UCLA
UCLA Electronic Theses and Dissertations

Title

Does Living in Latino Neighborhoods Affect Risk for Obesity? Findings from a Study of Social Capital and Park Availability in Los Angeles Neighborhoods

Permalink
https://escholarship.org/uc/item/2h92n260

Author
Garcia, Jennifer

Publication Date
2014

Peer reviewed|Thesis/dissertation

eScholarship.org Powered by the California Digital Library
University of California

UNIVERSITY OF CALIFORNIA

Los Angeles

Does Living in Latino Neighborhoods Affect Risk for Obesity?

Findings from a Study of Social Capital and Park Availability in Los Angeles Neighborhoods

A dissertation submitted in partial satisfaction of the

requirements for the degree Doctor of Philosophy

in Public Health

by

Jennifer Garcia

2014

ABSTRACT OF THE DISSERTATION

Does Living in Latino Neighborhoods Affect Risk for Obesity?

Findings from a Study of Social Capital and Park Availability in Los Angeles Neighborhoods

by

Jennifer Garcia

Doctor of Philosophy in Public Health

University of California, Los Angeles, 2014

Professor Gilbert Gee, Chair

Social and physical features of the neighborhood environment may influence obesity risk for the general public, as well as, for specific ethnic minority groups such as Latinos. According to the ethnic enclave perspective, minority communities contain protective resources such as social capital, which can promote the exchange of information and enhance trust among residents. In turn, these social resources can encourage healthful diets and physical activity, which then reduces the likelihood of health problems such as obesity. At the same time, according to the residential segregation perspective, minority communities also face structural disadvantages including the limited availability of health promoting resources such as parks. A lack of neighborhood parks can reduce opportunities for physical activity and increase obesity risk.

Accordingly, this dissertation investigated two features of Latino neighborhood environments in Los Angeles that may be related to obesity risk: social capital and park availability. First, I examined the relationship between Latino neighborhood composition and individual obesity risk among a sample of adults (n=2,919) using data from Wave 1 (2000-2001) of the Los Angeles Family and Neighborhood Survey (L.A. FANS). I used multilevel regression analysis to model the relationship between neighborhood percent Latino and Body Mass Index (BMI) controlling for individual age, race/ethnicity, gender, nativity status, family income and education. To test the hypothesis that social capital may help explain the relationship between neighborhood percent Latino and obesity, I used multilevel mediation analysis. My analyses showed that Latino-concentrated neighborhoods were associated with higher BMI, but I found no support for the mediating role of social capital (e.g., social cohesion or group participation) in the neighborhood-obesity pathway.

Second, I also examined differences in neighborhood-level park features using data from the Los Angeles County Location Management System (2010), a database of park location information for all Los Angeles County census tracts (n=2,258). I used zero-inflated negative binomial regression to model the number of park features as a function of Latino immigrant neighborhoods, controlling for percent black, percent Asian, percent living in poverty, total population, population density, land area, and attached housing. These data showed that there were fewer total park features available in Latino immigrant neighborhoods. Further, Latino immigrant neighborhoods had fewer natural park features such as campgrounds and hiking trails.

Findings from this dissertation contribute to the emerging body of literature that suggests Latino neighborhoods may have obesogenic features. I find some support for the residential segregation perspective—Latino neighborhoods were associated with higher BMI, and social

capital does not appear to attenuate this relationship. In addition, Latino immigrant neighborhoods had few park features. These findings are noteworthy because differences in neighborhood resources may contribute to the disproportionately high prevalence of obesity among Latinos. More research is required to explicate what role, if any, the neighborhood social environment plays in the relationship between Latino neighborhoods and obesity. In addition, future work should consider the connections between disparities in the availability of neighborhood resources such as parks, and disparities in physical activity and obesity.

The dissertation of Jennifer Garcia is approved.

Anne Pebley

May C. Wang

Vilma Ortiz

Gilbert Gee, Committee Chair

University of California, Los Angeles

2014

Table of Contents

ABSTRACT OF THE DISSERTATION ii

Table of Contents vi

LIST OF FIGURES ix

LIST OF TABLES x

Acknowledgments xii

VITA xiv

Chapter 1. Introduction 1

Multilevel Approach to Studying Obesity 2

Latino Neighborhoods and Obesity 3

Purpose of Dissertation 4

Social Capital 5

Parks 6

Structure of the Dissertation 7

Chapter 2. Conceptual Framework 9

Conceptual Framework 10

Research Questions 30

Chapter 3. Latino Neighborhoods, Social Capital, and Body Mass Index (Multilevel Analysis) 32

Data 33

Measures 37

Analytic Approach 44

Results 50

Chapter 4. Latino Neighborhoods and Park Availability (Ecological Analysis) 59

Data 60

Measures 62

Analytic Approach 66

Results 69

Chapter 5. Discussion 79

Strengths and Limitations 81

Implications and Future Directions 82

APPENDIX A. Sensitivity Analysis for L.A. FANS Neighborhood Measure 86

Operationalizing Latino Neighborhoods 86

Choice of Neighborhood Measure 89

APPENDIX B. Mediation Analysis with Alternative Social Capital Measures 94

APPENDIX C. Creation of Parks Data 98

APPENDIX D. Census Tracts that Were Dropped from the Parks Analysis 99

APPENDIX E. Diagnostic Tests 100

Collinearity Diagnostics 100

Count Data Diagnostics 101

REFERENCES 105

LIST OF FIGURES

Figure 1. Model of Theoretical Framework. 31

Figure 2. L.A. FANS Analytic Sample Flow Chart. 37

Figure 3. Count of Disaggregated Park Features for Los Angeles County. 71

Figure 4. Mean Number of Developed Versus Natural Park Features by Latino Quartile Category. 73

Figure E- 1. Count of Total Park Features by Tract. 102

Figure E- 2. Histogram of Park Features with Predicted Probabilities. 102

LIST OF TABLES

Table 1. Survey Items Used to Create Social Capital Measures.[a] 41

Table 2. Operationalization of Variables Used in L.A. FANS Analysis. 44

Table 3. Comparison of Tract Characteristics for L.A. County and L.A. FANS (Weighted). 50

Table 4. Unweighted and Weighted L.A. FANS Sample Characteristics (n= 2,919 Adults)..... 51

Table 5. Mean Values for Select Characteristics by Latino Quartile (Weighted). 53

Table 6. Multilevel Regression Model on BMI (Weