly. In the United States, there are also documented disparities in the prevalence of asthma by age, disproportionately affecting children in urban areas, poor children, and the elderly (Moorman et al., 2012; Ryan-Ibarra et al., 2016). Likewise, there are documented disparities in the prevalence and incidence of heart disease simply due to the process of aging. Aging causes the heart to change, known as cardiac aging; therefore, older adults (65+) are much more likely to develop heart disease than younger adults (National Institutes of Health, 2018).

2.2 Socioeconomic Position

Socioeconomic position (SEP) is a term used in the public health literature to capture "socially derived economic factors that influence what position individuals or groups hold within the multiple-stratifies structure of society" (Galobardes et al., 2007, p. 3). Income, income inequality, poverty, wealth, education, employment status, and occupation-based indicators are common measures of SEP (Galobardes et al., 2006), with wealth being the least explored determinant (Havranek et al., 2015). At the neighborhood level, there are also several ways to define SEP and often the terms "social class," "social stratification," and "SES" are used interchangeably with SEP. One proposed mechanism through which SEP may influence health, particularly physical activities like walking, is that lower SEP at the neighborhood level is usually marked by disparities in social spending and presence of health-related social services. This includes unequal distribution of resources across neighborhoods. For instance, underinvestment in public facilities that influence healthy behaviors, like parks or walking trails, influence opportunities for walking (Gordon-Larsen et al., 2006). Underinvestment in the provision of health care services, like hospitals and clinics (Lynch, & Kaplan, 2000), can influence chronic disease outcomes. However, the transportation literature notes there is more walking among low-income individuals for utilitarian purposes, like commuting to work, because they are less likely to have cars (Pucher et al., 2011). I included median household income as well as the share of the population with at least a bachelor's degree as proxies of measuring SEP at the neighborhood level.

2.3 Chemical Environment

A basic principle of epidemiology is that disease varies across person, place, and time; as such, the literature on the impact of the environment is focused on area-based differences and the associations between features of these environments (Havranek et al., 2015). The term "environment" has been used in many different ways. Here, I focus on the chemical exposures in the environment, specifically air pollution and extreme heat. I expect these measures will be negatively associated with the outcomes of interest for the following reasons. In their review on the epidemiology of asthma in the United States, Follenweider and Lambertino (2013) identified the following outdoor environmental risks: smoking, vehicle exhaust, and desert dust consisting of silica, ambient inhalable particulate matter (PM) from sources such as vehicle and diesel exhaust, and proximity to highways. Ambient PM like soot, elemental carbon, ozone, and nitrogen dioxide gases (NO_2) are associated with increased asthma symptoms.

Aside from aggravating respiratory illnesses, neighborhood air pollution is also associated with poor cardiovascular health and greater stroke risk (see the review by Xiao & Graham, 2018). Further, one study measuring the relationships between air pollution, race/ethnicity, and residential segregation finds that living in majority Latino neighborhoods is associated with higher levels of air pollutants, including fine PM with diameter < 2.5 μm ($PM_{2.5}$) and nitrogen oxides (NO_X) (Jones et al., 2014). Existing cross-sectional studies in the United States also suggest that air pollution discourages physical activity (An et al., 2018). Together, heart disease, asthma, and air pollutants can further limit physical activity, which compounds other chronic diseases that limit the mobility of Latinos.

To measure risk factors associated with the chemical environment, I focus on two measures of air pollution that are readily available and have important health implications: ozone (O_3) and PM concentrations ($PM_{2.5}$). I also include a measure of extreme heat days, as heat can trigger chemical reactions that increase these air pollutants (U.S. Environmental Protection Agency, 2014). Ozone is the major component of smog, hence it is nicknamed "urban smog." It is a highly reactive and unstable gas that can damage the linings of human lungs, causing and worsening a variety of respiratory symptoms (California Air Resources Board, 2019b). Ozone forms through photochemical reactions in greater quantities on hot, sunny, and calm days and ozone concentrations often exceed current state health-protective standards in the summertime (California Air Resources Board, 2019b). Ozone concentrations are high in urban areas of California as well as downwind of urban centers, such as the suburbs of Riverside and San Bernardino that are downwind of Los Angeles (South Coast Air Quality Management District, 2016). The current standard in California is a daily maximum eight-hour ozone concentration of 0.070 ppm (parts per million).

PM is a mixture of substances from many sources, including activities involving combustion such as cars and trucks, factories, wood burning, and other activities. In addition to primary emissions, PM can also be formed through photochemical reactions. The composition of PM changes from one place to another. Adverse effects of PM are related to particle size, as smaller particles can more easily penetrate the lungs. $PM_{2.5}$ refers to particles that have a diameter of 2.5 micrometer or less, which have been shown to have adverse effects on the heart and lungs, and exacerbate cardiovascular and respiratory diseases (California Air Resources Board, 2019a). Reductions in $PM_{2.5}$ emissions are associated with reductions in premature death risk, hospitalizations, and emergency room visits, in particular for sensitive groups such as children, the elderly, and those with respiratory illnesses (California Air Resources Board, 2019a). The current standard in California is an annual arithmetic mean of 12 $\mu g/m^3$.

2.4 Built Environment

The built environment is that which humans create and it includes all the physical features located where the population lives and works, such as homes, buildings, work sites, streets, open spaces, and infrastructure (National Centers for Disease Control and Prevention, 2019). These features of the built environment can have significant health effects. For instance, air pollution is moderated by features of the built environment such as neighborhood greenspace and proximity to major roadways. The following aspects of the built environment have been proposed as likely correlates of walking and physical activity: land-use form, transportation safety, neighborhood safety and perception, esthetic appearance of surroundings, accessibility of facilities, and recreational opportunities (Gordon-Larsen et al., 2006; Wang et al., 2016). Many of the characteristics of the built environment that may encourage walking can be categorized within the “3Ds” framework (residential density, neighborhood design, and diversity of land uses) to study travel choice (Cervero & Kockelman, 1997; Ewing & Cervero, 2010; Sallis et al., 2006). To examine the relationship between walking and the built environment, I included three measures of the built environment: parkland access, bike traffic collisions, and pedestrian traffic collisions, and I use the U.S. EPA National Walkability Index as a proxy to capture land-use mix. These measures are detailed in the next section of this essay.

I also included these variables to examine lifetime asthma and heart disease prevalence rates for the following reason. The built environment can have a direct influence on a person's level of physical activity by facilitating or hindering access to activities that contribute to sedentary habits, which in turn are associated with obesity, high blood pressure, and other chronic diseases that may influence cardiovascular health as well as asthma risk from exposure to pollutants (see the detailed in the review by Bhatnagar, 2017).

2.5 Neighborhood Resource Accessibility

A shortfall of the 3Ds framework and the ecological approach is the narrow accessibility definition to physical features of the built environment that enhance health. The term "access" is complex and multifaceted and includes both the availability of a resource in a neighborhood as well as having the means to access it; for instance, having a job that provides health insurance to access a medical center or having transportation options to access a medical center. As scholars suggest, health outcomes and access to health-promoting resources depend not only on one's absolute economic well-being but rather on the equitable distribution of societal resources (Auerbach et al., 2000). One example are disparities in the distribution of cardiologists and access to nearby medical services. These disparities are particularly detrimental to disadvantaged communities with state-funded health insurance like Medi-Cal, as many physicians and clinics do not accept this type of insurance due to low reimbursement rates (Coffman & Fix, 2017).

One underexamined neighborhood characteristic in the public health literature is access to health care resources (Bell et al., 2013) and resources that promote health. In the health literature, accessibility is used to describe the fit between the patient and the health care system (Neutens, 2015), or as a shorthand term to denote the lack of "barriers to access" to use the health care system. These barriers to access can be cultural, social, or educational. Barriers also encompass the variety of medical care opportunities, such as primary or emergency care facilities, the quality of the care, and the monetary means to access these resources (Talen, 2003). Among urban planners, accessibility is usually defined as the ease by which a resident can reach a given urban amenity; access a destination of interest or a public service, such as attending a school of choice; or get to desired job, retail, recreational, and health care opportunities.

For this research, I focus on "geographic" accessibility to neighborhood resources, as geographic access has been a focal point of scholarly attention in recent years in public health (Neutens, 2015). Geographic accessibility is an important aspect of the broader "health care access" literature, as increased geographic distance to heath care services can result in reduced utilization of the health care system (Haynes, 2013; Hiscock et al., 2008). There are at least five measurement approaches for geographic accessibility used in the health literature: container, coverage, minimum distance, travel costs, and weighted decay (Burkey, 2012; Talen, 2003). Due to the cross-sectional nature of this part of the dissertation and limitations to accessing the geographic information available for CHIS respondents, I use the simplest measure of geographic accessibility (the container approach) to medical care and transportation resources. The container approach is simply the count of facilities within a given geographic "container" such as a ZCTA. More complex measures are included in the multilevel analysis in Essay 3.

I also consider the availability of neighborhood-level transportation, the ways that people get from one place to another, because transportation resources are considered a social determinant of health (American Public Health Association, 2017; Wilkinson & Marmot, 2003). In the urban planning and health literature, scholars often emphasize the negative health externalities of transportation. For example, vehicle travel contributes to air pollution and associated poor health outcomes like asthma (World Health Organization, 2019). Other examples of negative externalities are related to reliance on automobile travel, including commuter sedentary lifestyles and associated cardiovascular disease (Hoehner et al., 2012), mental health (Putrik et al., 2015), and increased risk of disabling or fatal accidents (Savage, 2013). A negative externality of poor transportation access are the costs associated with the use of emergency services, including emergency departments, urgent care, and ambulatory services due to delayed care or lack of education over symptoms that do not require emergency care (Kim et al., 2009; Wallace et al., 2005) and the cost of missing appointments (Wallace et al., 2005).

Conversely, having access to a variety of transportation options can be beneficial to health outcomes. For instance, by improving transportation access to a variety of health care options beyond the local health clinic, such as regional hospitals with more advanced treatment options (Syed et al., 2013). Likewise, access to transportation improves adherence to medical treatment, such as follow-up appointments and refilling medications (Syed et al., 2013). Transportation resources also enable other health-promoting activities such as access to employment opportunities, job access in different sectors, social and civic engagement activities, educational attainment, and residential choice and quality (Ong & González, 2019). Walking, biking, and other forms of “active” transportation also can have positive health benefits (Renalds et al., 2010) in safe neighborhoods. The time saved by auto travel may also allow more time for exercise. Despite the importance of transportation, the topic has not received adequate attention in the health literature; likewise, health outcomes are rarely included in transportation policy decisions (Robert Wood Johnson Foundation, 2012). This was the premise for a 2016 workshop sponsored by the Transportation Research Board of the National Academy of Sciences; the convening explored partnerships, data, and measurement issues at the intersection of the health care and transportation sectors (National Academies of Sciences, 2016).

3. Data and Methodology

3.1 Unit of Analysis

The unit of analysis for this study is the ZCTAs from the U.S. Bureau of the Census. There are many ways to define neighborhoods and no real consensus on the appropriate meaning or scale of neighborhoods; however, social science research often relies on the census-based geographies as a proxy for neighborhoods, such as census tracts. In contrast, public health and epidemiological data are often at the U.S. postal ZIP Code level. A reason for this difference is that health data are often derived from medical records, which contain patients' residential postal ZIP Code. Zip Code–level data are often used in conjunction with ZCTAs, but there are major differences between these two spatial units that are worth noting. The first are differences in spatiotemporal methodologies for defining boundaries and the second is the stability of the geographic boundaries (e.g., Grubesic & Matisziw, 2006; Krieger et al., 2002).

As administrative units used primarily by the U.S. Postal Service, ZIP Code geographies reflect the street addresses served without regard to the statistical representation of the population within the boundaries (Grubesic & Matisziw, 2006). ZCTAs are statistical units for tabulating summary statistics from the census. ZCTAs are generalized representations of postal

ZIP Codes built by aggregating census blocks (the smallest geographical unit of the census) based on the given ZIP Code the block falls into (Krieger et al., 2002). As such, ZIP Code boundaries change periodically, whereas ZCTA boundaries change with each decennial census. Further, ZIP Codes can also be added or removed between censuses. While ZIP Codes and ZCTAs might share a common five-digit numerical identifier, the boundaries between these may not be the same because of the reasons outlined in the preceding text. This study uses 2010 ZCTA data when possible; however, various data were transformed from other geographic units (e.g., block groups, tracts) using either population or area allocation factors obtained from the Missouri Census Data Center's geographic correspondence tool "Geocorr2014" (Missouri Census Data Center, 2019). In California, there are 1,769 ZCTAs. It is important to note that data may not be available for all ZCTAs and that large, unpopulated areas are often excluded from the delineations. As such, there are no datasets that cover the complete state.

3.2 Primary Data

The research dataset for this study data was constructed from multiple data sources. As such, a key challenge was reconciling differences in the temporal and geographical resolutions of the various datasets. For instance, the AskCHIS data are for 2013-14, whereas demographic data are from 2013-2017. To address temporal differences, I opted to use data that overlap in coverage. To address differences in geographic boundaries, I used spatial allocation methods. The following subsections discuss the primary data sources and methodology for constructing these measures. Table 1-1 provides further information on the specific measures and data sources and geographical transformations.

The dependent measures were obtained directly from the 2013–2014 AskCHIS Neighborhood Edition. These outcome measures include the modeled proportion of adult respondents (18 and over) who walked for transportation or leisure for at least 150 minutes in the past week (walking), proportion of adult respondents (18 and over) who were ever diagnosed with asthma by a doctor (lifetime asthma), and the proportion of adult respondents (18 and over) who were ever diagnosed with heart disease by a doctor (heart disease prevalence).

AskCHIS is published online at the ZCTA level through a mapping portal. Data are free to query for single geographies but there is a per-variable cost associated with accessing the statewide dataset. According to the UCLA Center for Health Policy Research, the measures are derived by using both survey data and contextual data and unit-level generalized linear mixed models. These models include individual-level fixed predictors to capture individual effects as well as random effects at the survey strata level to capture the effects of the geographically stratified survey design (UCLA Center for Health Policy Research, 2020a). According to the UCLA Center for Health Policy Research, a non-parametric function of census tract level auxiliary variables is applied to the unit-level parametric model to better reflect the non-linear association between the contextual variables and the outcome. The estimated model parameters are then applied to a population dataset with the same set of independent variables and contextual variables to obtain the predicted probabilities at the individual level. Finally, individual-level predicted values are aggregated into area level estimates. The estimates are then calibrated and unstable estimates and estimates for areas with populations of less than 1,000 are suppressed or combined to produce stable estimates or to achieve a large enough population. Contextual data used for AskCHIS are from the ACS and population projections from Nielsen Claritas (UCLA Center for Health Policy Research, 2020a).

3.3 Contextual Data

The following paragraphs describe the contextual data considered for the three outcomes of interest; however, not all variables are included in all models as there may be no documented relationship between the measures. Demographic and socioeconomic data are from the 2013–2017 five-year American Community Survey at the ZCTA level. These include race and ethnic composition for the total population, child and elderly dependency ratios, foreign born, measures of income such as poverty, and the log of median household income (different models use different measures). I examined a variety of educational attainment measures in preliminary models (e.g., less than high school, high school, college); however, I only include the share of the population with at least a bachelor's degree to simplify the model.

I classified ZCTAs into supermajority Latino and white neighborhoods where the share of the group is equal to or greater than 75%, roughly between the 90 and 95th percentile of the Latino distribution for which there are AskCHIS data, which translates to about the 75th percentile for whites. This resulted in 126 Latino neighborhoods and 454 white neighborhoods. I also conducted a sensitivity analysis using an 80% cutoff, which showed similar results (see Appendix 1). I opted to focus on the extremes as these areas correspond to neighborhoods with high ethnoracial coliving. This approach also allows for more confident inferences that the observed relationships reflect the experiences of the Latino and white population in these areas because a key limitation of ecological statistical models is that the observed neighborhood-level inferences cannot be attributed to the population in those neighborhoods. Map 1-1 shows the distribution of these neighborhood types in California. Latino neighborhoods are concentrated in urban centers such as Los Angeles, the border areas, and central California. White neighborhoods are much more dispersed, including in lower density areas of the state. Future research should account for these spatial patterns to improve regression estimates.

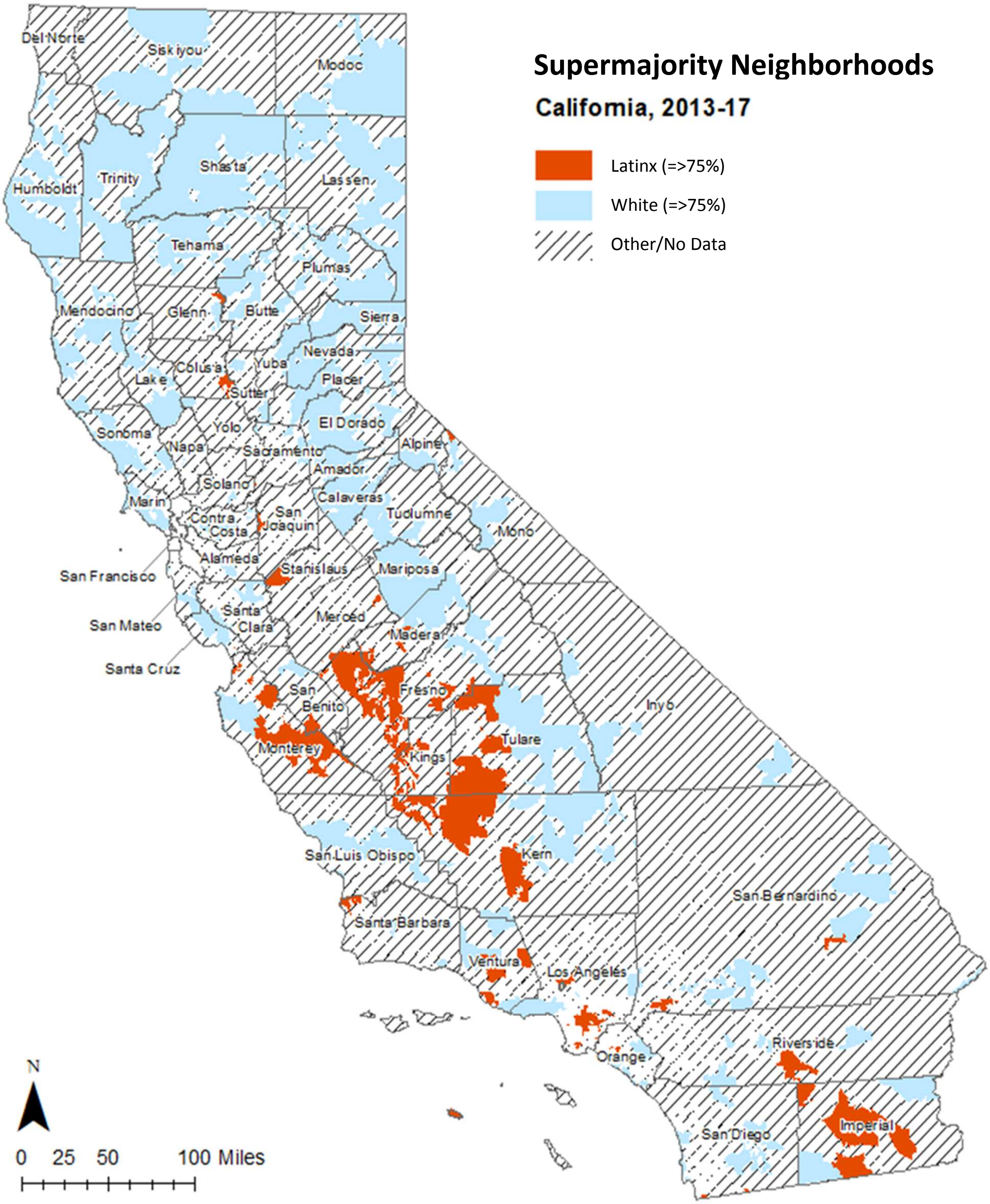
Information on the chemical environment comes from the CES and Cal-Adapt. The CES is the most comprehensive, readily available statewide database with measures related to environmental pollution, as well as information on emergency room asthma-related visits and heart attack emergency room visits (California Environmental Protection Agency, 2017). In this essay, I utilize measures related to ozone and particulate matter concentrations. The ozone concentrations are derived for CES through a modeling technique called Inverse Distance Weighted (IDW). IDW is a method of interpolation that estimates values by averaging sample data values in the neighborhood of each processing cell, as a result, the closer a point is to the center of the cell being estimated, the more weight it has in the averaging process (Environmental Systems Research Institute, 2020). Particulate matter were estimated for CES at the geographic center of the census tract using ordinary kringing, a geostatistical method that incorporates the monitoring data from nearby monitors (California Environmental Protection Agency, 2017). Data from CES on emergency room visits are used to assess the AskCHIS data (see next subsection).

The CES data are available for 7,929 out of the 8,035 census tracts in the state of California due to limited data availability for some areas. In this analysis, CES indicators are allocated from the census tract to the ZCTA using spatial areal weights from Geocorr2014 (Missouri Census Data Center, 2019). A key limitation with this approach is that spatial weights assume data are evenly distributed. Further, the methods used to spatially allocate data from air-monitoring stations to census tracts for CES are likely outdated given recent advancements using more sophisticated spatiotemporal models and machine-learning techniques. These advanced techniques have been shown to yield better exposure estimates to estimate health effects in epidemiological studies (Girguis et al., 2020).

The count of average extreme heat days are from Cal-Adapt, a data website developed by the California Energy Commission to synthesize existing California climate change scenarios and climate impact research and to encourage local decision making (California Energy Commission, 2020). The counts are available at the census-tract level and are area weighted using Geocorr2014 (Missouri Census Data Center, 2019) and allocated to the ZCTA. The data are derived from 2013 to 2014 annual localized downscaled climate projections for temperature and precipitation. These data are trained using machine-learning algorithms with gridded historical observed meteorological and hydrological data from 1950 to 2013 to produce projections (Livneh et al., 2015). The data were obtained from CalAdapt at the census-tract level and were area weighted using Gocorr2014 to the ZCTA level. The optimal measure for extreme heat days is observed historical temperature (observed historical data); however, these data are not readily accessible at the ZCTA or census-tract level.

The built environment measures are from various data sources. Parkland access is a modified indicator based on the "Park Access Tool" from the California Department of Parks and Recreation, created at the census-tract level, which measures acres of park per thousand residents in a tract. The tool was developed to comply with the 2015–2020 Statewide Comprehensive Outdoor Recreation Plan (SCORP). The UCLA CNK modified the measure using a floating quarter-mile buffer to address instances in which parkland may lie at or is close to the edge of a particular tract, a condition not captured by the current Park Access Tool (Ong et al., 2020). The measure is weighted by the population of the ZCTA and the distribution was divided into quartiles, with the bottom quartile capturing areas with the worst parkland access, or "park deserts" and the top quintile capturing "park-rich" areas.

Map 1-1: Map of Supermajority Neighborhoods



Source: 2013-2017 ACS

Table 1-1: Neighborhood Contextual Measures

Variable	Description	Data Source and Geography
Dependent Outcomes		
Walking	Modeled proportion of adult respondents (18+) who walked for transportation or leisure for at least 150 minutes in the past week	California Health Interview Survey (CHIS), Neighborhood Edition, 2013–2014; 2010 ZCTA
Lifetime asthma prevalence	Modeled proportion of adult respondents (18+) who were ever diagnosed with asthma by a doctor	California Health Interview Survey (CHIS), Neighborhood Edition, 2013–2014; 2010 ZCTA
Heart disease prevalence	Modeled proportion of adult respondents (18+) who were ever diagnosed with heart disease by a doctor	California Health Interview Survey (CHIS), Neighborhood Edition, 2013–2014; 2010 ZCTA
Independent Factors **Demographic**		
Latino & white neighborhoods	ZCTAs where share of population of the group is equal to or greater than 75%, roughly the 95% percentile (80.37%) of Latino distribution	2013–2017 5-year American Community Survey; ZCTA; Latino or Hispanic of any race; Non-Hispanic White pop
Child & elderly dependency ratio	[(population under 18 years/population 18 to 64 years)]; and [(population =>65 years/population 18–64 years)]	2013–2017 5-year American Community Survey; ZCTA
Foreign born	Share of the total population who are not a U.S. citizen at birth, including those who become U.S. citizens through naturalization	2013–2017 5-year American Community Survey; ZCTA
Socioeconomic		
Median household income	Log of median household income	2013–2017 5-year American Community Survey; ZCTA
College	Share of the total population with a bachelor's degree or higher	2013–2017 5-year American Community Survey; ZCTA
Chemical & Built Environment Characteristics		
Ozone	Mean of summer months (May–October) of daily maximum 8-hour ozone ppm for 2012–2013, averaged across the three years	CalEnviroScreen 3.0 at the census tract; allocated to ZCTA

$PM_{2.5}$	Annual mean concentration of $PM_{2.5}$ (average of quarterly means, μg/m3) from 2012 to 2014	CalEnviroScreen 3.0 at the census tract; allocated to ZCTA
Extreme heat days	[Average of modeled historical extreme heat days at the census tract over 2013–2014] * [ZCTA land area weight]	Adapted from CalAdapt CAnESM2 (Average Model) RCP 4.5 “Medium” Emissions Scenario; census tract allocated to ZCTA
Park “desert” and park “rich”	Bottom and top quartiles of [avg. area of park land within a floating buffer of block group/census tract 2010 population] * [ZCTA population weight]	Adapted from Ong et al. (2020) at the block group, allocated to ZCTA
Total bike + ped collisions by road network	[Total bike and ped from 2011 to 2015/(Total road network density D3a *Total geometric area of a census block group AC_TOT)] *[ZCTA land area weight]	Statewide Integrated Traffic Records System (SWITRS) UCB Transportation Injury Mapping System (TIMS), 1/1/2011 to 12/31/2015 geocoded to the ZCTA; Total Road Network from EPA Smart Location Database 2.0, 2010 block groups allocated to ZCTA
Total collisions by road network	[Total collisions from 2011 to 2015/(Total road network density D3a *Total geometric area of a census block group AC_TOT)] *[ZCTA land area weight]	Statewide Integrated Traffic Records System (SWITRS) UCB Transportation Injury Mapping System (TIMS), 1/1/2011 to 12/31/2015 geocoded to the ZCTA; Total Road Network from EPA Smart Location Database 2.0, 2010 block groups allocated to ZCTA
Walkability score	Index from 1 to 20, higher values indicate more walkability, weighted formula of indicator rank scores related to housing, employment, street characteristics	EPA National Walkability Index Smart Location Database; 2010 block groups allocated to ZCTA
Neighborhood Resources Transportation Access		
Walk to work	Share of workers 16 and over who walked to work	2013–2017 5-year American Community Survey; ZCTA
% Households with no car	Share of households without a vehicle	2013–2017 5-year American Community Survey; ZCTA
High-quality transit	% of population in a ZCTA that are within a quarter mile of HQTL	Adapted from Ong et al. (2018) at the block group, allocated to ZCTA
Medical Care Availability		
Primary care availability	Number of primary care providers accepting Medi-Cal, normalized by the population living in poverty	Profile of Enrolled Medi-Cal Fee-for-Service (FFS) Providers for April 2019 from the California Health and Human Services, ZIP Code allocated to ZCTA

Collision data are from the California Highway Patrol Statewide Integrated Traffic Records System (SWITRS), geocoded by the UC Berkeley Transportation Injury Mapping System (TIMS). I included all collisions from January 1, 2011 to December 31, 2015 with a latitude and longitude and allocated these to the ZCTA. I then divided the total number of collisions by a measure of the total road network derived from U.S. Environmental Protection Agency (EPA) Smart Location Database 2.0 (Ramsey & Bell, 2014). The road network is available only at the 2010 block group, which I then area weighted to the ZCTA. A limitation of this variable is that larger ZCTAs will not capture the heterogeneity of smaller neighborhood spatial units. An alternative measure is the number of pedestrian and bicycle collisions normalized by the road network. This alternative measure is used only in the walking regression models. It is important to note that the SWITRS represents only a portion of all incidents that occur as the database consists only of collisions where a police response took place and a report was taken in the field. Further, the SWIRTS is more likely to capture more serious incidents that require a police response; therefore, minor collisions are less likely to be included in the data.

The walkability index is derived from the EPA's National Walkability Index. The index characterizes every U.S. census block on its relative walkability. The index ranges from 1 to 20, with higher scores indicating greater conditions that are shown to affect the propensity of walk trips. The index uses a simple formula that ranks selected indicators from the EPA Smart Location Database, which influence the likelihood of walking as a mode of travel (Ramsey & Bell, 2014). These indicators include the mix of employment type (e.g., office, retail, and service) and quantity of occupied housing units; higher values of these indicators are correlated with more trips. Pedestrian-oriented street intersection density and predicted commute modes (carpool) are also included in the constructed National Walkability Index as higher values are also correlated with a higher propensity of walk trips (Ramsey & Bell, 2014).

The neighborhood access measures were also derived from a variety of sources. Given the ecological approach of this analysis, I use the simplest and most widely used measure of access: the “container” approach, or a simply the count of facilities within a given geographic “container” such as a ZCTA. More sophisticated measures that account for boundary effects (e.g., when facility is located just over the boundary of the area) are utilized in Essay 3.

The first data source for the primary care availability measure is the California Health and Human Services’ (CHHS) “Profile of Enrolled Medi-Cal Fee-for-Service (FFS) Providers” from April 2019 (California Health and Human Services Agency, 2020). This dataset provides basic information of FFS providers who are enrolled in the Medi-Cal program and their geographic location, including ZIP Code, which was used to allocate data to the ZCTA. Information is based on a point in time and is usually updated monthly. I retrieved the data from the Provider Master File (PMF), which is used for the claims payment process and is maintained by the Provider Enrollment Division (PED). The CHHS data do not identify which providers are “primary care” practitioners; as such, I made inferred using the provider specialty code description (Provider_Specialty_Code_Desc) available in the dataset. I included the following groups as they commonly serve as primary care practitioners: internal medicine, general practice, family practice, obstetrics-gynecology neonatal (medical doctor only), gynecology (Doctor of Osteopathic Medicine only), and preventive (medical doctor only). The subset resulted in 53,517 practitioners out of 207,940 total observations in the dataset. I further used 2014–2018 5-year ACS data to normalize the provider count by the number of low-income individuals in the ZCTA.

I used the 2013–2017 ACS at the ZCTA to estimate the share of the population that commute to work by walking and the share of households that do not own a vehicle. The high-quality transit availability measure is from the Sustainable Communities Strategies Statewide Monitoring System, a database constructed by the CNK (Ong et al., 2018). The measure was constructed at the census-block group level, which I then area weighted to the ZCTA using Geocorr2014 (Missouri Census Data Center, 2019). The measure represents the proportion of the population in a ZCTA within a quarter of a mile of any rail and bus with <15 min headway morning commute.

3.4 Assessment of Primary Data

There are no other California-based publicly available estimates of lifetime and heart disease prevalence at the neighborhood level other than AskCHIS. I assessed the reliability estimates of AskCHIS against the underlying CES data on asthma and myocardial infarction emergency room visits. The underlying data are from the California Office of Environmental Health Hazard Assessment (OEHHA) and include two types of estimates: conventional and spatially modeled. Like AskCHIS, the underlying data are at the ZCTA level. I assessed the AskCHIS measures by conducting a Pearson correlation test against the underlying data from CES. I also conducted a simple OLS regression with the underlying data as dependent variables. I assumed the AskCHIS estimates would be correlated with the underlying data; however, they are minimally associated. The simple OLS also show that the underlying data for CES are not associated with factors commonly identified in the literature and included in my statistical models for AskCHIS (e.g., heart attacks per 10,000 people as a function of heart disease, race, and income). These differences may be due to differences in the methodological approach to derive these measures as AskCHIS are derived from a survey sample and CES are based on emergency room visit patient records, which are rare occurrences.

3.5 Statistical Approach

This essay uses ecological inference using macrolevel data at the neighborhood level to infer microlevel relationships. The unit of analysis is the ZCTA. I created a research database of all ZCTAs in California using data from the various publicly available data sources and merged these with the AskCHIS data. To give details on the neighborhood factors associated with walking, lifetime asthma, and heart disease, I first analyze basic descriptive and bivariate statistics to describe differences among all neighborhoods in the dataset, and between Latino and white neighborhoods.

In addition to summarizing the central tendency (means) by neighborhood types, I also developed a statistical modeling strategy to examine the linear relationship between the outcomes of interest and neighborhood contextual factors identified in the public health and planning literatures. I developed three types of statistical models. Model 1 includes only the ethnoracial distribution of the population. Model 2 is the full model, which includes all predictors of interest, regardless of any issues of collinearity and statistical significance. Model 3 is a parsimonious model that includes only variables that are significant at <0.10 level. Except for the ethnorace variables, I also replace or exclude variables with a variance inflation factor (VIF) over 5.0, a common threshold used to identify a problem with linear collinearity between predictor variables (see review by Kock & Lynn, 2012). To examine how and by how much racialized spaces matter, Model 2 and Model 3 include ethnorace regardless of the significance. The residuals for the walking models are normally distributed; however, the residuals for the asthma and heart disease models are not normally distributed but instead the response distributions have a rather strong central mass and heavy tails. This indicates that using a parametric model to perform clustering may be a better statistical approach (Kessler & McDowell, 2012). A limitation of these models is that there is no agreed upon R-squared for any generalized linear models and the coefficients are difficult to interpret. Given the already complex spatial modeling used to derive AskCHIS estimates, I opted to use simple OLS regression models to establish baseline estimates to inform future research that will be useful for preparing the dissertation for peer-reviewed journal publications.

I also used decomposition analysis to examine the differences in walking between Latino and white neighborhoods to tease out the degree to which different factors play a role in these neighborhoods. The purpose of this exercise is twofold. First, I wish to identify important dimensions that play a key role in the outcomes of interest. Second, I plan to suggest points of policy and planning intervention along the dimensions identified. I do not replicate this analysis for asthma or heart disease given the non-normal distribution of the residuals.

Each of the analyses is limited by the sources of publicly available data. Further, as with other neighborhood-level analyses, some level of self-selection bias and simultaneity is expected. For instance, one study cited in the literature review (Cao et al., 2009) show that self-selection accounts anywhere between 20-40% of the observed influence on travel behavior. Whereas other scholars argue that residential self-selection plays a small and inconsistent role in biasing associations between neighborhoods and health (James, Hart, et al., 2015; McCormack & Shiell, 2011). Finally, as with any empirical analyses of aggregated cross-sectional data, the analyses presented in this essay are complicated by ecological fallacy. Ecological fallacy comes from correlating aggregated individual data and assuming that a correlation at the aggregate level holds true at the individual level when, in fact, the relationship may be the inverse (Robinson, 1950). The search for a valid method has challenged many methodologists for years and a variety of approaches have been developed for different geographical levels, such as spatially weighted regressions, all of which are either praised or contested (Fotheringham et al., 2003; Withers, 2001). These analyses do not incorporate new approaches given the already complex spatial modeling used by AskCHIS. Further, the data used for the analyses do not account for edge effects or spillover effects from one geographical unit to the other.

Regression Analysis

I used OLS regression for the analysis of walking, lifetime asthma, and heart disease, which have an approximate normal distribution. I rely on the following generalized functional form for my analysis:

$$Y_i = f(NR_i, NF_i) \text{ for observations } i = 1 \ldots n$$

Where Y_i is the outcome of interest; NR_i is the neighborhood racial composition, the independent variable of interest; and NF_i is a vector of other contextual neighborhood-level measures.

Decomposition Analysis

To develop a clearer picture of the differences between Latino and white neighborhoods in terms of walking, I used an adaptation of the Blinder–Oaxaca decomposition. However, after completing this first analysis, I opted not to use decomposition analysis for other outcomes of interest given the similarities between the mean prevalence rates. There are numerous variations and extensions to the decomposition approach I have taken in this study. For background on these alternatives, see the work by Fairlie (2005); Fortin, Lemieux, and Firpo (2011); Hlavac (2014); Jann (2008); and O’Donnell, van Doorslaer, Wagstaff, and Lindelow (2007). The decomposition is a popular econometric technique that has been applied to the study of gender wage discrimination in the labor market since the 1970s (Blinder, 1973; Oaxaca, 1973). The technique has been used to study sources of disparities in neighborhood studies, for example, to examine the relative disadvantage of South Los Angeles to the rest of the region (Comandon & Ong, 2019). In the health field, decomposition is often used to examine disparities among individuals of varying SESs and changes in disparities over time, among other disparities (e.g., O'Donnell et al., 2007). The core idea is to explain the gap in the means of an outcome variable between two groups, but the analysis is purely descriptive, revealing the associations that characterize the gap in walking prevalence.

For the decomposition for walking, I classified ZCTAs into Latino and white neighborhoods where the share of the group is equal to or greater than 75%, roughly the 95% percentile (80.37%) of the Latino distribution. I then took the difference of mean values of each independent variable and multiplied these values by the coefficient β of the parsimonious model presented in the results section. Finally, I pooled the decomposed effects into the major categories of variables of interest, and adjusted the result. For alternate specifications, see Appendix 1.

4. Analytical Results

In this section, I first present the estimated neighborhood rates for the outcomes of interest followed by separate discussions for the regression analyses for each outcome. I also present descriptive statistics for the sample neighborhoods in California for each outcome of interest, as these are slightly different across the outcomes of interest. Table 1-2 shows the estimated share of the adult population that walked at least 150 minutes for leisure and travel over one week, the share with lifetime asthma and heart disease prevalence rates, as well as the means by neighborhood types. The California estimates are reported by AskCHIS, whereas the estimates at the neighborhood level are the means of the ZCTAs for which data are published by AskCHIS.

Table 1-2: Estimated Neighborhood Rates

Characteristics	Statewide	Neighborhood Type		
% Adults 18 and over	AskCHIS	All	Latino	White
Walked at least 150 minutes	33.0%	32.2%	31.0%	31.4%
Lifetime asthma prevalence	13.9%	14.5%	13.5%	15.0%
Heart disease prevalence	5.9%	6.8%	5.4%	9.0%

Source: AskCHIS 2014 for all ZCTAs with data in at least one outcome of interest. Note: neighborhood types are ZCTAs where share of population of the group is equal to or greater than 75% using ACS 2013–2017.

Roughly only one out of three adult Californians walked long enough to meet the national health guideline of 150 minutes per week. These rates are similar to those from AskCHIS at the neighborhood level. Latino and white neighborhoods have slightly lower rates of walking than the state average. The difference between Latino neighborhoods and all neighborhoods is statistically significant at the 0.05 level. The difference between Latino and white neighborhoods is marginally significant ($p < 0.056$). About 14% of adults reported a medical asthma diagnosis at some point in their lives. The mean lifetime asthma prevalence at the neighborhood level is slightly lower for Latino neighborhoods (13.5%) than white neighborhoods (15.0%). The difference in means between Latino and all neighborhoods and white neighborhoods is statistically significant ($p < 0.005$ and $p < .0001$, respectively). The prevalence of heart disease is roughly 7% in California neighborhoods and is higher among white neighborhoods (9%) than Latino neighborhoods (5.4%). The difference in means between Latino, all, and white neighborhoods is statistically significant ($p < .0001$). In summary, supermajority Latino neighborhoods have lower rates of walking and diagnosed heart disease and asthma than white neighborhoods and the average neighborhood in California.

4.1 Neighborhood Walking for Leisure and Transport

Table 1-3 provide the descriptive statistics for the neighborhoods in California with AskCHIS data for walking (n = 1,458 out of the 1,769 ZCTAs partially or completely within California). The statistics represent the averages for the neighborhoods. Pearson correlations (not displayed) show a negative association between the prevalence of walking and the percent of the population that is Latino. However, on average, the prevalence of walking in supermajority Latino neighborhoods is similar to that of white neighborhoods. As shown in Map 1-2, neighborhoods with a majority of the adult population meeting the national 150-minute standard tend to be located in large urban areas (blue color), like the San Francisco Bay and Los Angeles. Not surprising, the data show clear qualitative differences between supermajority Latino and white neighborhoods. For example, Latino neighborhoods tend to have a greater absolute population size, both in terms of the total population and the population over the age of 18. Latino neighborhoods also have higher child dependency ratios and, as expected, a greater share of residents in these neighborhoods are foreign born.

Map 1-2: Share of Adults That Walked 150+ Minutes

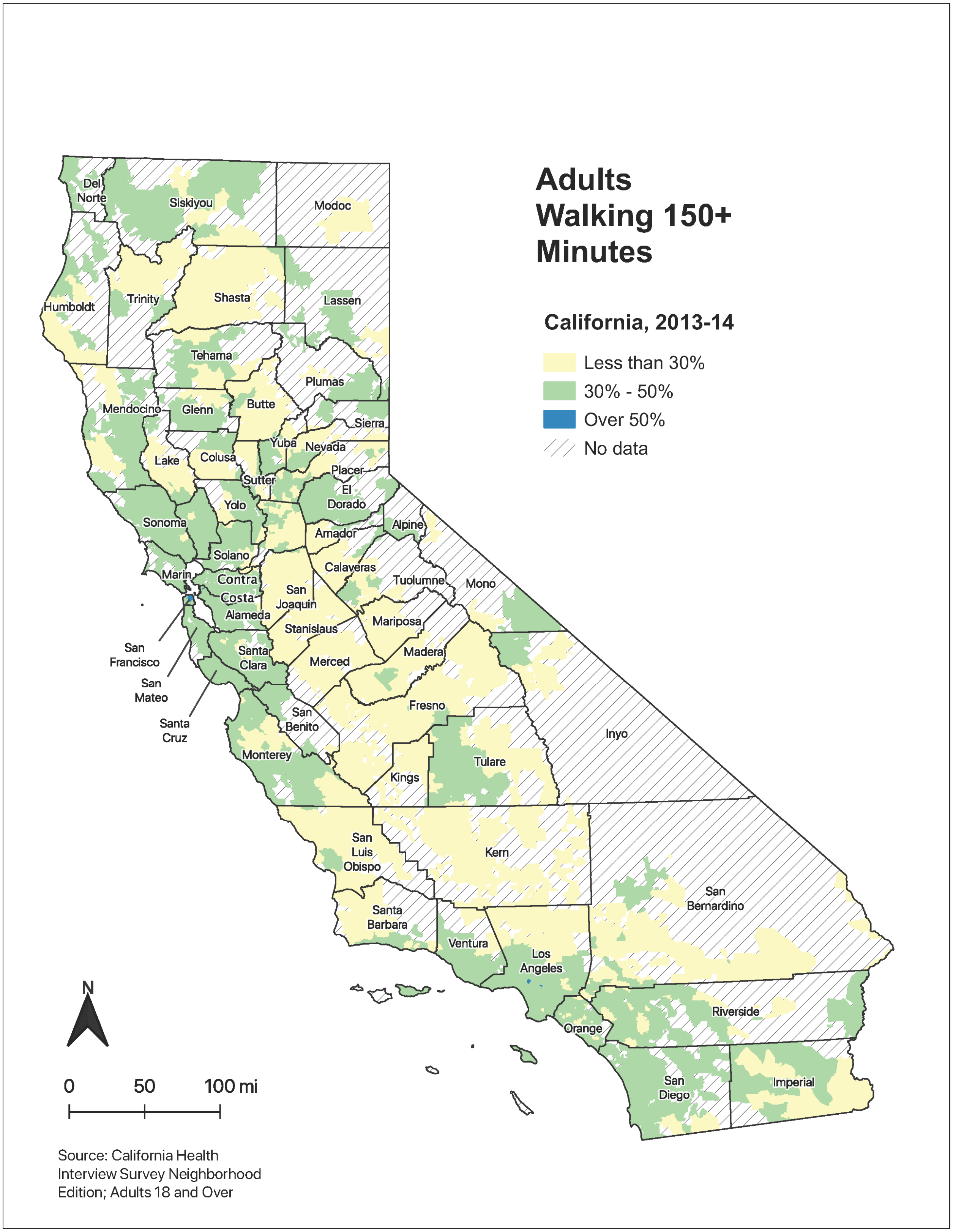


Table 1-3: Descriptive Statistics, Neighborhoods with Walking Data

Characteristics	Neighborhood Type		
	All	Latino	White
Walked at least 150 minutes	32.2%	31.0%	31.4%
Demographic			
Mean population	26,402	32,333	8,011
Adult population 18 and over	19,515	21,801	6,359
% Latino	32.1%	86.2%	8.5%
% White	48.9%	7.7%	84.4%
Child dependency ratio	0.36	0.52	0.30
Elderly dependency ratio	0.29	0.14	0.49
% Foreign born	21.8%	37.4%	7.5%
Socioeconomic Position			
Median household income (2017$)	70,665	41,913	74,553
Poverty rate	15.3%	27.8%	11.7%
College degree +	31.7%	8.2%	35.3%
Chemical & Built Environment			
Ozone (parts per million?)	0.048	0.053	0.046
$PM_{2.5}$ µg/m3	9.61	12.08	7.44
Average extreme heat days	5.5	5.6	6.5
Park desert	29%	55%	2%
Park rich	16%	10%	45%
Average total crashes	524	622	163
Average bike & pedestrian crashes	83	108	21
Accessibility to Neighborhood Resources			
EPA walkability (1–20)	9.8	9.3	7.2
% Workers commute by walking	3.8%	2.4%	3.9%
% Households with no vehicle	6.5%	8.1%	3.8%
% Pop with high-quality transit access	19.5%	24.7%	5.1%
Primary care availability ratio	0.013	0.003	0.012
ZCTAs (CA 1,769)	1,458	107	309

Source: AskCHIS 2014 for all ZCTAs with data in at least one outcome of interest. Note: neighborhood types are ZCTAs where share of population of the group is equal to or greater than 75% using ACS 2013–2017.

One interesting demographic difference is the elderly dependency ratio. In white neighborhoods, the ratio is not only higher than the statewide average; it is also three times that of Latino areas (0.49 compared to 0.14). As expected, Latino neighborhoods are disadvantaged in terms of SEP relative to white neighborhoods and the typical neighborhood in California. A striking difference is the lower college attainment rate in Latino neighborhoods. This is concerning as there is a robust literature documenting a large and persistent association between education and health behaviors and health status. For instance, Cutler and Lleras-Muney (2006) show that more educated Americans report lower morbidity from the most common acute and chronic diseases, including heart condition and asthma attacks.

In terms of the chemical environment, there are notable disparities in $PM_{2.5}$ concentrations between neighborhood types. $PM_{2.5}$ is known to exacerbate cardiovascular and respiratory diseases, especially for older adults with chronic heart or lung disease, children, and asthmatics (California Air Resources Board, 2019a). Average $PM_{2.5}$ concentrations in supermajority Latino neighborhoods border the California standard of 12µg/m3, the maximum amount that can be present in outdoor air without harming human health (California Air Resources Board, 2019a).

As it relates to the built environment, the greatest disparity is visible in the parkland access measure. The majority of Latino neighborhoods (55% or 59 neighborhoods) fall in the lowest quartile of the parkland access measure compared to only 1 in 10 of white neighborhoods (10% or 31 neighborhoods). On average, Latino neighborhoods have a much greater number of auto collisions and crashes involving bicyclists and pedestrians. Further, the neighborhood resource measures indicate that relative to white neighborhoods and the typical neighborhood in California, Latino neighborhoods are more walkable as they have greater diversity of land uses and greater high-quality transit access. There is also greater dependency on public transportation given the lower automobile access rates and walking commutes. The disparities and differences in the built environment and neighborhood access measures may be due to the concentration of the Latino population in denser urban areas, as shown in Map 1-1. This could explain why traffic collisions are more prevalent in Latino neighborhoods, as previous research has shown that street and land use diversity, as well as the diversity of automobile and pedestrian trip purposes, are associated with higher collision rates (Ewing et al., 2006; González et al., 2019; Loukaitou-Sideris et al., 2007).

Walking OLS Regression Results

Using multiple regression, I modeled the propensity of walking on the linear combination of variables related to demographic, health, SEP, environmental, and neighborhood access measures. The measures were subsequently reviewed to assess the relative importance in the prediction of walking propensity. The regression results presented in Table 1-4 are for three selected models. The VIFs and tolerances suggest possible collinearity between the college degree and foreign-born variables and other independent variables, as the VIFs for these are slightly over the 5.0 rule of thumb, and tolerance values were under the standard 0.3 level at 0.17. However, the VIF is well under the 10.0 threshold that is common in many social science research (Kock & Lynn, 2012).

Following the conceptual framework for the model-building approach, I first estimate a model only with ethnoracial composition to establish a base relationship with the propensity of walking (Model 1). Roughly 10% of the variability at the neighborhood level is explained by the ethnoracial composition of a neighborhood, which is higher than that for the ethnorace models presented in the next section for asthma (8%) but also much lower than that for heart disease prevalence (39%). This finding indicates that neighborhood race plays a slightly more important role in predicting walking than it does for predicting lifetime asthma but a smaller role than it does for heart disease.

Table 1-4: Walking OLS Regression

Independent Variables	Model 1: Ethnorace n = 1,469		Model 2: Full n = 1,403		Model 3: Parsimonious n = 1,413	
Demographic						
% Asian	0.106	***	–0.024	+	–0.019	*
% Black	0.075	***	–0.005		–0.001	
% Latino	–0.029	***	0.062	***	0.065	***
% Other	0.020		0.099	***	0.093	***
Child dependency ratio			–0.024	*	–0.029	**
Elderly dependency ratio			0.007			
Foreign born			0.001			
Other Health Indicators						
% Lifetime asthma			–0.046			
% Heart disease prevalence			0.174	**	0.199	***
Socioeconomic Position						
Median household income (log)			0.017	***	0.016	***
% College degree			0.117	***	0.124	***
Chemical Environmental						
Ozone ppm			–0.981	***	–0.945	***
$PM_{2.5}$ µg/m3			–0.002	***	–0.002	***
Average heat days			0.000			
Built Environment						
Park desert			–0.009	***	–0.008	***
Bike + ped/road network density			1.850	***	1.904	***
EPA walkability (1–20)			0.000			
Accessibility to Neighborhood Resources						
% Workers commute by walking			0.060	**	0.060	**
% Households with no vehicle			0.183	***	0.190	***
% Pop with high-quality transit access			0.051	***	0.054	***
Constant	0.316	***	0.106	*	0.114	**
Adjusted R-Squared	0.100		0.632		0.640	

Probabilities: +p < 0.10; *p < 0.05; **p < 0.01; ***p < 0.001.

Neighborhoods with higher percentages of Latinos correlate with a lower propensity of walking; however, the direction of the relationship for Latinos changes when controlling for other factors as does the magnitude of the coefficients, as shown in Model 2 and the parsimonious model 3. The decomposition analysis described in the next section suggests that a plausible explanation is related to the built environment, indicating that it is the combination of being in a Latino neighborhood and the quality of the built environment influences walking. A similar shift in the direction of the relationship is observed for Asians.

Interestingly, there is a positive correlation between propensity of walking and heart disease. The negative correlation between walking and lifetime asthma prevalence is not significant. As expected, there is an inverse relationship between walking and child dependency, air pollution, and poor access to parks. Measures of SEP and access to neighborhood resources perform as expected. For instance, higher household income and educational attainment is associated with an increase in walking. Another analysis presented in Appendix 1 also shows a threshold effect for parkland access. Neighborhoods with the worst parkland access ("park deserts") play a significant role in the walking prevalence. In other words, the absence of parkland has detrimental effects on walking. However, there is no relationship between park-rich areas and walking.

There is also a positive relationship between walking in neighborhoods with a higher proportion of workers that commute to work by walking, with no vehicle, and with access to public transit. One interesting relationship is the positive association with bike and pedestrian collisions, which could indicate people are walking in higher-risk environments. Traffic collisions are higher along major arterials (Campbell et al., 2004; Miles-Doan & Thompson, 1999), and this is often where commercial, retail, and other neighborhood resources may be located and where people would walk in these neighborhoods (Loukaitou-Sideris et al., 2007).

Segmented OLS Analysis for Walking

Table 1- 5 presents the segmented models for Latino and white neighborhoods considering the full suite of independent predictors in the Full Model 2. Heart disease is a significant factor for Latinos (positive association) as shown in the difference in the magnitude

of the coefficients between the neighborhoods typologies. Neighborhood walkability and access to high-quality transit are associated with walking in Latino neighborhoods. Air pollution as measured by $PM_{2.5}$ has a negative association with walking. These set of factors are not relevant to white neighborhoods. The differences between Latinos and whites are further explored using decomposition analysis in the next subsection.

Table 1- 5: Walking Propensity Segmented OLS

	All Neighborhoods		**Neighborhood Type**			
	Full Model		**Latino**		**White**	
Independent Variables	n =1,403		n =105		n=279	
Demographic						
% Asian	–0.024	+				
% Black	–0.005					
% Hispanic	0.062	***				
% Other	0.099	***				
Child dependency ratio	–0.024	*	–0.026		0.015	
Elderly dependency ratio	0.007		0.059		0.011	
Foreign born	0.001		0.012		0.010	
Other Health Indicators						
% Lifetime asthma	–0.046		–0.022		0.265	***
% Heart disease prevalence	0.174	**	0.978	***	0.013	
Economic						
Median household income (log)	0.017	***	–0.035		0.023	**
% College degree	0.117	***	0.138		0.119	***
Chemical Environmental						
Ozone	–0.981	***	–0.305		–0.267	
$PM_{2.5}$	–0.002	***	–0.004	*	–0.002	
Average heat days	0.000		–0.001		–0.002	*
Built Environment						
% Park desert	–0.009	***	0.000		0.003	
Bike and pedestrian crashes	1.850	***	0.492		–0.807	
EPA walkability (1–20)	0.000		0.004	*	–0.001	
Accessibility to Neighborhood Resources						
% Workers commute by walking	0.060	**	0.181		0.078	+
% Households with no vehicle	0.183	***	0.077		0.114	+
% Pop with high-quality transit access	0.051	***	0.048	*	0.095	
Constant	0.106	*	0.630	*	0.001	
Adjusted R-Squared	0.632		0.557		0.659	

Probabilities: +p < 0.10; *p < 0.05; **p < 0.01; ***p < 0.001.

Decomposition Analysis

The decomposition of regression coefficients highlights the dimensions in the conceptual model that most affect the differences in walking between Latino and white neighborhoods. The purpose of this exercise is twofold: to identify important neighborhood characteristics that influence neighborhood-level walking and also to suggest points of policy and planning intervention. The most important dimension associated with lower walking levels in Latino neighborhoods is the built environment. The second most important dimension is the demographic and ethnic composition of a neighborhood. Alternate model specifications (neighborhoods with 75% Latinos) show similar patterns (see Appendix Table 1A-2: Alternate Specifications for Walking Decomposition). The decomposition analysis along with the regression results indicate that it is the combination of the share of Latinos in a neighborhood and the quality of the built environment that influences walking. This finding suggests the need for further research to disentangle the observed relationship.

Table 1-6: Decomposition Comparison between Latino and White Neighborhoods

	Neighborhood Means			Disparities			
	Latino	**White**	**Difference**	**Coefficients**	**Coefficient *Difference**	**Pooled Gaps**	**Normalized**
Walking Prevalence	31.0%	31.4%	–0.39%				
Demographic						**4.15%**	**–0.00010%**
% Asian	2.47%	2.31%	0.16%	–0.019	0.0000		
% Black	2.62%	0.70%	1.92%	–0.001	0.0000		
% Latino	86.19%	8.46%	77.73%	0.065	0.0508		
% Other pop	1.04%	4.10%	–3.06%	0.093	–0.0028		
Child dependency ratio	0.52	0.30	22.10%	–0.029	–0.0065		
Other Health Indicators						**-0.71%**	**0.00002%**
Heart disease prevalence	5.42%	8.97%	–0.036	0.199	–0.0071		
Socioeconomic Position						**-4.17%**	**0.00010%**
Med HH income (log)	10.608	11.110	–0.501	0.016	–0.0082		
% College degree	8.24%	35.25%	–0.270	0.124	–0.0335		
Chemical Environmental						**–1.54%**	**0.00004%**
Ozone ppm	0.053	0.046	0.007	–0.945	–0.0062		
$PM_{2.5}$ µg/m3	12.075	7.445	4.631	–0.002	–0.0092		
Built Environment						**16523%**	**–0.38761%**
% Park desert	0.545	0.023	0.523	–0.008	–0.0044		
Bike and pedestrian crashes	107.86	21.10	86.76	1.90	165.23		
Accessibility to Neighborhood Resources						**1.79%**	**–0.00004%**
% Workers commute by walking	0.024	0.039	–0.015	0.060	–0.0009		
% Households with no vehicle	0.081	0.038	0.044	0.190	0.0083		
% Pop with high-quality transit access	0.247	0.051	0.196	0.054	0.0105		

Source: California Health Interview Survey 2014 for all ZCTAs with data for the outcome of interest (lifetime asthma prevalence); Note: Neighborhood types are =>75% proportion of the population.

4.2 Neighborhood Lifetime Asthma Prevalence

Table 1-7 provides the descriptive statistics for the sample neighborhoods in California with data for lifetime asthma prevalence (n = 1,458 out of the 1,769 ZCTAs partially or completely within California). On average, the lifetime asthma in supermajority Latino neighborhoods is slightly lower (13.5%) than that of white neighborhoods (15.0%). Map 1-3 shows the distribution of lifetime asthma rates across California. The lightest share represents areas with rates below the state average of 15%. As expected, areas with the least asthma burden are concentrated along the coasts where land values are highest, and neighborhoods with the highest burden are in the inland areas and valleys such as the San Joaquin Valley.

The descriptive statistics for the sample of neighborhoods in this analysis are very similar to those presented in the analysis for walking in the previous section. As such, I do not summarize them here. However, two new statistics worth highlighting are primary care access and diesel PM. Primary care access for low-income populations in Latino neighborhoods is only one-third that for the average California neighborhood and white neighborhoods.

The CARB estimates that, aside from the known cancer-related effects, exposure to diesel PM is associated with more than 700 cardiopulmonary deaths, 160 hospitalizations, and 370 emergency room visits for asthma annually (California Air Resources Board, 2020). The average concentration of diesel PM from on-road and off-road sources for a typical summer day is slightly higher in Latino neighborhoods than the average for all California neighborhoods but almost four times the concentration found in white neighborhoods (14.2 compared to 3.7, respectively). According to the CARB, major sources of diesel emissions come from ships, trains, and trucks that operate in and around ports, rail yards, and heavily traveled roadways. Further, these areas are usually located in highly populated areas where a large number of people are exposed relative to less dense rural areas (California Air Resources Board, 2020). The Latino–white disparity is concerning given the concentration of Latino neighborhoods in urban areas (Brown & Lopez, 2013).

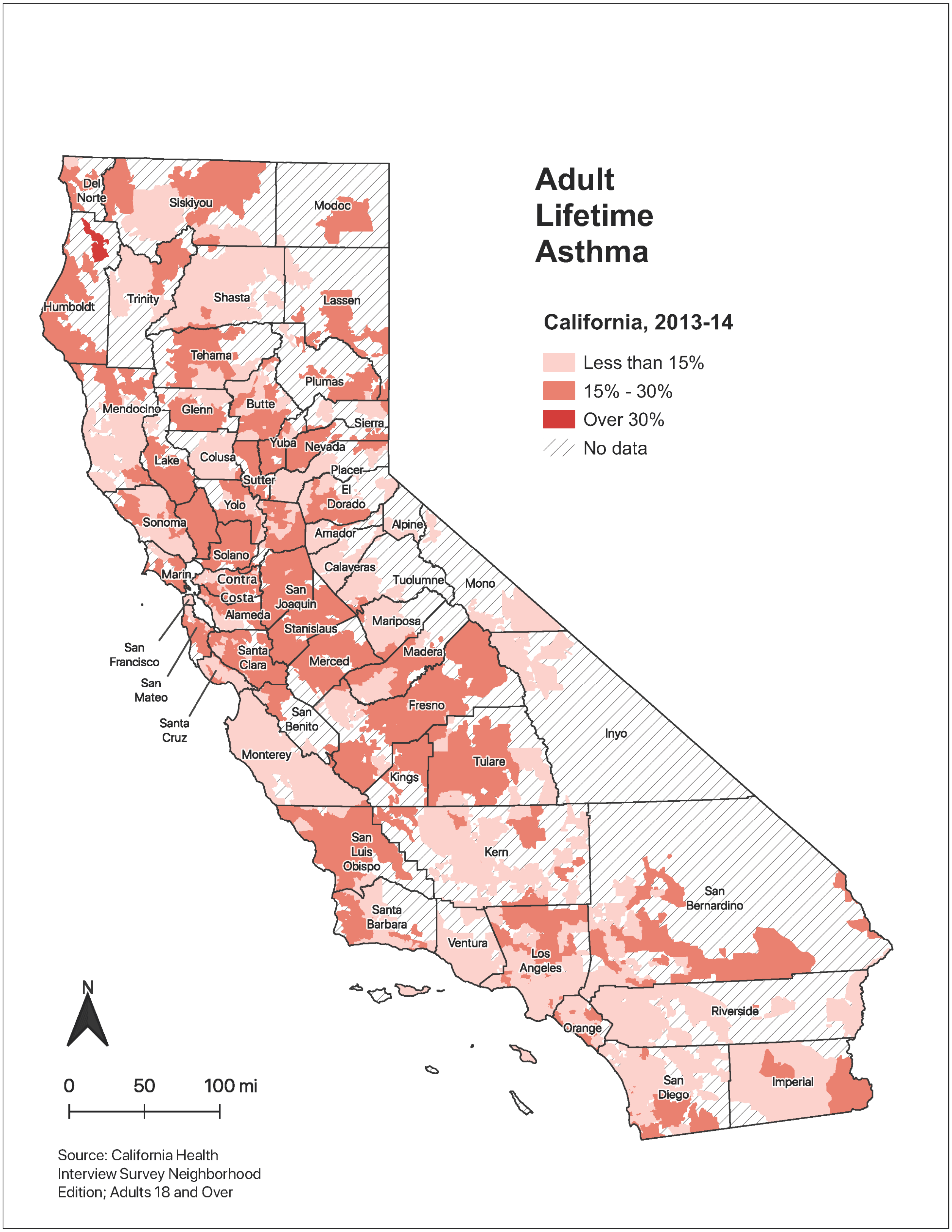
In general, the descriptive findings mirror those from other studies that indicate Latino neighborhoods, like other inner-city neighborhoods of color, experience inequalities in outcomes that lead to greater physical health risks as well as stress and mental health issues. These risks include challenges accessing health care (Becker et al., 2019; Ruiz et al., 2016); significant disparities in income, education, employment, and housing (Ong & González, 2019; Wilson, 1987); and toxic environmental health burdens (Houston et al., 2004; Pastor et al., 2004; Sadd et al., 2011).

Table 1-7: Descriptive Statistics, Neighborhoods with Asthma Data

Characteristics	Neighborhood Type		
	All	Latino	White
Lifetime Asthma Prevalence	14.5%	13.5%	15.0%
Demographic			
Child dependency ratio	0.36	0.52	0.30
Elderly dependency ratio	0.29	0.15	0.49
% Foreign born	21.7%	37.3%	7.5%
Socioeconomic			
Median household income (2017$)	70,909	42,227	74,553
Poverty rate	15.1%	27.5%	11.7%
College degree	31.6%	8.4%	35.3%
Chemical & Built Environment			
Diesel PM kg/day	13.82	14.23	3.68
Ozone ppm/	0.05	0.05	0.05
$PM_{2.5}$ µg/m3	9.60	12.09	7.4
Average extreme heat days	5.5	5.5	5.5
Park desert	0.28	0.56	0.02
Park rich	0.16	0.09	0.45
Accessibility to Neighborhood Resources			
% Households with no vehicle	6.3%	8.1%	3.9%
% Pop with high-quality transit access	19.3%	25.4%	5.1%
Primary care availability ratio	0.013	0.003	0.012
ZCTAs (CA 1,769)	1,458	107	309

AskCHIS 2014 for all ZCTAs with data in at least one outcome of interest. Note: neighborhood types are ZCTAs where share of population of the group is equal to or greater than 75% using ACS 2013–2017.

Map 1-3: Share of Adults with Asthma



Lifetime Asthma Prevalence OLS Regression Results

Similar to the walking analysis, lifetime asthma prevalence rates were modeled using the linear combination of variables related to demographic, health, SEP, environmental, and neighborhood access measures. As with the descriptive analysis, two new measures include diesel PM and primary care availability. Following the conceptual framework for the model-building approach, I first estimated a model only with ethnoracial composition to establish a base relationship (Model 1). Roughly, 8% of the variability at the neighborhood level is explained by the ethnoracial composition of a neighborhood. This finding indicates that neighborhood race plays a smaller role for lifetime asthma than for walking (R-squared = .10; see previous section).

Model 2 is the full model, which includes all predictors of interest, regardless of any issues of collinearity and statistical significance. Model 3 is a parsimonious model that includes only variables that are significant at <0.10 level and do not include variables with VIFs and tolerances over standard thresholds. The VIF and tolerances do not suggest collinearity between any of the independent variables for the parsimonious model as the VIFs were in the range of 1.06 and 2.9, below the standard threshold of 5.0. No tolerance values were under the standard 0.3 level. The regression results presented in Table 1-8 are for three selected models. The factors contained in Model 3 account for approximately 31% of the observed variance in lifetime asthma, a much lower coefficient of determination than Model 3 in the analysis of walking discussed previously (R-squared = 64%) and the analysis of heart disease prevalence discussed in the next section (R-squared = 59%).

The percent Latino variable performed as expected. Neighborhoods with higher percentages of Latinos correlate with lower lifetime asthma prevalence. The relationship is constant across all models, even after controlling for other factors. This association for Latino areas is consistent with another study that documents that asthma prevalence is lowest among Latino adults relative to other ethnic groups (Gorman & Chu, 2009). The prevalence of heart disease is positively associated with lifetime asthma, which speaks to potential chronic disease comorbidity or the greater likely that both are reported.

Table 1-8: Lifetime Asthma OLS Models

	Model 1: Ethnorace		Model 2: Full		Model 3: Parsimonious	
Independent Variables	n = 1,458		n = 1,259		n = 1,260	
Demographic						
% Asian	–0.041	***	–0.035	***	–0.034	***
% Black	–0.021	*	0.003		0.002	
% Latino	–0.011	***	–0.020	**	–0.023	***
% Other	0.103	***	0.098	***	0.094	***
Child dependency ratio			–0.012			
Elderly dependency ratio			–0.018	***	–0.017	***
% Foreign born			0.002			
Other Health Indicators						
% Walking			–0.024		–0.018	
% Heart disease prevalence			0.200	***	0.188	***
Socioeconomic Position						
% Poverty			0.044	***	0.043	***
% College degree			0.002			
Chemical Environmental						
Diesel PM			0.000	***	0.000	***
Ozone ppm			–1.115	***	–1.113	***
$PM_{2.5}$ µg/m3			0.004	***	0.004	***
Average heat days			0.002	***	0.002	***
Built Environment						
Park rich (top quartile)			–0.009	***	–0.009	***
Accessibility to Neighborhood Resources						
% Households with no vehicle			–0.012		–0.012	
% Pop with high-quality transit access			–0.025	***	–0.024	***
Primary care availability			0.032	+	0.033	+
Constant	0.149	***	0.162	***	0.159	***
Adjusted R-Squared	0.075		0.310		0.311	

Probabilities: +p < 0.10; *p < 0.05; **p < 0.01; ***p < 0.001.

As expected, poverty is also a significant predictor of lifetime asthma. All environmental predictors are significant and performed as expected, with the exception of ozone. There is an inverse relationship between asthma and park-rich areas, suggesting that greenspaces such as parks could potentially be a protective mechanism against asthma as vegetation has been found to buffer air pollution by removing ozone, PM, and other contaminants from the air (James, Banay, et al., 2015). Greenspaces also reduce air pollution sources as areas with vegetation are not direct emission sources. Another explanation is that healthier people (e.g. more affluent, those with better health care etc.) are more likely to live by parks. However, the literature documenting this relationship is inconsistent.

Comparison between Latino and White Neighborhoods

The segmented models point to a few major difference between Latino and white neighborhoods. First, there is a positive relationship between heart disease prevalence and asthma in white neighborhoods, a relationship that is not significant for Latinos. The observed relationships for white neighborhoods is expected given that the descriptive statistics show that they tend to house older populations with a higher prevalence of comorbidity (Piccirillo et al., 2008). However, elderly dependency is negatively associated with lifetime asthma for white neighborhoods, which have older populations. The difference in the direction and magnitude of elderly dependency between white and Latino neighborhoods is also worth noting. Another difference worth noting is the positive relationship between heart disease and walking in white neighborhoods that is absent in Latino neighborhoods, as well as the negative association between heart disease and no-vehicle households in Latino neighborhoods that is absent for white neighborhoods. A limitation of these models is the low R-squared for white neighborhoods; the model performs better at predicting asthma prevalence in Latino neighborhoods.

Table 1-9: Lifetime Asthma Segmented OLS, Latino and White Neighborhoods

	Latino		White	
Independent Variables	n = 97		n = 198	
Demographic				
Elderly dependency ratio	0.11059	+	-0.0097	+
Other Health Indicators				
% Walking	0.01515		0.17012	***
% Heart disease prevalence	0.08102		0.19966	*
Socioeconomic Position				
% Poverty	0.01918		0.08267	*
Chemical Environment				
Diesel PM	–0.00108	**	–0.00108	**
Ozone	–0.45994		–1.15358	***
$PM_{2.5}$	0.00398	**	0.00334	**
Average heat days	0.00192		0.00174	*
Built Environment				
% Park rich	–0.01435		–0.00129	
Access to Neighborhood Resources				
% Households with no vehicle	–0.15724	*	0.0236	
% Pop with high-quality transit access	0.01743		–0.02196	
Primary care availability	0.37498		0.0924	
Constant	0.09555	**	0.09494	***
Adjusted R-square	0.3655		0.2259	

Probabilities: +p < 0.10; *p < 0.05; **p < 0.01; ***p < 0.001. Note: neighborhood types are ZCTAs where share of population of the group is equal to or greater than 75% using ACS 2013–2017.

4.4 Neighborhood Heart Disease Prevalence

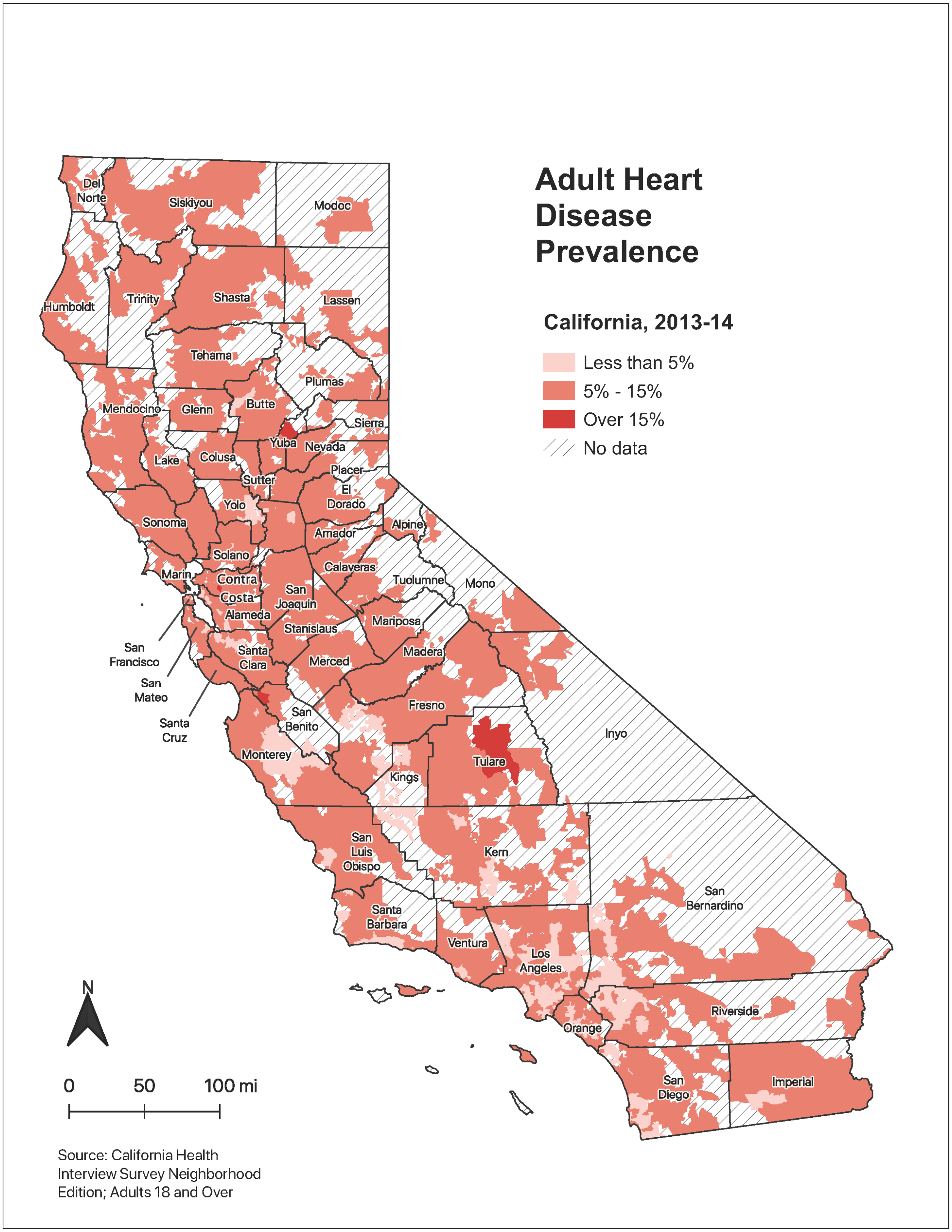
Table 1-10 provides the descriptive statistics for the sample neighborhoods in California with data for heart disease prevalence (n = 1,457 out of the 1,769 ZCTAs partially or completely within California). The average heart disease prevalence rate in supermajority Latino neighborhoods is almost half that of white neighborhoods (5.4% compared to 9.0%, respectively). Most studies show that Latinos, despite increased risk factors and greater socioeconomic disadvantage, are less likely to have heart disease and are less likely to die from heart disease compared to whites (Leigh et al., 2016). The relationships visible in the descriptive statistics for the sample of neighborhoods in this analysis are very similar to those presented in the analysis for walking and asthma in the previous sections. As such, I do not summarize them here. Map 1-4 shows the distribution of heart disease prevalence rates across California. The lightest share represents areas with rates below the state average of 7%. Areas with the least asthma prevalence tend to be concentrated in more urban neighborhoods, while average to higher asthma prevalence can be seen in areas that are more rural.

Table 1-10: Descriptive Statistics, Neighborhoods with Heart Disease Data

Characteristics	**Neighborhood Type**		
	All	**Latino**	**White**
Heart Disease Prevalence Rate	6.8%	5.4%	9.0%
Demographic			
Mean population	26,444	32,524	8,011
Adult population 18 and over	19,544	21,936	6,359
Child dependency ratio	0.36	0.52	0.30
Elderly dependency ratio	0.29	0.14	0.49
% Foreign born	21.8%	37.2%	7.5%
Socioeconomic			
Median household income (2017$)	70,809	42,052	74,553
Poverty rate	15.2%	27.7%	11.7%
College degree	31.6%	8.3%	35.3%
Chemical & Built Environment			
Ozone	0.05	0.05	0.05
$PM_{2.5}$	9.61	12.13	12.13
Average extreme heat days	5.5	5.5	5.5
% Park desert	0.29	0.55	0.02
% Park rich	0.16	0.09	0.45
EPA walkability (1–20)	9.8	9.3	7.2
Accessibility to Neighborhood Resources			
% Households with no vehicle	6.4%	8.1%	3.8%
% Pop with high-quality transit access	19.3%	24.9%	5.1%
Medi-Cal providers to poor population	0.013	0.003	0.012
ZCTAs (CA 1,769)	1,457	107	309

Source: AskCHIS 2014 for all ZCTAs with data. Note: neighborhood types are ZCTAs where share of population of the group is equal to or greater than 75% using ACS 2013–2017.

Map 1-4: Share of Adults with Heart Disease



Heart Disease Prevalence OLS Regression Results

As with other analyses in this part of the dissertation, heart disease prevalence rates were modeled on the linear combination of variables related to demographic, health, SEP, environmental, and neighborhood access measures. Following the conceptual framework for the model-building approach, I first estimate a model only with ethnoracial composition to establish a base relationship (Model 1). As shown in Table 1-11, roughly 34% of the variability at the neighborhood level is explained by the ethnoracial composition of a neighborhood. This indicates that neighborhood ethnorace plays a more prominent role in predicting heart disease than it does walking (R-squared = 10%) or asthma (R-squared = 8%). The percent Latino variable performed as expected given the lower prevalence rates of heart disease documented in the literature compared to white neighborhoods (Leigh et al., 2016).

Model 2 is the full model, which includes all predictors of interest, regardless of any issues of collinearity and statistical significance. Model 3 is a parsimonious model that includes only variables that are significant at <0.10 level and do not include variables with VIFs and tolerances over standard thresholds. The VIFs and tolerances do not suggest collinearity between any of the independent variables for the parsimonious model as the VIFs were in the range of 1.06 and 2.9, below the standard threshold of 5.0. No tolerance values were under the standard 0.3 level. The factors contained in Model 3 account for approximately 59% of the observed variance in heart disease prevalence, a slightly lower coefficient of determination than Model 3 in the analysis of walking (R-squared = 64%) but much stronger than for asthma (R-squared = 31%). There is a negative relationship between heart disease and the share of the Latino population, which remains constant across all models even after controlling for other factors. As with the analytical results for asthma model, the results show a positive relationship between asthma and heart disease, which speaks to potential comorbidity of these chronic diseases. Similarly, there is a positive relationship between the prevalence of heart disease and elderly dependency, poverty, and measures of air pollution.

Table 1-11: Heart Disease Prevalence OLS

	Model 1: Ethnorace		Model 2: Full		Model 3: Parsimonious	
Independent Variables	n =1,457		n=1,259		n =1,260	
Demographic						
% Asian	–0.064	***	–0.010	+	–0.026	***
% Black	–0.066	***	–0.040	***	–0.030	***
% Latino	–0.040	***	–0.035	***	–0.026	***
% Other	–0.007		–0.024	*	–0.010	
Child dependency ratio			0.017	***		
Elderly dependency ratio			0.047	***	0.047	***
Foreign born			–0.020	**		
Other Health Indicators						
% Walking			0.040	***	0.005	
% Asthma			0.064	***	0.063	***
Economic						
% Poverty			0.013	+	0.032	***
% College degree			–0.027	***		
Chemical Environmental						
Diesel PM			0.000	***	0.000	***
Ozone			–0.076		–0.074	
$PM_{2.5}$			0.001	***	0.001	***
Average heat days			0.000	*	0.001	
Built Environment						
% Park rich			0.004	**	0.006	***
Accessibility to Neighborhood Resources						
% Households with no vehicle			0.020	*	–0.009	***
% Pop with high-quality transit access			–0.006	**	–0.002	
Medi-Cal providers per low income			0.007			
Constant	0.090	***	0.045	***	0.046	***
Adjusted R-Squared	0.344		0.607		0.587	

Probabilities: +p < 0.10; *p < 0.05; **p < 0.01; ***p < 0.001.

Comparison between Latino and White Neighborhoods

Table 1- 12 shows the segmented models for Latino and white neighborhoods. The models are more simplified than Model 3, as there were issues with collinearity between the independent variables with VIFs well over 5.0. These variables were removed; however, the full model can be found in Appendix 2. Additional Lifetime Asthma Neighborhood Models. Table 3A-1 includes additional Lifetime Asthma Neighborhood models.

As with the segmented models for asthma, the model for Latino neighborhoods explains more of the observed variation in heart disease prevalence compared to white neighborhoods (52% compared to only 37%, respectively). Interestingly, the elderly dependency ratio is positive for both groups. This finding is consistent with the literature on heart disease and aging. In Latino neighborhoods, there is a positive relationship between the propensity of walking and heart disease rates. In white neighborhoods, there is a positive association between heart disease rates and access to parklands.

Table 1- 12: Heart Disease Prevalence Segmented OLS, Latino and White Neighborhoods

	Neighborhood Type			
	Latino		White	
Independent Variables	n = 97		n = 198	
Demographic				
Elderly dependency ratio	0.094	*	0.031	***
Other Health Indicators				
% Walking	0.162	***	-0.020	
% Asthma	0.072		0.132	*
Socioeconomic Position				
% Poverty	0.035	+	0.008	
Chemical Environmental				
Diesel PM	–0.0005	*	–0.0001	
Ozone	0.217		0.382	+
$PM_{2.5}$	0.001	+	0.001	
Average heat days	0.0006		–0.0008	
Built Environment				
% Park rich	0.001		0.009	**
Accessibility to Neighborhood Resources				
% Pop with high-quality transit access	–0.016	+	–0.023	+
Primary care providers	–0.273		0.041	
Constant	–0.049	**	0.041	*
Adjusted R-Squared	0.525		0.365	

Probabilities: +p < 0.10; *p < 0.05; **p < 0.01; ***p < 0.001. Note: neighborhood types are ZCTAs where share of population of the group is equal to or greater than 75% using ACS 2013–2017.

5. Summary and Discussion

Table 1-13 summarizes the different relationships identified in the analytical results section in this essay. Five main points that can be drawn from the analytical findings. First, neighborhood ethnorace plays a much more prominent role in predicting heart disease (R-squared = 34%) than in predicting walking for leisure and transport (R-squared = 10%) and asthma (R-squared = 8%). Second, the ecological (neighborhood-level) approach is more useful for examining walking (R-squared = 64%) and heart disease (R-squared = 59%) than it is for asthma (R-squared = 31%). These findings are consistent with studies in the public health field showing that individual-level factors may outweigh the neighborhood-level characteristics for asthma and heart disease (Kawachi & Berkman, 2003b). The results also indicate that neighborhood factors may play a more important role in predicting the propensity to walk and prevalence of heart disease than they do for predicting lifetime asthma rates. One limitation is that the data do not include information on the residential history of respondents; thus, I cannot determine the impact of historical exposures on lifetime asthma and heart disease. Third, the analysis suggests that elderly and childcare dependency are important factors. Child dependency is associated with less walking in Latino neighborhoods, whereas elderly dependency is associated with increased asthma and heart disease rates for white neighborhoods.

Table 1-13: Summary of Neighborhood-level Significant Factors

Outcome	**All Adults**		**Latinos**		**Whites**	
	Positive	Negative	Positive	Negative	Positive	Negative
Walking	% Hispanic* College Income Heart disease Bike+ped accidents	% Asian* Child dep Ozone $PM_{2.5}$ Park desert	% Heart disease Walkability HQ Transit	$PM_{2.5}$	HH income % College % Walk work HH no car	Asthma Heat days
Asthma	% Other race % Heart disease % Poverty Diesel PM $PM_{2.5}$ Heat days Primary care	% Black % Latino Elderly dep Ozone Park desert HQ Transit	Elderly dep Ozone	Diesel PM HH no car	%Poverty %Heart disease Ozone %Walk work	Elderly dep Diesel PM Heat days
Heart Disease	Elderly dep %Asthma %Poverty Diesel PM $PM_{2.5}$ Park rich	Asian Black Latino HH no car	Elderly dep %Poverty $PM_{2.5}$ HQ Transit	Diesel PM	Elderly dep %Asthma Park rich Ozone	HQ Transit

*changes direction/sign after controlling for other factors

The last significant finding is related to Latino neighborhoods relative to white neighborhoods. While Latino neighborhoods exhibit greater inequalities in outcomes that lead to greater health risks, including challenges with primary care availability and significant disparities in income and education, these do not necessarily lead to greater prevalence of heart disease and asthma. The exception across the three outcomes of interest is toxic environmental health burdens. This research suggests that the most important dimension that leads to lower walking levels in Latino neighborhoods relates to the built environment. A key driver that deters walking in Latino neighborhoods is limited access to parks; whereas, the diversity of the built environment in Latino neighborhoods is conducive to higher rates of walking.

The findings suggest neighborhood-level interventions should be pursued to promote walking; and individual-level interventions alongside neighborhood policies and programs are need for asthma and heart disease prevention. The findings related to walking also have implications for planning with ethnoracial minorities, ethnic enclaves, and disadvantaged communities. This study documents stark differences between majority Latino and white neighborhoods, which likely translate to other minority groups. Latino neighborhoods, on average, have fewer material resources, are more polluted, and have less access to parks. These findings are not new. In fact, findings such as these have led researchers to argue that spaces with more black and brown people are less conducive to healthy lifestyles. However, this study also indicates that it is not just a compositional effect of who lives in a neighborhood that affects walking but the availability of parks or other forms of greenspace, diversity of neighborhood and resources, and air quality—all of which can be promoted through neighborhood-level interventions. Given the evidence in this and other research which suggests air pollution discourages physical activity, policymakers, planners, and advocates should continue to pursue localized strategies to decrease fine particulate pollutants. These policies will benefit not only ethnoracial minorities but also the population as a whole. Second, given the threshold effect related to park availability, policies to improve access to parks and greenspaces should focus on "park deserts" (the most park-poor areas), since increasing parks in areas that are even moderately "park rich" may not necessarily lead to more neighborhood-level walking.

The research also has policy and planning implications for asthma and heart disease prevention. The low R-squared values for the asthma and heart disease models indicate that neighborhood-level independent variables do not explain much of the variation in outcomes. These findings are consistent with studies in the public health field which show that individual-level factors may outweigh the neighborhood-level characteristics for asthma and heart disease (Kawachi & Berkman, 2003b). Nonetheless, there are significant neighborhood-level process identified in this research that planners, health advocates, and should consider. For instance, primary care access is positively related to lifetime asthma rates, suggesting higher rates may be indicative of more opportunities by health care providers to both diagnose and treat asthma. Further, given the relationship identified in this research between heart disease and air pollution, enacting policies that promote healthy air quality as a means improve cardiovascular health should be pursued in tandem with those related to asthma prevention. As it relates to heart disease, this research indicates that areas with high levels of the disease are more likely to house elderly populations and, as such, policies directed at meeting the needs of this age group should be a priority.

Essay 2: The Role of Individual Determinants in Constructing Health Disparities

Abstract

This study used individual responses from the 2015 and 2016 CHIS to explore the association between individual-level determinants of health and the odds of walking for transport and leisure, having lifetime asthma, or having heart disease. The study also explores the differences and commonalities between Latino and white respondents. Results show that individual ethnorace on its own is a better predictor for the prevalence of asthma than for walking and heart disease; however, race no longer plays a role when controlling for other factors. This relationship is also evident for heart disease, which indicates the complex nature of health and individual risk factors. The findings from this analysis also highlight several important differences between Latino and white adults, as being Latino is an important factor related to heart disease and walking, even after controlling for other factors. While Latinos experience inequalities that pose health risks, these do not necessarily lead to a greater prevalence of heart disease and asthma. Another finding is the relationship between assimilation with a more sedentary lifestyles and greater odds of lifetime asthma. The findings have important implications for urban planning practice and placed-based approaches, as these approaches alone may not be sufficient to addressing disparities between Latinos and whites or improving health.

1. Introduction

I use microlevel data from PUFs of the CHIS to examine the individual factors associated with walking, lifetime asthma, and heart disease in California. I used standard descriptive, bivariate, and individual logistic regression to examine the factors associated with the three health-related outcomes. I utilize the same definition used in the first essay to classify survey responses from adults 18 and older. An adult was coded as having lifetime asthma if they responded yes to the following question, “Has a doctor ever told you that you have asthma?” Likewise, an adult was classified as having heart disease if they gave an affirmative answer to “Has a doctor ever told you that you have any kind of heart disease?” I used a variety of responses to approximate the number of respondents who walked for transportation or leisure for at least 120 minutes in the past week (see Data and Methodology section for more details). This threshold is lower than that used by AskCHIS in the first essay (150 minutes), as I was not able to replicate the same definition due to limited data access.

This essay pays special attention to the differences between Latino and white respondents using fully segmented logit models. This approach aims to address the relative paucity of knowledge in health-related outcomes for the Latino population. For the statistical analyses, I include five types of variables identified in the literature as pertinent to individual health: (1) demographics, including the percent life in the United States as a proxy for assimilation, (2) economic position, (3) presence of chronic diseases, (4) behaviors that may affect health, and (5) perception of neighborhood safety. The following section provides a short description of these dimensions. A more detailed discussion on the empirical measures can be found in the “Data and Methodology” section.

The analyses show that individual ethnorace is a better predictor of the prevalence of asthma than of walking and heart disease, which coincides with some evidence that ethnoracial differences may be attributed to biological differences based on race. Latinos who spend the majority of their lives in the United States have lower odds of walking relative to Latinos who arrived more recently, which suggests assimilation into a more sedentary lifestyle they assimilate away from non-automobile modes of travel (Blumenberg & Shiki, 2007). There is also a positive correlation between assimilation and the odds of lifetime asthma morbidity. As with the ecological analysis in Essay 1, I find that while Latinos experience inequalities that pose health risks, these do not necessarily lead to greater prevalence of heart disease and asthma.

2. Conceptual Approach

Most contemporary epidemiology studies have focused on individual-level behavioral and biological risk, without considering the context that share these risks (Havranek et al., 2015). In general, scholars in public health agree proximal individual and household circumstance have stronger associations with the outcomes of interest than neighborhood characteristics (Kawachi & Berkman, 2003a). This part of the dissertation research takes a traditional approach by examining aspatial individual demographic and socioeconomic characteristics, health, and behaviors associated with the outcomes of interest. This relationship is represented in the bottom left quadrant of Figure I-1 in the generalized research design section of the dissertation. The following section provides a short description of the literature on these dimensions, which guide the theoretical specifications for the statistical approach.

2.1 Individual Demographic Patterns

I divide demographic composition into five types of variables that scholars show to be associated with the outcomes of interest: (1) individual race and ethnicity, which is the primary independent variable of interest, (2) assimilation, (3) age, (4) sex, and (5) household composition. In general, certain demographic characteristics are often associated as having negative impact on health. As discussed in Essay 1, ethnoracial variations are documented for the outcomes of interest. As it relates to walking, the evidence in the public health literature is mixed in regard to race and ethnicity, as oftentimes there is no distinction made between leisurely walking and walking for transport, or only leisurely walking is measured as part of the broader physical activity literature (Babey et al., 2018; Paul et al., 2015). For instance, there is considerable evidence that people of racial and ethnic minority groups have more sedentary lifestyles compared to their white counterparts, with Latinos being more inactive than other racial groups (Marshall et al., 2007).

The evidence in transportation studies is clearer as far as walking for commuting. Latinos, particularly immigrants, are likely to walk more in part because of their residential and employment patterns (Contrino & McGuckin, 2009), make greater use of public transit (Blumenberg & Shiki, 2007; Myers, 2001), and concentrate in inner-city enclaves that are said to promote walking (Rojas, 2012). The evidence on the intersection between individual ethnorace and asthma is even more varied (Anandan et al., 2010); however, there is some indication that asthma prevalence is lower among Latinos than adults of other races (Gorman & Chu, 2009). The evidence on cardiovascular disease is also not clear cut, with some evidence suggesting Latinos are amongst the most adversely affected with high rates of prevalence, morbidity, and mortality (Mensah et al., 2005; Sharma et al., 2004). Other studies suggest this group is as likely to have heart disease but less likely to die from heart disease compared to whites. This finding has been coined “the Hispanic or Latino Paradox” (Leigh et al., 2016). Given the analytical results in Essay 1 of the dissertation, I anticipate the probability of walking to be higher amongst Latinos relative to whites. I also expected to see the opposite pattern for lifetime asthma and heart disease.

The literature on Latino health often references acculturation and assimilation as a determinant of health status and health care usage along with the broader literature that shows immigrants are in better health when they arrive to the United States compared to their American counterparts, but this health advantage diminishes over time (Cunningham et al., 2008; Franzini et al., 2001). Scholars assume that the erosion of the "healthy immigrant effect" is related to the processes of acculturation and assimilation. Cultural behaviors of an immigrant group may change over time because of interaction with the mainstream culture, a process referred to as acculturation. Further, as groups assimilate or acquire the basic habits, attitudes, language, diet, and American lifestyle they may also lose any traditional health-enhancing habits or behaviors, further diminishing the immigrant health advantage. A competing theory is that assimilation is positively correlated with both better and worse health because there are many, and possibly divergent, pathways for immigrant health as a result of assimilation into different social strata (Akresh, 2007; Akresh et al., 2016), or segmented assimilation (Portes & Zhou, 1993), a topic discussed more in depth in Essay 3. A proxy for acculturation often found in the literature is English language ability. Proxies for assimilation include the length of time in the United States as well as naturalization (Franzini et al., 2001). I speculate that higher levels of acculturation and assimilation are positively correlated with worse health and lower levels of walking amongst Latinos relative to whites.

I also incorporated control variables for age in the analytical approach, as older Americans are more likely to suffer from acute illnesses, chronic diseases, and degenerative illnesses conditions as a result of aging (National Centers for Chronic Disease Prevention and Health Promotion, 2019b). For instance, diseases of the heart and circulatory vessels are prevalent amongst older adults, as well as comorbidity with other conditions that affect the ability to function well, including physical capabilities. These include arthritis, asthma, chronic respiratory disease, heart disease, and high blood pressure (National Centers for Chronic Disease Prevention and Health Promotion, 2019a).

Gender and household composition could also have a negative relationship to the outcomes of interest. For instance, while Latinas are the fastest-growing female population group in the United States, they also report the lowest physical activity levels due to impediments such as a lack of childcare as a result of traditional gender household roles (see the review by Larsen et al., 2013). With respect to asthma, there are differences in prevalence and severity between males and females but these are also stratified by age. For instance, lifetime asthma prevalence in the United States is higher in boys until the age of 14 and in girls 15 or older due to sex hormones; it is confounded by internal and external factors, including aging, obesity, and differences in behavior and exposures (Zein & Erzurum, 2015). As it relates to heart disease, several studies document gender disparities in the incidence of heart disease as well as interactions with SEP. For instance, women are overrepresented among those living in poverty but women with ischemic heart disease are more likely to be uninsured and to have higher drug costs and hospitalization rates (Schultz et al., 2018).

2.2 Socioeconomic Position

I divided socioeconomic composition into two types of variables that scholars show to be associated with the outcomes of interest: poverty and educational attainment. A challenge with including such variables is simultaneity, a term used in econometrics to describe instances when the value of one independent variable is dependent on the value of another predictor variable (Avery, 2005). In epidemiology, simultaneity is referred to as "reverse causality." In urban economics, health status is more important than economic position or "the healthy become wealthy and get better jobs while the unhealthy become poorer and unemployed," whereas epidemiologists argue that economic position has a greater influence, that is “improving income and education leads to improved health” (Gunasekara et al., 2008, p. 861).

Although the mechanisms through which SEP influence health outcomes are not well understood, it is generally accepted among scholars that lower SEP may lead to differences in access to health-promoting to resources, behaviors, stress, and lifestyles that allow individuals to better respond to adverse health conditions (McNeill et al., 2006). An example are people with greater disposable incomes who can obtain resources, such as membership to recreational facilities, that help them be physically active during hot weather (McNeill et al., 2006). A second theory suggests that low SEP, such as poverty, reduces access to health care resources, which in turn results in poor health. As a consequence, those in poorer health are then less likely to be physically active than those in better health (McNeill et al., 2006).

In the United States, there are documented disparities in the prevalence of asthma by SES (Moorman et al., 2012). The majority of epidemiologic evidence suggests that asthma prevalence is positively associated with lower economic status; however, as in other countries, in the United States the association is not universal (Anandan et al., 2010; Wright & Fisher, 2003). The variation in findings may be due in part to the heterogeneity in methodologies used to study asthma, as previously discussed in Essay 1. Within the context of the determinants of cardiovascular health, the most well-documented determinants are those related to SEP (Galobardes et al., 2006; Havranek et al., 2015; Kaplan & Keil, 1993; Mensah et al., 2005). According to the review by Schultz et al., (2018) on SES and cardiovascular outcomes, four markers for SES are association with cardiovascular disease in high-income countries such as the United States: income level, educational attainment, employment status, and environmental factors as a result of residential location. The WISE study (Women’s Ischemic Syndrome

Evaluation study) showed income had a far greater impact than any other SES measure, including education, marital status, and employment status, as well as race (Shaw et al., 2008). Further, risk factors associated with heart disease are more common among Americans with low SES, particularly among non-Latino blacks (Sharma et al., 2004).

2.3 Comorbidity, Behaviors, and Medical Care Access

There is an increasing realization among public health scholars that research needs to address a new norm: individuals with multiple coexisting diseases, which are often but not always related (Starfield, 2006). As such, I included measures related to obesity and disability status. For instance, less physical inactivity is associated with increased risk for heart disease, diabetes, obesity, high blood pressure, premature death, and some types of cancer (Office of the Surgeon General, 2015). Including these control variables is challenging since they raise issues of simultaneity or reverse causality as the relationship works the other way as well as those with those ailments are less likely to be physically active.

I also considered controls for current smoking, as the literature documents smoking and secondhand smoke as risk factors for chronic pulmonary diseases and increased asthma symptoms (Follenweider & Lambertino, 2013). Smoking is also a risk factor for heart disease. In fact, the Centers for Disease Control and Prevention considers smoking as a major causal factor of cardiovascular disease, which is responsible for one of every four deaths from cardiovascular disease (Centers for Disease Control and Prevention, 2020). Disability, which is defined as difficulty or dependency in carrying out activities essential to independent living, includes physical disabilities that may also affect the outcomes of interest. For example, disability may weaken muscles and decrease exercise and walking tolerance (Fried et al., 2004). Finally, I also incorporated health insurance coverage as a predictor of health outcomes. In 2008, Freeman et al.

published a review of more than 9,700 empirical studies estimating the relationship between health insurance, health care utilization, and health outcomes. The authors conclude that health insurance consistently increases utilization and improves health, the use of physician services, preventive services, and self-reported health status (Freeman et al., 2008).

2.4 Perception of Neighborhood Safety

The final dimension guiding the specifications for the statistical approach is an individual's perception of neighborhood safety. As it relates to walking, perception of safety may inhibit physical activities, which could ultimately affect health conditions. However, the evidence on the impact of safety is unclear. For instance, a study using the confidential data from the 2003 CHIS finds that safety is not an important determinant of walking for leisure and transport (Wen et al., 2007). However, a new systematic review of the literature finds that perceived individual safety *is* positively associated with overall walking and walking for transport among disadvantaged groups (Hilland et al., 2020).

3. Data and Methodology

3.1 Primary Data

The research dataset for this study data was constructed from the 2015 and 2016 CHIS PUFs for adult respondents only. The PUFs files contain records of individual self-responses to questions related to health status, health conditions, health-related behaviors, health care access, health insurance information, and demographic and socioeconomic descriptors (UCLA Center for Health Policy Research, 2020b). As such, the unit of analysis for this part of the dissertation research is adults 18 and over with valid responses to questions related to the outcomes of interest (walking, lifetime asthma, and heart disease) and responses to variables of interest related to demographics, SEP, health and health-related behaviors, and perception of neighborhood safety.

A key limitation of the PUFs data is that these do not contain geographic identifiers and many of the variables are suppressed or recoded as categorical to minimize the risk of indirect identification and data confidentiality. This sensitive information is only accessible through the confidential data available through the DAC, for which there is a cost to access. There are no costs to access single-year PUFs; as such, I use these data to inform the analysis in Essay 3 that draws on the confidential data. This creates a challenge in comparing model results between the two essays as the construction of a variable can influence the final results. For instance, a categorical age variable may show a different relationship than a continuous age variable. For this analysis, I pooled 2015 and 2016 adult files for two reasons. I opted to use newer data in anticipation of the 2015–2016 AskCHIS release that would allow me to update the analysis in Essay 1 for academic publication. At the time of data collection, the most recent estimates for AskCHIS were for 2013–2014. Second, the smaller sample size of the one-year data requires pooling datasets to create a bigger sample, particularly for racial and ethnic groups and for sparse events such as emergency room visits or even the prevalence of the outcomes of interest. The following discusses my methodology for constructing the outcomes of interest more in depth. In addition, Table 2-1 summarizes the independent variables and their construction.

Table 2-1: Individual Characteristics

Variable	Variable Code
Walked 120 min or more	Number of times walked for least 10 minutes is the sum of variables (AD38W2 + AD41W2) =>7; assumes round trip
Lifetime asthma prevalence	AB17 = 1 (yes)
Heart disease prevalence	AB52 = 1 (yes)
Ethnorace	OMBSRR_P1; Latino of any race
Majority life in the U.S.	PCTLF_P=>4 (61% or more)
Limited English proficiency	SPK_ENG=3, those who speak another language, those who indicate speaking English not well or not at all
Obese	RBMI=>4, which represents a body mass index >29.99
Disability	AD50 = 1 (blind or deaf, or have a severe vision or hearing problem) or AL22 = 1 (receiving social security disability insurance)
Smoker	SMKCUR = 1 (current smoker)
Neighborhood safety	AK28 = 1 (How often feel safe in neighborhood? All the time.)

3.2 Outcomes of Interest

The independent variables of interest are dichotomous variables (1, 0). Asthma and heart disease morbidity were determined directly from survey responses, whereas the amount of walking was approximated using multiple variables. To construct the measure for walking, I first identified respondents who responded yes to the following question: "During the past 7 days, did you walk for at least 10 minutes to go to some place?" I then determined the number of times a respondent walked using the following question: "In the past 7 days, how many times did you do that?" I assumed each trip taken was a roundtrip, or 20 minutes total, and classified those who walked for at least six times as walking for 120 minutes. This threshold is lower than the one used by AskCHIS in the first essay (150 minutes), as I was not able to replicate the same definition, due to limited documentation on how the AskCHIS data was created. I used other thresholds and variables to construct estimates that mirror published statewide estimates on the AskCHIS website for 2015–2016 (38.9%, with a 95% confidence interval of 37.6%–40.3%); however, the selected approach produced the closest estimates (42% with a confidence interval between 40.7%–43.2%).

3.3 Other Control Variables

Table 2-1 includes descriptions of the control variables. The following section details two measures that require explanation. The first is the race and ethnicity designation using variable OMBSRR_P1. These ethnorace variables follow the Office of Management and Budget (OMB)–revised guidelines (1997) and the census modification of the guidelines, and combine ethnicity (Hispanic/Latino identification) with OMB race categories (UCLA Center for Health Policy Research, 2020b). As such, Latino respondents may be of any race as the assignment is independent of the values of the race variables. Non-Latino respondents are assigned a race value as such and blacks represent non-Hispanic African Americans only, as do Asians and whites. All others are captured in the "other" category.

A second measure worth noting is the "majority life in the U.S." variable. This measure draws from "PCTLF_P," a recode of the continuous construct variable PCTLF available only in the confidential files, which is used in Essay 3. This variable is a categorical measure of the percentage of the adult respondent's life spent in the United States (UCLA Center for Health Policy Research, 2020b). I recoded respondents in the fourth (61%–80%) and fifth (80% or more) categories to identify adults that have lived a majority of their life in the United States as a proxy for assimilation.

3.3 Statistical Approach

I use basic descriptive statistics to provide details on the factors associated with the outcomes of interest (walking, lifetime asthma, and heat disease), focusing on differences between all adult respondents, Latino, and white respondents. I then use fully segmented logistical (logit) multivariate models to assess the relationship between the primary outcomes of interest and individual-level characteristics for all adults, Latino, and white respondents. The outcomes (walking, lifetime asthma, cardiovascular disease) are defined as the dependent variable Y_i in the following functional form where the outcome is dichotomous or categorical:

$$\frac{\text{Probability (Outcome } Y_i\text{)} = \exp(\beta X_i + \varepsilon_i)}{1 + \exp(\beta X_i + \varepsilon_i)}$$

$$\text{for } Y \subset (1,0)$$

Exp is the exponential function, X is the vector of independent variables, β is a vector of coefficients, and ε is a stochastic term. Maximum likelihood will be used to estimate the parameters.

I use the Proc SurveyReg procedure in SAS, as suggested in the PUFs documentation, weighting the descriptive and logistic regression analyses to reflect the population of California. This procedure allows for a series of 160 replicate weight variables to account for the complex design of the CHIS, the pooling of two years of data, and appropriate weighting of the pooled year responses. As suggested in the documentation, I use the jackknife method to compute estimates for the standard errors.

I present three sets of models. The first set includes Model 1 with only ethnorace and the second includes all predictors of interest (Model 2), regardless of any issues of collinearity and statistical significance. To examine whether and how much individual race and ethnicity matter, the full model includes ethnorace regardless of its significance. The final set of models that I present are segmented models for Latinos and whites (Model 3 and Model 4, respectively). These segmented models include only variables that are significant at the <0.10 level in the full model. I also replace or exclude variables with a VIF over 5.0 in these segmented models, a common threshold used to identify a problem with linear collinearity between predictor variables (see review by Kock & Lynn, 2012). It is difficult to estimate how well the ethnorace models predict outcomes of interest as there is no equivalent to the R-squared for multiple logistic regression. I include Max-rescaled pseudo R-squared; however, CHIS staff noted that other researchers do not typically request pseudo R-squares to measure how well a regression model fits the CHIS data set. Odds ratios (OR) were calculated using those who do not walk at least 120 minutes as the reference group. A number less than 1.00 indicates that those meeting the threshold are less likely to be affected by the factor being analyzed than the reference group. An OR of greater than 1.00 shows that those that meet the threshold are more likely to be affected by the factor being analyzed than the reference group. An OR of 1.00 would indicate no difference between the two groups.

4. Analytical Results

This section first presents the estimated individual rates for the outcomes of interest and is followed by separate discussions for the regression analyses for each outcome. Table 2-2 shows the estimated share of California adults who walked for at least 120 minutes for leisure and travel, as well as the share of those with lifetime asthma and heart disease prevalence rates. A slightly higher share of the Latino adults (43.4%) walked for at least 120 minutes for leisure and travel relative to all adults (42.0%) and white adults (39.9%). The differences between Latinos and whites are statistically significant ($p<.0001$).

Table 2-2: Estimated Individual-Level Rates

Outcome of Interest	All Adults	Latino	White
Walked at least 120 minutes	42.0%	43.4%	39.9%
Lifetime asthma prevalence	14.9%	12.8%	16.4%
Heart disease prevalence	6.4%	4.3%	8.8%

Source: California Health Interview Survey 2015 and 2016 pooled estimates of the proportion of adult respondents (18 and over).

Lifetime asthma rates are lower among Latinos (12.8%) relative to whites (16.4%) and the general population (14.9%). The differences between Latinos and whites are statistically significant ($p<.0001$). Likewise, heart disease is lower for Latinos (4.3%) compared to the average Californian (6.4%) and half that of whites (8.8%). The differences between Latinos and whites are statistically significant ($p<.0001$).

4.1 Individuals Walking for Leisure and Travel

Table 2-3 show the descriptive statistics for the sample of adults used for the regression analysis. The descriptive statistics mirror other studies that show Latinos experience inequalities usually associated with greater health risks, including lower levels of leisurely walking, disparities in educational attainment, and poverty rates despite higher levels of employment, limited English proficiency, disability, and obesity. However, Latinos also have lower rates of asthma, heart disease, and smoking relative to whites. These patterns are consistent with the Latino health paradox, "a pattern of morbidity and/or mortality for a particular group (e.g., Latinos, immigrants) that is at odds with what would be expected given its socioeconomic profile" (Acevedo-Garcia & Bates, 2008, p. 103). The table also shows that the majority of Latinos (56%) are immigrants and that a large proportion (about 40%) of respondents have not lived in the United States for more than 60% of their lives. This high share of Latino immigrants may explain the lower levels of heart disease and asthma because the counter theory to the paradox is that Latino immigrants are healthier than their nonimmigrant co-nationals due to self-selection (Acevedo-Garcia & Bates, 2008).

Additional differences worth noting are related to migration patterns, and the age and household structure of Latino relative to white adults. A majority of Latinos are foreign-born have not lived a majority of their life in the United States. A larger share of Latinos is under 35 years of age and a smaller share is over age 65, pointing to a younger population. A much larger percentage of Latino families has children under the age of 18, compared to whites and the general population, indicating greater child dependency. Finally, a larger share of Latinos (17.4%) felt that their neighborhood was not safe all or most of the time.

Table 2-3: Descriptive Statistics, Adults Walking 120 min+

		All Adults	Latino	White
Walking				
	Walked 120 min+	42.0%	43.4%	39.9%
	Walked for transportation 120 min+	37.7%	36.5%	36.4%
	Walked for leisure 120 min+	41.1%	35.5%	47.7%
Demographic				
	Asian	15.2%		
	Black	5.2%		
	Latino	36.5%		
	White	39.8%		
	Other	3.2%		
	Majority life in the U.S.	75.4%	59.6%	94.4%
	Foreign born	34.0%	55.6%	9.4%
	Noncitizen	18.8%	38.5%	3.2%
	Limited English proficiency	17.1%	39.4%	0.4%
	Under 35 years	35.1%	39.4%	27.3%
	Age 65+	16.2%	10.2%	22.6%
	Female	48.4%	48.3%	48.1%
	Family with children	28.2%	37.5%	21.2%
Socioeconomic Position				
	Bachelor’s degree or higher	38.6%	16.2%	53.2%
	Employed	66.4%	67.8%	64.9%
	Poverty	19.1%	31.3%	8.8%
Health				
	Asthma	14.3%	12.5%	15.5%
	Heart disease	5.5%	3.9%	7.3%
	Smoker	13.2%	12.2%	13.9%
	Obese	27.9%	37.0%	23.4%
	Overweight	59.7%	72.3%	53.6%
	Disability	10.4%	11.8%	9.1%
Built Environment				
	Neighborhood not safe	13.6%	17.4%	8.2%
n (valid)		16,893	4,362	9,108

Source: California Health Interview Survey 2015–2016 pooled years. Adults 18 years and older; estimated modeled proportion of adult respondents (18 and over) who walked at least 6 times for 10 minutes, roundtrip (~120 minutes) for leisure or travel.

Logit Regression Results for Walking

Following the conceptual framework for the model-building approach, I first used logistical regression to estimate a model only with ethnorace for individual respondents (Model 1) to establish a base relationship with the dichotomous variable walking (1 = walked 120 min+). I then modeled walking along with a combination of variables related to demographics, health, SEP, and perception of neighborhood safety. To examine how and by how much individual race and ethnicity matter, the latter model includes ethnorace regardless of its significance. I also include a fixed effect to control for the survey year.

Table 2-4 shows the results of four selected models, which include the coefficients, the adjusted odds ratios (as these control for other variables in the model), and the significance levels. Model 1 shows that being Latino has a positive effect on the odds of walking, even after controlling for other factors. For instance, the predicted odds of walking are about 16% higher when an adult is Latino compared to the odds when the adult is white. The results also show a negative association for black adults, which no longer holds after controlling for other factors. The model suggests ethnorace plays a unique role for Latinos relative to other minority groups.

Model 2 shows that being female, being elderly, and having children are negatively associated with walking; however, these seem to play a more important role for whites (Model 4) than for Latinos (Model 3). Living the majority of one's life in the United States also is negatively associated with walking for all adults in the sample. I expected the latter as the health literature notes that immigrants assimilate or acculturate into "bad" habits of American life, including lifestyles that are more sedentary. The transportation literature also shows that over time, immigrants are more likely to have cars and assimilate away from non-automobile modes of travel, a process referred to as "transportation assimilation" (Blumenberg & Shiki, 2007). The effect of assimilation is also evident in the segmented models for Latinos; the predicted odds of walking are lower when a Latino adult has lived a majority of their life in the United States compared to the odds when they have not. The effect on obesity is consistent across all three models. It is important to note that very few variables are significant for Latinos and being a new immigrant is the most important predictor for walking for this group.

The full model (Model 3) also points to an interesting relationship between SEP and walking. Being poor and having a college education is positively related to the likelihood of walking for at least 120 minutes per week. However, poverty is not a significant factor in the segmented model for whites, while it is for Latinos. Further, the benefits of walking are seen in relation to the health variables. For instance, there is a negative association between walking, obesity, and heart disease morbidity.

Table 2-4: Segmented Logit Model, Latino and White Adults Walking 120 min+

	Model 1: Ethnorace			Model 2: All Adults			Model 3: Latinos			Model 4: Whites		
Independent Variables	Est	OR	Sig.	Est.	OR	Sig.	Est.	OR	Sig.	Est.	OR	Sig.
Demographic												
Asian	0.207	1.23		0.055	1.056							
Black	–0.044	0.957	*	–0.030	0.970							
Latino	0.144	1.155	***	0.118	1.126	+						
Other	0.273	1.313	*	0.284	1.328	*						
Female				–0.185	0.831	**	–0.159	0.853		–0.159	0.853	*
Age 65+				–0.134	0.874	*	–0.015	0.985		–0.223	0.800	**
Family with children				–0.162	0.850	**	–0.059	0.943		–0.276	0.759	**
Majority life in the U.S.				–0.224	0.800	**	–0.238	0.788	*	–0.170	0.843	
Socioeconomic Position												
Poverty				0.155	1.168	*	0.217	1.242	*	0.066	1.068	
Bachelor’s or higher				0.144	1.155	*	0.063	1.065		0.287	1.332	***
Health												
Asthma				–0.015	0.985		0.003	1.003		–0.034	0.967	
Heart disease				–0.202	0.817	*	–0.212	0.809		–0.200	0.819	+
Obese				–0.306	0.736	***	–0.197	0.821	*	–0.466	0.627	***
Smoker				0.093	1.098		0.086	1.090		0.137	1.147	
Disability				–0.076	0.927		0.025	1.026		–0.205	0.815	*
Built Environment												
Neighborhood not safe				0.092	1.096		0.052	1.054		0.224	1.251	
Year												
In 2016				–0.051	0.951		–0.144	0.866	+	0.010	1.010	
Constant	–0.410			–0.015	0.000		0.045	0.000		–0.090	0.000	
Pseudo R-Square	0.003			0.020			0.016			0.033		
n (valid)	42,089			42,089			10,285			23,697		

Source: California Health Interview Survey 2015–2016 pooled years. Adults 18 years and older; estimated modeled proportion of adult respondents (18 and over) who walked at least six times for 10 minutes, roundtrip (~120 minutes) for leisure or travel.
Probabilities: +p < 0.10; *p < 0.05; **p < 0.01; ***p < 0.001.

4.2 Asthma Prevalence amongst Individuals

The descriptive statistics for the sample of individuals in this analysis are very similar to those presented in the analysis for walking in the previous section. As such, I do not present the ethnoracial breakdown for these but instead show descriptive statistics for all respondents and those with asthma in Table 2-5. Lifetime asthmatics in California are more likely to be white (46%), be female (56%), have spent the majority of their life in the Unites States (89%), and be able to manage their asthma. These patterns are visible for both Latinos and whites.

Disparities between whites and Latinos are related to SEP and medical care. For instance, only 23% of Latinos with asthma have at least a four-year college degree compared to 43% for whites. Amongst Latinos with asthma, 26% are in poverty compared to only 11% of the white population. However, the poverty rate for Latinos with asthma is lower than for the Latino population as a whole (29%, not shown). Whereas the poverty rate for whites with asthma is higher than for the white population as a whole (9%, not shown). In terms of medical care, a lower share of Latinos is able to manage their disease, more are uninsured, and a slightly higher proportion visited the emergency room due to their asthma because they did not have a doctor. Further, the share of all Latinos that are uninsured is almost twice that on those Latinos ever diagnosed with asthma (17.5% compared to 9.6%, respectively) whereas for whites the rates are similar (4.8% with asthma compared to 4.1% with no asthma). These differences may indicate that either Latinos are underreporting insurance coverage or Latinos lag in coverage access.

Table 2-5: Descriptive Statistics, Adults with Lifetime Asthma

		With Lifetime Asthma		
	All Adults	**Adults**	**Latino**	**White**
Lifetime Asthma Prevalence	14.9%	100%	100%	100%
Demographic				
Asian	14.2%	11.9%		
Black	5.6%	7.7%		
Latino	35.3%	30.4%		
White	41.9%	45.9%		
Other	2.9%	4.1%		
Female	51.1%	56.2%	53.9%	57.3%
Age 65 +	17.6%	16.8%	10.0%	22.9%
Family with children	29.2%	26.8%	31.4%	24.1%
Majority life in the U.S.	78.0%	88.8%	79.1%	97.1%
Socioeconomic Position				
Poverty	17.8%	17.6%	26.2%	11.4%
Bachelor's degree or higher	37.3%	37.1%	23.2%	43.2%
Health				
Walks 120 min+	42.0%	40.2%	42.2%	37.7%
Heart disease	6.4%	10.2%	9.0%	11.3%
Obese	27.9%	34.5%	41.6%	31.5%
Smoker	12.4%	14.3%	11.1%	14.4%
Disability	11.0%	15.4%	16.7%	14.4%
High blood pressure	28.6%	34.4%	31.8%	35.4%
Medical Care				
Able to manage asthma	11.7%	78.5%	71.4%	83.8%
ER asthma visit	1.0%	6.8%	8.2%	4.6%
ER asthma visit, no doctor	0.7%	4.4%	5.9%	2.8%
Uninsured	9.6%	6.0%	9.6%	4.1%
Delay in transportation	0.3%	0.6%	0.2%	0.4%
Built Environment				
Neighborhood not safe	12.9%	14.3%	17.2%	9.5%
n (valid)	42,089	6,652	1,463	3,880

Source: California Health Interview Survey 2015–2016 pooled years. Adults 18 years and older; modeled proportion of adult respondents (18 and over) who were ever diagnosed with heart disease by a doctor.

Logit Regression Results for Individuals with Lifetime Asthma

Following the conceptual framework for the model-building approach, I first estimate a model only with ethnorace for individual respondents to establish a base relationship with the dichotomous variable lifetime asthma (1 = yes), which is presented in Model 1. As with other analyses, I then modeled the odds of having lifetime asthma along a combination of predictors related to demographics, health, SEP, and perception of neighborhood safety, which are shown in Model 2. I did not include most of the medical care–related variables discussed in the descriptive statistics, as the sample sizes for these were small. To examine how and by how much individual race and ethnicity matter, Model 2 includes ethnorace regardless of its significance. I also include a fixed effect to control for the survey year, as there were differences in reported rates for the outcomes between the two years of data pooled for this analysis.

Table 2-6 shows the results for four selected models, which include the coefficients; the adjusted odds ratios, as these control for other variables in the model; and the significance levels. While the pseudo R-squares are usually not comparable across models, the ethnorace model shows that individual race and ethnicity is a better predictor for lifetime asthma than it is for walking but less so than for heart disease, as discussed in the next section. Overall, the ethnorace model shows a negative association for all groups relative to whites (See Model 1). For instance, the predicted odds of lifetime asthma are about 25% lower when an adult is Latino, compared to when the adult is white. However, the relationship between race and walking is no longer statistically significant after accounting for other demographic, socioeconomic, and health factors.

The full model shows a positive association between lifetime asthma and being female, majority life in the United States, heart disease, obesity, and disability (See Model 2). However, being female is not related to the likelihood of having asthma for Latinos. Walking also is not significantly related to asthma but heart disease, obesity, and disability are positive and statistically significant across all models. There is a negative association between those over age 65 across all models. For Latinos, the odds of having lifetime asthma are negatively associated with being uninsured, which may indicate that either Latinos are underreporting insurance coverage or Latinos lag in coverage access. Another plausible explanation is related to the survey sample for 2016, as the fixed effect for the sample year is negative and statistically significant for Latinos.

Table 2-6: Segmented Logit Model for Adults with Lifetime Asthma

	Model 1: Ethnorace			Model 2: All			Model 3: Latino			Model 4: White		
Independent Variables												
Demographic	Est.	OR	Sig	Est.	OR	Sig	Est.	OR	Sig	Est.	OR	Sig
Asian	–0.313	0.731	*	0.020	1.020							
Black	0.270	1.310	*	0.184	1.202							
Latino	–0.284	0.753	***	–0.088	0.916							
Other	0.321	1.379	*	0.226	1.254							
Female				0.286	1.331	***	0.203	1.225		0.341	1.407	***
Age 65 +				–0.299	0.742	***	–0.399	0.671	*	–0.251	0.778	*
Family with children				–0.074	0.928		–0.224	0.799		0.090	1.094	
Majority life in the U.S.				0.840	2.317	***	0.788	2.198	***	0.463	1.589	
Economic												
Poverty				0.050	1.051		0.065	1.067		0.134	1.143	
Bachelor's or higher				0.024	1.024		0.441	1.554	*	–0.151	0.860	
Health												
Walked 120+ min				–0.009	0.991		0.007	1.007		–0.033	0.968	
Heart disease				0.608	1.836	***	0.986	2.680	***	0.364	1.439	**
Obese				0.347	1.414	***	0.263	1.300	+	0.436	1.546	***
Smoker				0.133	1.142		–0.014	0.986		0.061	1.063	
Disability				0.349	1.417	***	0.378	1.459	*	0.282	1.326	*
Uninsured				–0.381	0.683	*	–0.516	0.597	**	–0.200	0.819	
Built Environment												
Neighborhood not safe				0.112	1.119		0.055	1.056		0.152	1.164	
Year												
In 2016				–0.101	0.904		–0.288	0.750	*	–0.045	0.956	
Constant	–1.631			–2.673	0.000	***	–2.572	0.000	***	–2.322	0.000	***
Pseudo R-Square^	0.008			0.050			0.071			0.031		
n (valid)	42,089			42,089			10,285			23,697		

Probabilities: +p < 0.10; *p < 0.05; **p < 0.01; ***p < 0.001. ^See caveat in text.

Source: California Health Interview Survey 2015–2016 pooled years. Adults 18 years and older; modeled proportion of adult respondents (18 and over) who were ever diagnosed with heart disease by a doctor.

4.3 Heart Disease Prevalence Logit Models

The descriptive statistics for the sample of individuals in this analysis are very similar to those presented in the analysis for walking in the previous section. As such, I do not present the ethnoracial breakdown for these but instead in Table 2-7 I show descriptive statistics for all respondents and for those who had ever been diagnosed by a doctor with heart disease. Respondents with heart disease are twice as likely to be white (58%) compared to Latinos (24%), are male (54.5%), and have spent the majority of their life in the United States (83%) but less than half are able to manage their heart disease (42%). These patterns are visible for Latinos and whites as well.

Disparities between whites and Latinos are related to poverty and medical care. For instance, amongst Latinos with heart disease, 38% are in poverty compared to only 11.5% of the white population. Only 10.4% of Latinos with asthma have at least a four-year college degree, compared to 40% for whites. In terms of medical care, a lower share of Latinos is able to manage their disease, a much larger proportion are uninsured, and a slightly higher proportion have visited the emergency room due to their heart disease, and twice as many because they did not have a doctor. The latter is expected as emergency room care plays a vital role in the care for the uninsured.

Logit Regression Results for Individuals with Heart Disease

Following the conceptual framework for the model-building approach, I first estimated a model only with ethnorace for individual respondents to establish a base relationship with the dichotomous variable heart disease (1 = yes). I then regressed heart disease with a combination of variables related to demographic, health, SEP, and perception of neighborhood safety. I did not include most of the medical care–related variables discussed in the descriptive statistics, as the sample sizes for these are small. To examine how and how much race and ethnicity matter, the latter model included ethnorace regardless of the significance. I also incorporated a fixed effect to control for the survey year.

Table 2-8 shows the results for four selected models; the coefficients; the adjusted odds ratios, as these control for other variables in the model; and the significance levels. While the pseudo R-squares are not directly comparable across models, they do give a rough indication that individual race and ethnicity are better predictors for heart disease than they are for asthma and walking. Overall, the ethnorace model shows a negative association for all groups relative to whites. For instance, the predicted odds of heart disease are about 54% lower when an adult is Latino compared to when the adult is white, even after accounting for other demographic, socioeconomic, and health factors.

The full model shows a negative association between heart disease and being female, having a family with children, and a lack of insurance coverage. Education and walking are marginally significant negative predictors. Age 65 and over is positive and significant across models, as is poverty status, asthma, and disability status.

Table 2-7: Descriptive Statistics, Adults with Heart Disease

		With Heart Disease		
	All Sample	All	Latino	White
Heart Disease Prevalence	6.4%	100%	100%	100%
Demographic				
Asian	14.2%	10.4%		
Black	5.6%	5.1%		
Latino	35.3%	23.7%		
White	41.9%	57.5%		
Other	2.9%	3.3%		
Female	51.1%	45.5%	48.7%	44.0%
Age 65 +	17.6%	54.7%	40.0%	63.7%
Family with children	29.2%	11.2%	24.0%	5.8%
Majority life in the U.S.	78.0%	82.7%	62.2%	97.2%
Socioeconomic Position				
Poverty	17.8%	20.7%	37.8%	11.5%
Bachelor's or higher	37.3%	33.1%	10.4%	40.3%
Health				
Walks	17.8%	36.0%	38.9%	33.1%
Asthma	14.9%	23.8%	26.7%	21.0%
Obese	17.8%	32.8%	43.8%	30.3%
Smoker	37.3%	11.0%	8.6%	11.0%
Disability	17.8%	28.1%	34.7%	25.9%
High blood pressure	37.3%	67.4%	72.4%	63.7%
Medical Care				
Able to manage heart disease	2.7%	42.2%	34.5%	47.6%
ER heart disease visit	1.2%	18.9%	19.4%	17.4%
ER heart disease visit, no doctor	0.53%	8.3%	12.3%	6.0%
Uninsured	9.6%	3.5%	9.0%	1.4%
Delay in transportation	0.30%	0.4%	0.4%	0.4%
Built Environment				
Neighborhood not safe	12.9%	13.6%	16.6%	9.0%
n (valid)	42,089	4,587	662	3,158

Source: California Health Interview Survey 2015–2016 pooled years. Adults 18 years and older; modeled proportion of adult respondents (18 and over) who were ever diagnosed with heart disease by a doctor.

Table 2-8: Segmented Logit Model, Heart Disease

	Model 1: Ethnorace			Model 2: All			Model 3: Latino			Model 4: White		
Independent Variables												
Demographic	Est	OR	Sig	Est.	OR	Sig	Est.	OR	Sig	Est.	OR	Sig
Asian	–0.674	0.510	***	–0.449	0.638	*						
Black	–0.455	0.635	*	–0.493	0.611	*						
Hispanic	–0.763	0.466	***	–0.590	0.554	***						
Other	–0.193	0.825	***	–0.092	0.912							
Female				–0.388	0.678	***	–0.214	0.807		–0.469	0.625	***
Age 65 +				1.697	5.458	***	1.710	5.529	***	1.714	5.549	***
Family with children				–0.477	0.621	**	–0.127	0.880		–0.812	0.444	***
% Life in the U.S.				–0.150	0.861		–0.119	0.888		0.136	1.145	
Economic												
Poverty				0.414	1.513	**	0.411	1.508	*	0.447	1.563	*
Bachelor's or higher				–0.164	0.849	+	–0.276	0.759		–0.188	0.828	+
Health												
Wall 120 min+				–0.179	0.836	+	–0.194	0.824		–0.191	0.826	
Asthma				0.623	1.864	***	0.985	2.677	***	0.383	1.467	**
Obese				0.281	1.324	**	0.252	1.286		0.283	1.327	*
Smoker				–0.113	0.893		–0.234	0.792		–0.092	0.912	
Disability				0.935	2.548	***	1.111	3.038	***	0.858	2.359	***
Uninsured				–0.560	0.571	*	–0.345	0.708		–0.789	0.454	+
Built Environment												
Neighborhood not safe				0.244	1.276		0.037	1.038		0.313	1.368	
Year												
In 2016				–0.058	0.944		0.013	1.013		–0.093	0.911	
Constant	–2.339		***	–2.848	0.000	***	–3.733	0.000	***	–2.979	0.000	***
Pseudo R-Square^	0.019			0.186			0.158			0.194		
n (valid)	42,089			42,089			10,285			23,697		

Source: California Health Interview Survey 2015–2016 pooled years. Adults 18 years and older; modeled proportion of adult respondents (18 and over) who were ever diagnosed with heart disease by a doctor.
Probabilities: +p < 0.10; *p < 0.05; **p < 0.01; ***p < 0.001. ^See caveat in text.

5. Summary and Discussion

Table 2-9 provides a summary of the different relationships identified in the analytical results section in this essay. Four general findings emerged from the empirical results. First, while it may seem that an individual's ethnorace plays a more important role in predicting the odds of lifetime relative to walking heart disease (based on the pseudo R-squared in Model 1); the influence of ethnorace is explained away by other demographic variables, SEP, and health-related behaviors. This signals a complex relationship between race and other factors that future research should explore. For instance, being Latino is an important factor related to heart disease and walking, even after controlling for other factors, but not for asthma.

Table 2-9: Summary of Significant Individual-Level Factors

Outcome	All Adults		Latinos		Whites	
	Positive	Negative	Positive	Negative	Positive	Negative
Walking	Latino Other Poverty College	Black~ Female Age 65+ Fam w/child Life US	Poverty	Life US Ozone In 2016 survey	Elderly dep	Female Age 65+ Fam w/child Obese Disability Heart disease
Asthma	Other~ Female Life US Heart disease Obese Disability	Asian~ Latino~ Age 65+	Life US College Heart disease Obese Disability	Family w/child Uninsured In 2016 survey	Heart disease Obese Disability	In 2016 survey
Heart Disease	Age 65+ Fam w/child Poverty Asthma Obese Disability	Asian Black Hispanic Female College Walk 120min Uninsured	Poverty Asthma Disability	Family w/child	Age 65+ Poverty Asthma Obese Disability	Female Fam w/child College

~changes to non-significant after controlling for other factors

The second finding is that similar patterns emerge across all models for lifetime asthma and heart disease, which suggest these outcomes are related. For instance, age and disability are important predictors of morbidity for both outcomes. The findings are in line with studies that note older Americans are more likely to suffer from acute illnesses, chronic diseases, and degenerative illnesses conditions as result of aging (National Centers for Chronic Disease Prevention and Health Promotion, 2019b). Other research also shows that cardiovascular diseases also cause substantial morbidity and disability (United States Institute of Medicine, 2010). Asthma is also a predictor for heart disease and, vice versa, heart disease is a predictor for asthma.

A third key finding is the role of assimilation. Latinos who spend the majority of their lives in the United States have decreased odds of walking, which suggests assimilation into a more sedentary lifestyle and car culture. An area for further research is the observed positive correlation between assimilation and lifetime asthma, as these findings mirror other research that shows that the erosion of the "healthy immigrant effect" is related to acculturation and assimilation into the American mode of life (Cunningham et al., 2008; Franzini et al., 2001), or simply increased diagnoses or prevalence as the population ages while living in the United States. Overall, the analytical results are similar to those in Essay 1—while Latinos experience greater socioeconomic inequalities associated with greater health risks, they have lower odds of being diagnosed with heart disease and lifetime asthma. These findings may be indicative of the Latino health paradox, or the result of underreporting due to the high-uninsured rate in the Latino population. Future research should explore the differences and commonalities between Latinos and other racial minorities.

Finally, the individual-level framework as a whole seems to be more useful for predicting heart disease and asthma than the neighborhood-level approach presented in Essay 1, which coincides with the general agreement amongst health scholars that neighborhood-effects are of secondary importance compared to more proximal individual and household-level effects. This finding has important implications for urban planning practice for two reasons. To start, many policies and programs to promote health are many times place-based, focused on improving the built environment for a specific area. For instance, the Transformative Climate Communities is a multimillion-dollar effort launched by the state of California in 2017 to promote greenhouse gas reduction in disadvantaged communities as a way to create health and economic co-benefits. While there are theoretical grounds for place-based initiatives, planners and policy makers should consider how interventions change neighborhood characteristics that contribute to individual risk factors such those identified by this research: disability, poverty, and comorbidity with asthma and other diseases. Second, these place-based efforts should focus on improving the built environment while addressing issues rooted in persistent structural inequalities, such as concentrated poverty.

Essay 3: Racialized Neighborhoods and Spatialized Disparities

Abstract

This study used confidential microdata from the CHIS connected to neighborhood of residence to examine the influence of factors beyond individual characteristics to predict the odds of lifetime asthma and heart disease, and walking for at least 120 minutes per week. The study used multilevel logistical regression models to explore individual- and neighborhood-level associations, as well as the differences and commonalities between Latino and white adults. Results show that ethnorace seems to be a stronger predictor for heart disease, individual-level factors outweigh neighborhood level predictors, and coethnic living and assimilation also play an important role among Latinos. The findings from this essay confirm that neighborhood effects carry less weight relative to individual and household level factors. This is particularly true for heart disease and asthma. The findings have implications for place-based interventions as these alone may not lead to anticipated health benefits if they do not consider how to simultaneously incorporate programs and activities that address individual risk factors.

1. Introduction

This part of the dissertation links confidential microlevel data from the CHIS to a rich neighborhood-level (census-tract data) database to examine the factors beyond individual characteristics that are associated with walking, lifetime asthma, and heart disease among the adult population. I use standard descriptive and multilevel logistic regressions to examine the differences and commonalities between the three health-related outcomes. I pay particular attention to the disparities between Latinos and whites. This approach aims to address the relative paucity of knowledge in health-related outcomes for the Latino population and to suggest possible points of planning intervention.

For the statistical analyses, I break down the conceptual approach into the themes identified in the literature as pertinent at both the individual level and neighborhood level. These themes are discussed in more detail in Essay 1 and Essay 2 of the dissertation. At the individual level, they encompass (1) demographics characteristics, including assimilation, (2) SEP, (3) comorbidity with other chronic diseases, (4) behaviors that may affect health, and (5) perception of neighborhood safety. Neighborhood contextual characteristics include (1) ethnoracial composition, (2) SEP, (3) the chemical environment, (4) the built environment, and (5) broad measures of access to health-enhancing neighborhood resources. A short description of these dimensions can be found in Essay 1 and Essay 2. A more detailed discussion of the empirical measures not discussed in the first two essays can be found in the "Data and Methodology" section of the dissertation.

The primary independent variable of interest is ethnorace, both at the individual level as well as the neighborhood level. I also give special attention to differences between Latino and white respondents. I find ethnorace to be a stronger predictor for heart disease relative to the other outcomes, individual-level factors outweigh the neighborhood-level predictors, and coethnic living and assimilation also influence outcomes among Latinos.

2. Conceptual Framework

Scholars increasing recognize that the etiology (causal explanations) of health problems are a complex interplay among individual, family, and community factors. Further, a vast, multifaceted, and growing social science and public health literature elevates the role of urban space in health promotion and generation of health disparities. This ecological perspective is applied to inform the empirical analysis in this chapter to examine the factors beyond individual characteristics that are associated with walking, lifetime asthma, and heart disease among

Californians. This relationship is represented in Figure I-1 in the “Generalized Research Design” section of the dissertation, which proposes that health-related disparities are the product of a multitude of causal factors at multiple levels—that is, individual-level characteristics as well as socially constructed spatial factors tied to the place of residence.

The proposed conceptual approach is in line with efforts by public health researchers and practitioners to move toward a holistic approach to improve health. A holistic approach encompasses traditional research to examine causal mechanisms at the individual level and policies and interventions geared at changing individual behavior, as well as the sensitivity of health to the social environment. This has led to the development of the globally adopted social determinants of health (SDOH) (Wilkinson & Marmot, 2003). SDOH are typically organized around the following topics to capture the influence of the built environment on lifetime health: social gradients or hierarchies, stress, early life, social exclusion, work, unemployment, social support, food, and transport (Wilkinson & Marmot, 2003). In 2005, the World Health Organization created the Commission on Social Determinants of Health to translate public health knowledge into political action to improve the health of the world’s most vulnerable populations (Marmot, 2005). The commission defines SDOH broadly as the “circumstances in which people are born, grow, live, work, and age, and the systems in put in place to deal with illness” (Marmot, et al., 2008, p. 1661). This definition assumes that health, illness, and the resources to prevent illness and its effects “are not randomly distributed but instead cluster at the intersection of social, economic, environmental, and interpersonal forces” (Havranek et al., 2015, p. 874). However, scholars of cardiovascular disease, asthma, and physical activity (including walking) weigh various parts of the frameworks differently depending on the causal mechanism.

As it relates to the epidemiology of asthma, this multilevel approach is consistent with the recommendations by researchers such as Wright and Fisher (2003), who note that "Traditionally asthma epistemology has focused largely on individual and family risk factors, with far less attention given to broader social contexts. A multilevel approach that includes an ecological perspective might help understand heterogeneities in asthma across socioeconomic and geographic boundaries that today remain largely unexplained" (pg. 11). In fact, the literature on asthma often explicitly considers a broader suite of factors embedded within the larger context of people's lives that coincide with SDOH framework. Similarly, a growing literature on cardiovascular disease has adopted a multilevel framework as empirical research has documented the role of neighborhood content. For instance, studies show an inverse relationship between heart disease and markers of SEP such as education, poverty, and income both at the individual (Mensah et al., 2005) and the neighborhood level (Kershaw et al., 2015). This ecological and multilevel perspective also can be illustrated through the "healthy immigrant effect" and the processes of acculturation and assimilation discussed in Essay 1.

3. Data and Methodology

3.1 Primary Data

The primary dataset for this part of the dissertation research was constructed from the 2015 and 2016 CHIS confidential files for adult respondents. These confidential files include detailed geographic identifiers and sensitive information such as gender identity and citizenship status. Unlike the PUFs and AskCHIS data, these confidential files are only accessible physically at the UCLA Center for Health Policy Research DAC or by working directly through an assigned statistician at the DAC that runs the analyses and provides the outputs at a cost. This posed a challenge with using the confidential data, as I was not provided direct access to the data to run exploratory statistical analyses. The costs and length of time it takes to receive outputs and make additional requests (including approval for additional variables) also limited the number of possible exploratory analyses.

As with the dataset used in Essay 2, for this part of the dissertation, I pooled 2015 and 2016 adult files. I used different years in anticipation of the 2015–2016 AskCHIS release that will allow me to update the analysis in Essay 1 and to create a larger sample by ethnorace and for sparse events, such as emergency room visits or even the prevalence of the outcomes of interest. I do not discuss the methodology to construct the outcomes of interest or control variables more in depth as this is detailed in Essay 2 in Table 2-1. The only independent variable that is different from that used in Essay 2 is the "percent of life a respondent has spent in the United States." The PUFs data used in Essay 2 is a categorical variable whereas the variable in the confidential file is continuous, ranging from 1 to 100% with a mean of 87%.

3.2 Unit of Analysis

Many of the neighborhood-level indicators used in this part of the dissertation research are also used in Essay 1. A key distinction between the dataset in Essay 1 and this essay is the geographical unit of analysis. Most of the contextual indicators used for the ecological analysis in Essay 1 were developed at the census-tract level and spatially allocated to the ZCTA using area-weighted crosswalk from Geocorr2014 (Missouri Census Data Center, 2019). A key limitation of this approach is that the allocation assumes these measures are equally distributed across a much larger geographical area (ZCTA) than originally intended. As such, for this part of the dissertation, I opted to change the unit of analysis to the census-tract level, which is a commonly used proxy for neighborhoods in social science research. The Bureau of the Census defines "census tract" as a "relatively homogenous area with respect to population characteristics, economic status and living conditions" (U.S. Census Bureau, 2002). The average population of a census tract is 4,000 people, ranging from 2,500 to 8,000, and approximately 1,500 housing units. In California, there are 8,058 tracts; however, it is unclear how many tracts have CHIS observations. Due to privacy and confidentiality concerns, the UCLA Center for Health Policy Research staff could not release this information.

3.2 Neighborhood Contextual Data

This part of the dissertation utilizes similar neighborhood contextual measures used in Essay 1 but some measures are more refined, both in how they were constructed and in their geographical resolution. This includes shifting from a larger ZCTA to the smaller census-tract level, and for some indicators, creating a buffer around census tracts to capture spillover effects, as detailed further in the following text. Information on the chemical environment (ozone and PM) came directly from CES, as the count of extreme heat days came from Cal-Adapt. These indicators were not modified to capture spillover effects. These indicators are at the census-tract level. See Essay 1 for more details.

The built environment measures are also the same as those from Essay 1 and include the U.S. EPA's National Walkability Index available at the block level, which was allocated to the tract using an area-weighted crosswalk from Geocorr2014 (Missouri Census Data Center, 2019). The parkland access measure is from the California Department of Parks and Recreation, as modified by Ong et al. (2020) to address instances where parkland may be close to the edge of a particular tract. As with Essay 1, collision measures were derived using the SWITRS from 2011 to 2015. However, this indicator is different in that the latitude and longitude of all collisions (regardless of type) were allocated to the census tract and normalized by a weighted street length.

Using all collisions allows for a larger sample size. Creating the indicator required several steps, including creating a 200-foot floating buffer to allocate collisions to tracts. The buffer size was selected after assessing the location of collisions and widths of major streets. The street-length measure is the sum of street lengths in a buffered tract weighted by the number of lanes in the buffered tract. The street lengths and number of lanes were derived in ArcGIS using the 2016 ESRI Streets line layer (Streets File Geodatabase Feature Class), which includes streets, highways, roads, ramps, and ferries. This dataset was developed by Ong et al. (2020).

The neighborhood access measures were also derived from a variety of sources. I used the 2013–2017 ACS at the census-tract level to estimate the share of the population that commute to work by walking and the share of households that do not own a vehicle. The high-quality transit location (HQTL) measure is directly from the Sustainable Communities Strategies Statewide Monitoring System from the UCLA CNK (Ong et al., 2018). The measure was constructed at the census block group level, which I then area weighted to the census tract using Geocorr2014 (Missouri Census Data Center, 2019). The measure is a proxy for transit access and represents the proportion of the population in a census tract within a quarter of a mile of any rail and bus with <15-minute headway during the morning commute.

As with Essay 1, the first data source for the primary care availability measure is the CHHS "Profile of Enrolled Medi-Cal Fee-for-Service (FFS) Providers" from April 2019 (California Health and Human Services Agency, 2020). Unlike for Essay 1, which uses provider ZIP Codes for spatial allocation, provider addresses were geocoded to the census tract. Providers were also allocated by Ong et al. (2020) to a 250-feet buffer around each census tract to account for physician offices that may be located on a street bordering two or more census tracts. The counts of providers within each census-tract buffer area were then summarized to get a total number of providers in each tract buffer area. The points were then aggregated to the census-tract buffer area in which they were located. The data were then normalized by the number of low-income individuals in the tract using data from the 2014–2018 five-year ACS. For this particular indicator, "low-income" is defined as the number of individuals with income at or below 149% of the federal poverty level. In California, adults are eligible for Medi-Cal coverage if their income level is at or below 138% of the federal poverty level. In the ACS, the reported poverty bracket that is closest to 138% is 149%.

Finally, I used one new indicator related to transportation resources also developed by Ong et al. (2020) to examine the relationship between clean transportation resources and health-related outcomes for the CARB. These data were not available when the analysis for Essay 1 was completed. This indicator is the number of "clunker" vehicles as a share of all vehicles registered with the California Department of Motor Vehicles fleet database provided in 2017. A clunker is defined as a vehicle that is more than 20 years old based on the model year, a cutoff that was selected with input from the CARB. Data were provided at the block group level and summarized into census tracts. This measure is used only in the lifetime asthma models. Data only include vehicles registered to an individual, eliminating vehicles owned by corporations like car rental companies. Older cars that are unable to pass emissions tests represent only 10 to 15% of all vehicles in California, but are responsible for more than half of the smog generated by passenger vehicles (Wheeler, Morris, & Gordon, 2014). Many of the households that own these older cars are low income and located in car-dependent areas. As such, this measure is a proxy for poor transportation resources. Further, a cluster of gross polluting clunker vehicles could negatively affect air pollution and respiratory diseases such as asthma at the neighborhood level and through the infiltration from tailpipes at the individual level.

3.2 Statistical Approach

The statistical approach builds on the approach presented in Essay 2. I use multilevel logistical (logit) regressions to assess the relationship between individual- and household-level characteristics and neighborhood-level characteristics on the outcomes of interest. The first part of the analysis uses basic descriptive statistics to describe the differences between all adult respondents, and Latino and white respondents. I then use fully segmented models to assess the differences and commonalities between Latino and white respondents. Outcomes (walking, lifetime asthma, cardiovascular disease) are defined as the dependent variable Y_i in the following functional form, where the outcome is dichotomous or categorical:

$$\frac{\text{Probability (Outcome } Y_i\text{)} = \exp(\beta X_i + \varepsilon_i)}{1 + \exp(\beta X_i + \varepsilon_i)}$$

$$\text{for } Y \subset (1,0)$$

Exp is the exponential function, X is the vector of independent variables, β is a vector of coefficients, and ε is a stochastic term. Maximum likelihood will be used to estimate the parameters. I use the Proc SurveyReg procedure in SAS, as suggested in the confidential data documentation, to weigh the descriptive and logistic regression analyses to reflect the population of California. This procedure allows for a series of 160 replicate weight variables to account for the complex design of the California Health Interview, the pooling of two years of data, and appropriate weighting of the pooled year responses. As suggested in the documentation, I use the jackknife method to compute estimates for the standard errors.

4. Analytical Results

4. 1 Walking Multilevel Results

I present two sets of logit models. The first set is presented in Table 3-1 and includes four models, one with only ethnoracial predictors; another with all predictors of interest regardless of any issues of collinearity with other predictors and statistical significance; and segmented models for Latinos and whites for only variables that are significant at <0.05 level, a more conservative significance than the <0.10 level used in Essay 2. Unlike the approach in Essay 2, I do not exclude variables that may be collinear, as I did not have direct access to the confidential files for additional testing and to keep the data access cost within available resources. As a result, I build on lessons learned in Essay 2 to address these issues and include a second set of models in Table 3- 2 with fewer and slightly modified predictors. As in Essay 2, odds ratios (OR) were calculated using those that do not walk at least 120 minutes as the reference group.

The ethnorace model in Table 3-1 shows a positive relationship with walking at the individual level and a marginally negative relationship at the neighborhood level. At the individual level, being female and over the age of 65 are negatively associated with the odds of walking for 120 or more minutes per week. Similarly, with the odds walking decreases as the share of life spent in the United States increases. Further, individual-level poverty is positively related to walking. The relationship between poverty and walking is not unexpected as other studies demonstrate that low-income individuals are more likely to walk because they are less likely to have cars (Blumenberg, Brown, et al., 2018). At the neighborhood level, the share of the population with at least a four-year college degree and without a vehicle predict walking. The segmented model for Latinos shows there are more individual-level factors that are significant than neighborhood-level predictors. Age and obesity play different roles between whites and Latinos, as does neighborhood-level educational attainment.

The models in Table 3- 2 include fewer and slightly modified predictors. For instance, poverty is replaced with household income. Across models, obesity is a negative predictor for walking. A similar pattern emerges for Latinos—fewer neighborhood-level factors seem to play a role in predicting walking. Another interesting finding is the sign of the coefficient for percent white, a measure of coethnic living in the segmented model for white individuals. While coethnic living does not predict walking for Latino adults, coethnic living is a significant predictor for white individuals.

Table 3-1: Full Multilevel Logit Models Segmented by Ethnorace, Adults Walking 120 min+

	Model 1: Ethnorace			Model 2: All (n= 41,429)			Model 3: Latino (n=10,209)			Model 4: White (n=23,200)		
Individual	Est.	OR	Sig.	Est.	OR	Sig.	Est.	OR	Sig.	Est.	OR	Sig.
Asian	0.206	1.229	*									
Black	–0.016	0.984										
Latino	0.201	1.222	**									
Other	0.290	1.337	*									
Female				–0.194	0.823	***	–0.160	0.852	+	–0.152	0.859	+
Number of children				–0.038	0.963		–0.047	0.954		–0.076	0.927	
Age 65+				–0.122	0.885	*	–0.012	0.988		–0.198	0.821	**
% Life in the U.S.				–0.004	0.996	**	–0.003	0.997	*	–0.001	0.999	
Poor				0.151	1.162	*	0.212	1.236	*	0.124	1.132	
College				0.033	1.034		0.014	1.014		0.146	1.157	+
Asthma				–0.001	0.999		0.007	1.007		–0.031	0.970	
Heart disease				–0.187	0.829	+	–0.215	0.806		–0.183	0.832	
Obese				–0.274	0.760		–0.180	0.836	*	–0.411	0.663	
Not safe				0.069	1.072		0.054	1.055		0.211	1.235	
In 2016				–0.053	0.948		–0.133	0.876		–0.001	0.999	
Neighborhood												
% Asian	0.024	1.025		–0.214	0.808		–0.030	0.971		–0.368	0.692	
% Black	0.056	1.057		–0.084	0.920		–0.013	0.987		–0.081	0.923	
% Latino	–0.238	0.788	+	0.297	1.346		0.311	1.364				
% White										–0.098	0.906	
% Other	–0.900	0.407		–0.517	0.596		–0.488	0.614		–0.517	0.596	
Child dependency				–0.005	0.995	+	–0.008	0.992		–0.005	0.995	
Elderly dependency				0.000	1.000		–0.002	0.998		0.000	1.000	
% Poverty				0.301	1.352		–0.052	0.949		0.920	2.508	+
% College				0.702	2.018	**	0.283	1.327		1.270	3.561	***
% No vehicle				0.001	1.001	*	0.000	1.000		0.001	1.001	+
Avg heat days				–0.008	0.992		–0.002	0.998		–0.008	0.992	
$PM_{2.5}$				–0.022	0.978	+	–0.010	0.990		–0.024	0.976	
Park desert				0.071	1.073		0.126	1.134		–0.041	0.960	
Crashes				–0.017	0.984		–0.002	0.998		0.036	1.037	
EPA walkability				–0.005	0.995		0.002	1.002		–0.022	0.978	+
% Pop HQTL				0.198	1.219	+	0.049	1.050		0.209	1.232	
% Walked to work				0.908	2.480		2.097	8.141		–0.162	0.850	
Constant				0.278	0.000		0.269	0.000		0.005	0.000	
Pseudo r-squared	0.007											

Source: CHIS 2015–2016 pooled years. Probabilities: +p < 0.10; *p < 0.05; **p < 0.01; ***p < 0.001. Due to a data request transmission request error, pseudo R-squares were not produced for all models.

Table 3- 2: Alternate Logit Models Segmented by Ethnorace, Adults Walking 120 min+

	Model 1: All			Model 2: Latino			Model 3: White		
Independent Variables									
Individual	Est.	OR		Est.	OR		Est.	OR	
Female	–0.135	0.874	**	–0.029	0.971		–0.153	0.858	+
Number of kids	–0.039	0.962		–0.043	0.958		–0.076	0.927	
Age 65 +	–0.135	0.874	**	–0.029	0.971		–0.208	0.812	**
% Life in the U.S.	–0.004	0.996	**	–0.003	0.997	*	–0.002	0.998	
Less than high school	0.062	1.064		0.043	1.044		0.028	1.029	
Asthma	0.002	1.002		0.016	1.016		–0.033	0.967	
Heart disease	–0.185	0.831	+	–0.193	0.824		–0.191	0.827	
Obesity	–0.283	0.754	***	–0.178	0.837	*	–0.436	0.647	***
Neighborhood									
% Asian	–0.254	0.776		–0.044	0.957		0.312	1.366	
% Black	–0.261	0.770		–0.140	0.869		0.416	1.515	
% Latinx/Hispanic	–0.054	0.948		0.149	1.161				
% White							0.567	1.763	*
% Other	–0.671	0.511		–0.556	0.573		–0.315	0.730	
Med HH Income	0.000	1.000	*	0.000	1.000	+	0.000	1.000	+
Med HH Income (log)	–0.219	0.804		–0.444	0.642		–0.365	0.695	
$PM_{2.5}$	–0.021	0.979	+	–0.011	0.989		–0.022	0.978	
Avg extreme heat days	–0.011	0.989		0.000	1.000		–0.019	0.981	
All crashes	0.009	1.009		0.032	1.033		0.074	1.077	
Park desert	0.063	1.065		0.115	1.122		–0.035	0.965	
EPA walkability	0.000	1.000		0.006	1.006		–0.013	0.987	
% Pop HQTL	0.277	1.320	*	0.125	1.133		0.362	1.436	*
% Walk to work	0.001	1.001	*	0.000	1.000		0.001	1.001	+
Year									
In 2016	–0.053	0.948		–0.137	0.872		0.002	1.002	
Constant	2.456			4.246			3.497	0.000	
Pseudo R-Squared	0.033			0.025			0.045		
n (valid)	41,815			10,246			23,511		

Source: CHIS 2015–2016 pooled years. Adults 18 years and older; estimated modeled proportion of adult respondents (18 and over) who walked at least six times for 10 minutes, roundtrip (~120 minutes) for leisure or travel.
Probabilities: +p < 0.10; *p < 0.05; **p < 0.01; ***p < 0.001.

4.2 Lifetime Asthma Morbidity

I present two set of models to predict lifetime asthma morbidity. As shown in Table 3-3, the first model includes only ethnoracial predictors both at the individual and neighborhood levels. Model 2 includes other individual predictors and Model 3 and Model 4 are for Latinos and Whites, respectively. The second set of models in Table 3-4 following the approach in the previous analyses and presents a model with all predictors of interest regardless of any issues of collinearity with other predictors and statistical significance (Model 1); and segmented models for Latinos and whites (Model 3 and 4, respectively). The segmented models include variables that are significant at <0.05 level in the full model, a more conservative measure than the <0.10 level used in Essay 2. I did not address issues of collinearity given the limited access to the data and the cost and length of time associated for an additional modeling request.

The ethnorace model in Table 3-3 shows that being Latino or Asian is negatively associated with the odds of lifetime asthma morbidity, whereas the association is positive for black adults relative to whites. For instance, the predicted odds of lifetime asthma morbidity are about 18% lower when an adult is Latino compared to the odds when the adult is white. At the neighborhood level, only the share of the Asian population is a significant predictor but it is explained away when controlling for other individual factors. For the full model in Table 3-3, there are many significant individual-level predictors but only neighborhood coliving is significant. For both Latino and white asthmatics, coethnic living is a negative predictor of lifetime asthma. The minimal influence of neighborhood characteristics is also apparent in the various models presented in Table 3-4.

Table 3-3: Multilevel Models Segmented by Ethnorace, Adults with Lifetime Asthma

	Model 1: Ethnorace			Model 2 Full: All Adults			Model 3: Latino			Model 4: White		
	Est.	OR	Sig	Est	OR	Sig	Est	OR.	Sig	Est	OR.	Sig
Individual												
Asian	–0.389	0.678	***	0.216	1.24							
Black	0.2963	1.345	***	0.175	1.191							
Hispanic	–0.158	0.854	***	0.059	1.061							
White												
Other	0.3824	1.466	***	0.238	1.268							
Female				0.287	1.332	***	0.230	1.259	+	0.347	1.415	***
Age 65+				–0.347	0.707	***	–0.428	0.652	**	–0.321	0.725	**
% Life in the U.S.				0.017	1.017	***	0.017	1.017	***	0.009	1.009	*
Heart disease				0.623	1.864	***	1.009	2.742	***	0.380	1.463	**
Obese				0.312	1.365	***	0.196	1.216		0.417	1.517	***
High blood pressure				0.263	1.3	**	0.347	1.415	*	0.187	1.205	+
Uninsured				–0.319	0.727	+	–0.431	0.650	*	–0.177	0.838	
Neighborhood												
% Asian	–0.26	0.771	*	–0.295	0.744		–0.642	0.526		–0.295	0.744	
% Black	0.2429	1.275		0.272	1.312		–0.137	0.872		–0.044	0.957	
% Latino	0.0445	1.045		–0.093	0.911		–0.893	0.410	**			
% White										–0.424	0.655	+
% Other	1.6788	5.359		1.786	5.968	+	0.285	1.329		2.180	8.848	+
Constant		–1.697	***		–3.499	***		–2.805	***		–2.639	***
Pseudo R-squared	0.009											
n (valid)					42,084			10,285			23,693	

Source: California Health Interview Survey 2015–2016 pooled years. Adults 18 years and older; modeled proportion of adult respondents (18 and over) who were ever diagnosed with heart disease by a doctor. Due to a data request transmission request error, pseudo R-squares were not produced for all models. Probabilities: +p < 0.10; *p < 0.05; **p < 0.01; ***p < 0.001.

Table 3-4: Full Multilevel Models, Adults with Lifetime Asthma

	Model 1: All Adults			Model 2: Latinos			Model 3: White		
Individual	Est.	OR	Sig	Est.	OR	Sig	Est.	OR	Sig
Asian	0.216	1.241							
Black	0.160	1.173							
Hispanic	0.060	1.062							
White									
Other	0.202	1.224							
Female	0.285	1.33	***	0.206	1.229		0.348	1.417	***
Age 65+	-0.318	0.728	***	-0.380	0.684	*	-0.303	0.739	*
% Life in the US	0.017	1.017	***	0.017	1.017		0.008	1.008	*
Poor	0.115	1.122		0.159	1.172		0.139	1.149	
College	0.026	1.026		0.327	1.387	+	-0.132	0.876	
Heart disease	0.616	1.852	***	0.982	2.670	***	0.368	1.445	**
Obese	0.299	1.348	***	0.205	1.227		0.398	1.489	***
High blood pressure	0.258	1.294	**	0.340	1.406	*	0.186	1.205	+
Smoker	0.127	1.135		-0.012	0.988		0.059	1.060	
Walks	0.013	1.013		0.013	1.013		-0.031	0.969	
Not Safe	0.153	1.165		0.131	1.140		0.150	1.161	
Uninsured	-0.334	0.716	*	-0.426	0.653	*	-0.227	0.797	
In 2016	-0.104	0.901		-0.291	0.747	*	-0.045	0.956	
Neighborhood									
% Asian	-0.248	0.781		-0.421	0.657		-0.162	0.851	
% Black	0.240	1.271		-0.106	0.9		0.052	1.053	
% Latino	-0.227	0.797		-0.935	0.393				
% White							-0.386	0.68	
% Other	2.446	11.542	*	1.201	3.323		1.943	6.978	
% Poverty	-0.325	0.723		-0.694	0.5		0.452	1.571	
% College	-0.325	0.723		-0.476	0.622		0.166	1.181	
Average heat days	0.021	1.021		0.045	1.045		-0.014	0.986	
Ozone	-5.641	0.004		-4.718	0.009		-2.631	0.072	
PM 2.5	0.025	1.026		0.018	1.018		0.010	1.01	
Clunker Vehicle	-0.136	0.873		0.610	1.84		0.414	1.513	
Park desert	-0.016	0.984		0.073	1.075		-0.161	0.851	
EPA walkability	-0.006	0.994		-0.020	0.98		-0.008	0.992	
% Pop HQTL	-0.091	0.913		0.177	1.194		-0.113	0.893	
Medi-Cal Providers	-0.145	0.865		0.356	1.427		-0.579	0.561	+
Constant	-3.390	0.000	***	-2.824	0.000	**	-2.4485	0.000	***
n (valid)	41,567			10,213			23,315		

*Probabilities: +=p<0.10, *=p<0.05, **=p<0.01, ***=p<0.001*

Due to a data request transmission request error, pseudo R-squares were not produced for all models.

4.3 Heart Disease Morbidity

I present two set of models to predict heart disease. As shown in Table 3-5, the first model includes only ethnoracial predictors both at the individual and neighborhood levels. Model 2 includes other individual predictors and Model 3 and Model 4 are for Latinos and Whites, respectively. The second set of models in Table 3-6, and follow the approach in the previous analyses and presents a model with all predictors of interest regardless of any issues of collinearity with other predictors and statistical significance (Model 1); and segmented models for Latinos and whites (Model 3 and 4, respectively). The segmented models include variables that are significant at <0.05 level in the full model, a more conservative measure than the <0.10 level used in Essay 2. As with the other analyses in this essay, I did not address issues of collinearity given the limited access to the data and the cost and length of time associated for an additional modeling request.

Model 1 in Table 3-5 shows that at the individual level, race and ethnicity are negative predictors for the odds of heart disease relative to whites. The full model for all adults shows that, as with other models presented in this part of the dissertation, there are more significant individual-level factors that predict heart disease relative to neighborhood-level measures. The full model also shows that individual race is significant for minority groups, even after controlling for other factors. The direction of the coefficients for significant predictors is consistent across all models. For instance, age, poverty, and the various health indicators are all positive predictors in the ethnoracial models in Table 3-5. Interestingly, not having health insurance is not significant for Latinos or whites. Table 3-6 tells a different story about Latinos and whites, as there are fewer individual-level predictors that are significant when considering a wider range of neighborhood characteristics other than race.

Table 3-5: Multilevel Models Segmented by Ethnorace, Heart Disease

	Model 1: Ethnorace			Model 2: All			Model 3: Latino			Model 4: White		
	Est.	OR	Sig	Est.	OR	Sig	Est.	OR	Sig	Est.	OR	Sig
Individual												
Asian	–0.508	0.415	***	–0.464	0.629	*						
Black	–0.412	0.926	***	–0.614	0.541	**						
Hispanic	–0.879	0.602	***	–0.548	0.578	***						
White												
Other	–0.077	0.662		–0.070	0.933							
Female				–0.369	0.691	***	–0.142	0.868		–0.459	0.632	***
Age 65+				1.465	4.329	***	1.272	3.568	***	1.641	5.159	***
Poor				0.507	1.660	***	0.443	1.557	*	0.579	1.784	**
Asthma				0.628	1.873	***	0.914	2.493	***	0.407	1.502	**
High blood pressure				1.294	3.647	***	1.731	5.649	***	1.033	2.810	***
Uninsured				–0.458	0.633	*	–0.244	0.784		–0.656	0.519	
Neighborhood												
% Asian	–0.201	1.168		–0.029	0.972		0.616	1.852		–0.212	0.809	
% Black	0.155	0.219	+	0.084	1.088		0.291	1.337		0.586	1.796	
% Latino	0.147	1.158		0.205	1.228		0.277	1.319				
% White										–0.283	0.754	
% Other	–1.517	0.818	**	1.371	3.938		2.208	9.093		0.401	1.493	
In 2016				–0.064	0.938		0.004	1.004		–0.097	0.907	
Constant	–1.837	0.000	***	–3.606	0.000	***	–4.715	0.000	***	–3.204	0.000	***
Pseudo R-squared	0.021											
n (valid)				42,084			10,285			23,693		

Source: California Health Interview Survey 2015–2016 pooled years. Adults 18 years and older; modeled proportion of adult respondents (18 and over) who were ever diagnosed with heart disease by a doctor. Due to a data request transmission request error, pseudo R-sauces were not produced for all models. Probabilities: +p < 0.10; *p < 0.05; **p < 0.01; ***p < 0.001.

Table 3-6: Full Multilevel Models, Adults with Heart Disease

	Model 1: All (n=41,567)			Model 2: Latino (n= 10,213)			Model 3: White (n=23,315)		
	Est.	OR	Sig	Est.	OR	Sig	Est.	OR	Sig
Individual									
Asian	-0.547	0.579	*						
Black	-0.574	0.563	**						
Hispanic	-0.610	0.543	***						
White									
Other	-0.047	0.954							
Female	-0.390	0.677	***	-0.159	0.853		-0.489	0.613	
Age 65+	1.458	4.298	***	1.244	3.471		1.643	5.172	
Married	0.135	1.144		0.050	1.051		0.164	1.178	
% Life in the US	-0.002	0.998		-0.004	0.996		0.001	1.001	
Poor	0.471	1.601	**	0.458	1.581	*	0.509	1.664	*
College	-0.155	0.857		-0.165	0.848		-0.214	0.807	*
Asthma	0.635	1.887	***	0.942	2.565	***	0.393	1.482	**
Obese	0.057	1.059		-0.030	0.970		0.105	1.110	
High blood pressure	1.264	3.538	***	1.734	5.662		0.993	2.700	
Smoker	-0.095	0.909		-0.195	0.823		-0.061	0.941	
Walks	-0.136	0.873		-0.265	0.767		-0.136	0.873	
Not Safe	0.327	1.387		0.102	1.107		0.343	1.409	
Uninsured	-0.508	0.602	*	-0.308	0.735		-0.633	0.531	
In 2016	-0.061	0.941		-0.001	0.999		-0.100	0.905	
Neighborhood									
% Asian	0.287	1.332		1.016	2.762		0.707	2.028	
% Black	0.082	1.086		0.727	2.068		0.940	2.560	
% Latino	0.040	1.041		0.692	1.998				
% White							0.141	1.152	
% Other	1.877	6.535		4.251	70.158		0.552	1.736	
% Poverty	-0.105	0.901		-0.872	0.418		0.997	2.711	
% College	-0.258	0.773		0.166	1.180		-0.138	0.871	
Avg heat days	-0.001	0.999		-0.004	0.996		-0.015	0.985	
Ozone	9.707	>999.999^		6.986	>999.999^		9.545	>999.999^	
PM 2.5	-0.024	0.977		-0.026	0.974		-0.010	0.990	
Park desert	-0.022	0.978		0.229	1.257		-0.108	0.897	
EPA walkability	-0.003	0.997		0.008	1.008		-0.006	0.994	
% Pop HQTL	0.001	1.001		-0.458	0.632		-0.129	0.879	
Medi-Cal Providers	-0.082	0.921		-1.087	0.337		0.024	1.024	
Constant	-3.463	0.000	***	-4.550	0.000	***	-3.878	0.000	

Probabilities: +=p<0.10, *=p<0.05, **=p<0.01, ***=p<0.001; ^the values for ozone indicate a potential issue with sample size when connecting individual records to census tracts, which could not be addressed given the nature of data access procedures

5. Summary and Discussion

Table 3-7 summarizes the different relationships identified in the analytical results section in this essay. Five general findings emerged from the empirical results. First, ethnorace seems to be a stronger predictor for heart disease than for walking and asthma (based on the pseudo R-squares). Second, across all models, the number of significant individual-level factors outweigh the neighborhood-level predictors. This is particularly true for Latino adults; however, this may not be the case across different populations (e.g., children or the elderly), Latino subpopulations, and geographical spaces (e.g., urban vs. rural).

A third important finding is the relationship between the outcomes of interest and coliving. While coethnic living does not predict walking for Latino adults, coethnic living is a significant predictor for white individuals. For both Latino and white asthmatics, coethnic living is a negative predictor for asthma. Fourth, there is also significant evidence suggesting that Latinos acculturate or assimilate into sedentary lifestyle the longer they reside in the United States. Finally, demographics and comorbidity play a more substantial role in predicting asthma and heart disease than walking for transport and leisure. Future research should concentrate on exploring if the findings discussed in the preceding text hold true across geographies and Latino subpopulations.

As discussed in previous essays, the findings from this essay confirm that neighborhood effects are not as important relative to individual and household level factors. This is particularly true for health disease and asthma. These findings have policy and planning implications. As suggested in the other essays, while there are theoretical grounds for place-based initiatives that tackle neighborhood characteristics that pose health risks, planners and policy makers should consider how these interventions change neighborhood characteristics that contribute to individual risk factors such that continue to play a significant role on outcomes after accounting for both individual and neighborhood-level factors. The characteristics identified in this essay include poverty and comorbidity with other diseases, as well as gender disparities. A potential point of intervention for Latinos are policies and programs that promote transportation acculturation into active transit modes. Given the increase in the Latino population, the loss of immigrant health benefits over time, and escalating obesity rates among Latinos (Ogden et al., 2006), opportunities to increase walking and improve health among Latinos should be a public policy priority.

Table 3-7: Summary of Significant Multi-Level Factors

Outcome	All Adults		Latinos		Whites	
	Positive	Negative	Positive	Negative	Positive	Negative
Walking						
Individual	Asian Latino Other Poverty	Female Age 65+ Life US Heart disease Obese	Poverty	Female Life US Obesity	College	Female Age 65+
Neigh.	% College % HH no car HQ Transit	% Latino~ Child dep $PM_{2.5}$			% White % Poverty % College % HH no car	Walkability~
Asthma						
Individual	Black~ Female Life US Heart disease Obese High blood pressure	Asian~ Hispanic~ Age 65+ Uninsured	Female College Life US Heart disease High blood pressure	Age 65+ Uninsured	Female Life US Heart disease Obese High blood pressure	Age 65+
Neigh.	%Other~	% Asian~		% Latino~		Primary care % White~ % Other~
Heart Disease						
Individual	Age 65+ Poverty Asthma High blood pressure	Asian Black Hispanic Female Uninsured	Age Poverty Asthma High blood pressure		Poverty Asthma Age 65+ High blood pressure	Female
Neigh.	%Black~	%Other				

~becomes non-significant after controlling for other factors

Conclusion

In the face of global health, economic, and climate crises, scholars in the fields of urban planning and public health are converging again to study how the spatial context—the arrangement of neighborhoods and their characteristics—affects the health outcomes of residents. While there is growing evidence that health-related disparities are not only determined by individual characteristics, but also by the characteristics of the neighborhoods where people conduct their daily lives, this research shows that individual-level factors outweigh neighborhood-level effects. This is particularly true for lifetime asthma and heart disease, and for Latino populations. This research shows that individual ethnorace and in some instances racialized spaces are important factors that affect outcomes and creates disparities, especially for Latino. For example, I document that ethnic coliving plays both a positive and an adverse role on health outcomes.

Taken together, the findings presented in this research have important policy and planning implications for public health, environmental sustainability, social and racial equity. To start, many policies and programs in the applied planning field are often times place-based; for example, focused on improving the built environment for a specific area or area-based comprehensive planning approaches. While there are theoretical and practical grounds for place-based initiatives, planners and policy makers should consider how interventions change neighborhood characteristics that contribute to individual risk factors identified by this research—poverty, education, aging, migration, comorbidity with chronic diseases such as obesity, gender disparities, and race. Second, these place-based efforts should focus on improving tangible neighborhood characteristics (e.g., walkability) while also addressing issues rooted in persistent structural inequalities, such as concentrated poverty, segregation, and the spatial separation from resources and opportunities.

Further, as California goes through a demographic transition in the coming decades where Latinos will make up nearly half of the state's population (California Senate Office of Research, 2017), clearly promoting Latino health and wellness should be a public health priority. Despite this, there is a paucity of research on Latino health, even amongst the newer wave of more holistic studies that examine multilevel (individual, social, neighborhood) determinants of health. In this context, this dissertation research adds to the growing body of literature that explores multi-level determinants of health for Latinos and Latino neighborhoods. In doing so, the research documents significant risk factors affecting Latino health that can have cross-generational consequences. For instance, Latinos are significantly affected by chronic health diseases such as obesity, are least likely to have health insurance, less able to manage their heart disease and asthma, and score worse on a variety of SEP measures—higher rates of poverty and lower educational attainment. There are also glaring differences between majority Latino and white neighborhoods because of residential settlement patterns. In general, Latino neighborhoods have fewer resources that promote healthy lifestyles—availability of park spaces and primary care providers—as well as characteristics correlated with health risks such as high levels of environmental pollutants, traffic collisions, poverty, and lower levels of educational attainment. Latinos also walk just as much as whites regardless of safety issues, as measured by traffic, bike, and pedestrian collisions.

The differences and disparities documented in this dissertation research, however, are not new. In fact, the pervasiveness of these disparities has often led to a deficit framing of Latinos—and other black, indigenous, and communities of color (Valencia & Solórzano, 2012)—and the assumption that spaces with more brown people are less conducive to healthy lifestyles. More problematic is that larger structural forces of inequality, such as segregation, are rarely included in studies about Latinos. The COVID-19 pandemic has also revealed disproportionate strain and stress on Latino neighborhoods to respond to policies such as shelter-in-place, due to the unequal distribution of neighborhood-level resources (Ong, Ong, Ong, et al., 2020).

This dissertation shows Latino neighborhoods have fewer health-promoting resources, including parks and medical care, which as a result perpetuate existing systems of spatialized disadvantage (Roy, 2020). Despite these challenges, Latino neighborhoods have the same potential as white neighborhoods to be spaces that are conducive to healthy living. For instance, Latino neighborhoods already have prototypical characteristics for compact living (e.g., walkable neighborhoods, access to transit, and fewer cars). Yet Latinos are not necessarily more physically active in these spaces as measured by rates of walking for leisure and travel both at the individual and neighborhood level. Compared to white adults, Latinos are more likely to think their neighborhoods as unsafe. Latino immigrants also settle into sedentary lifestyles as they assimilate to the American mode of life. Together, heart disease, asthma, and air pollutants can further limit physical activity, which compounds other chronic diseases that limit the mobility of Latinos.

As such, one point of intervention to promote health for Latinos should be policies and programs that facilitate and promote walking—and not just by building walkable neighborhoods. Walking is underrated but it is the most accessible form of physical activity regardless of gender, age, and social groups and poses minimal risk of injury (Hootman et al., 2001; Murtagh et al., 2010). Physical activity, such as walking, not only improves overall health, fitness, and quality of life but also helps reduce the risk of chronic diseases, some cancers, and improves mental health (National Centers for Disease Control and Prevention, 2019). Given the key finding of this research, which indicates that individual-level factors outweigh the neighborhood-level effects, planning practice needs to approach equitable community development with a dual framework. Planning with spatial context as well as individual characteristics and behaviors is more important than ever to address the global health, economic, climate crises, and challenges to racial systems of oppression and segregated resources.

Appendix 1. Alternate Walking Neighborhood-Level Analysis

Alternate regression results to those presented in Essay 1 are reported in Table 1A-1. These alternate models include controls for variations in park availability and a fixed regional effect, which are excluded in the models in Essay 1. This alternate models also replaces bike and pedestrian collisions with total crashes and does not include measures of transit access and commute to work. This model also includes a measure of Ozone directly from AskCHIS from CalEnviroScreen 2.0 that is substantially different from those published in CalEnviroScreen 3.0.

Table 1A-1: Alternate Specifications for OLS Walking Model

Dependent Variable	**Prevalence of Walking**					
	Model 1: Race		Model 2: Full		Model 3: Parsimonious	
Independent Variables	(n = 1,615)		(n = 1,559)		(n = 1,559)	
Neighborhood Demographic Composition						
% Asian	0.113	***	–0.023	**	–0.023	**
% Black	0.080	***	–0.057	***	–0.058	***
% Latino	–0.026	***	0.013	*	0.013	*
Child dependency ratio			–0.043	***	–0.043	***
Elderly dependency ratio			0.014	**	0.014	**
Neighborhood Economic Resources						
Median household income (log)			0.035	***	0.035	***
% Carless households			0.274	***	0.274	***
Natural Environment						
Ozone			0.015	*	0.015	*
$PM_{2.5}$			–0.003	***	–0.003	***
Average heat days			–0.003	***	–0.003	***
Built Environment						
Park desert (lowest quartile)			–0.006	+	–0.005	*
Park poor			0.000			
Park rich			0.001			
Total collisions by road network			1.052	***	1.051	***
National walkability score			0.110	**	0.106	**
Fixed Regional Effect						
Los Angeles County			0.020	***	0.020	***
San Francisco Metro			0.033	***	0.033	***
San Diego Metro			0.061	***	0.061	***
Constant	0.314	***	–0.063	+	–0.059	+
Adjusted R-Squared	0.103		0.621		0.622	

Probabilities: +p < 0.10; *p < 0.05; **p < 0.01; ***p < 0.001.

VIFs and tolerances did not suggest collinearity for any independent variables; VIFs were in the range of 1.03 and 2.9, and no tolerance values were under the standard 0.3 level. I also weighted the models by the total population. Overall, the results are qualitatively similar but as expected, the coefficients vary. Weighting did not result to changes in the degrees of freedom in the models.

Model 3 is a parsimonious model, and includes only variables significant at the 0.10 level in the full model (Model 2). Model 3 explains approximately 62% of the systematic variation in neighborhood-level walking prevalence. The relationship between walking and child dependency holds, while extreme heat days identified in the descriptive section remains constant in this analysis. The child dependency poses an interesting question about the possible negative impact of childcare and family obligations and resulting lack of time that can interfere with walking for leisure or walking for transport. We see expected relationships with carlessness and higher neighborhood economic position, as measured by household income and the National Walkability Index.

Following the conceptual framework for the model-building approach, I first estimate a model only with ethnoracial composition to establish a base relationship with the prevalence of walking. Roughly, 10% of the variability in the prevalence of walking at the neighborhood level is explained by the ethnoracial composition of a neighborhood. Neighborhoods with higher percentages of Latinos tend to have lower rates of walking prevalence; however, the direction of the relationship for the groups changes when adjusting for other factors, as shown in Model 2 and the parsimonious model.

Three observations emerge from the statistical models. First, there is a threshold effect for parkland access. Neighborhoods with the worst parkland access (“park deserts”) play a significant role in the walking prevalence. In other words, the absence of parkland has detrimental effects on walking. A second pattern is related to road safety. Walking is positively correlated with areas with increased traffic collisions, which could indicate people are walking in higher-risk environments where traffic collisions are more common, such as along major arterials (Campbell et al., 2004; Miles-Doan & Thompson, 1999) where commercial, retail, and other neighborhood resources are located (Loukaitou-Sideris et al., 2007).

The third pattern is related to air pollution. While $PM_{2.5}$ follows the *a priori* assumption that areas with more pollution are less attractive for walking, the ozone levels show an opposite effect. Given that ozone or "urban smog" affects metropolitan areas the most, a possible interpretation is that people are walking in urban neighborhoods despite higher ozone pollution. This relationship make sense given the positive regional effect for major urban centers in California and that the ozone measure is a summertime average, which captures heightened effects for urban areas.

An alternate decomposition analysis is provided in Table 1A-2. The difference between this alternative model and that presented in Essay 1 is the definition of Latino and white neighborhoods. The alternate specification uses an 80% share of the population to identify neighborhood types, roughly the 95th percentile of the Latino distribution (80.4%), which resulted in 100 supermajority Latino neighborhoods and 438 white neighborhoods. The analysis in Essay 1 uses a more conservative cutoff of 75% to increase the number of Latino neighborhoods. The analysis shows demographic composition, mainly driven by child dependency, lowers walking in Latino neighborhoods. The second most important dimension that leads to lower walking levels in Latino neighborhoods relates to the natural environment, in particular $PM_{2.5}$ pollution. Finally, the built environment in Latino neighborhoods also plays a sizable role but in the opposite direction—helping to increase the prevalence of walking. Further quantitative and qualitative research is needed to unpack this relationship.

Table 1A-2: Alternate Specifications for Walking Decomposition

	Latino	White	Δ	Beta	Beta*Δ	Pooled
Walking Prevalence	31.13%	30.78 %	0.35%			
Neighborhood Demographic						–0.95%
% Asian	1.60%	1.18%	0.42%	–0.023	–0.0001	
% Black	1.39%	0.51%	0.89%	–0.058	–0.0005	
% Latino	90.26%	5.62%	84.64%	0.013	0.0109	
Child dependency ratio	60.83%	31.27 %	29.55%	–0.043	**–0.0128**	
Elderly dependency ratio	14.30%	64.24 %	–49.94%	0.014	–0.0070	
Neighborhood Economic Resources						–0.15%
Median household income (log)	10.583	10.976	–0.394	0.035	–0.0137	
% Households with no vehicle	8.07%	3.60%	0.045	0.274	0.0122	
Natural Environmental						–0.82%
Ozone	0.109	0.057	0.052	0.015	0.0008	
$PM_{2.5}$	10.276	5.546	4.730	–0.003	**–0.0136**	
Average heat days	5.931	7.559	–1.628	–0.003	0.0046	
Built Environment						0.66%
Park desert	0.490	0.016	0.474	–0.005	–0.0025	
Total collisions by road network	0.007	0.001	0.006	1.051	**0.0065**	
Walkability score	0.082	0.058	0.025	0.106	0.0026	
Regions						0.06%
Los Angeles County	0.230	0.011	0.219	0.020	0.0044	
San Francisco–Oakland–Fremont	0.020	0.018	0.002	0.033	0.0001	
San Diego–Carlsbad–San Marcos	0.000	0.064	–0.064	0.061	–0.0039	

Appendix 2. Additional Lifetime Asthma Neighborhood Models

Table 2A-1: Asthma Segmented OLS Based on Full Model

	Neighborhood Type			
	Latino		White	
Independent Variables	n = 97		n = 197	
Demographic				
Child dependency ratio	–0.002		0.013	
Elderly dependency ratio	0.180	*	–0.008	
Foreign born	–0.027		0.003	
Other Health Indicators				
% Walking	0.048		0.193	***
% Heart disease prevalence	0.010		0.188	*
Economic				
% Poverty	–0.003		0.070	+
% College degree	–0.176	+	–0.020	
Chemical Environmental				
Diesel PM	–0.001	**	–0.001	*
Ozone	–0.472		–1.207	***
$PM_{2.5}$	0.004	**	0.004	**
Average heat days	0.002		0.002	+
Built Environment				
% Park rich	–0.015		–0.001	
Accessibility to Neighborhood Resources				
% Households with no vehicle	–0.166	*	–0.002	
% Pop with high-quality transit access	0.019		–0.020	
Primary care availability	0.579		0.089	
Constant	0.111	*	0.095	***
Adjusted R-Squared	0.369		0.218	

Probabilities: +p < 0.10; *p < 0.05; **p < 0.01; ***p < 0.001.

Appendix 3. Additional Heart Disease Prevalence Neighborhood Models

Table 3A-1: Heart Disease Segmented OLS Based on Full Model

	Neighborhood Type			
	Latino		**White**	
Independent Variables	n = 97		n = 197	
Demographic				
Child dependency ratio	0.026		0.007	
Elderly dependency ratio	0.105	**	0.034	***
Foreign born	–0.087	***	–0.052	+
Other Health Indicators				
% Walking	0.163	***	0.021	
% Asthma	0.003		0.120	+
Socioeconomic Position				
% Poverty	0.049	*	0.009	
% College degree	–0.059		–0.014	
Chemical Environmental				
Diesel PM	–0.001	**	0.000	
Ozone	–0.135		0.345	+
$PM_{2.5}$	0.002	**	0.001	
Average heat days	0.001	+	–0.001	+
Built Environment				
% Park rich	0.002		0.008	+
Accessibility to Neighborhood Resources				
% Households with no vehicle	–0.119	***	–0.035	
% Pop with high-quality transit access	0.002		–0.019	
Primary care providers	–0.055		0.052	
Constant	–0.008		0.037	+
Adjusted R-Squared	0.636		0.360	

Probabilities: +p < 0.10; *p < 0.05; **p < 0.01; ***p < 0.001.

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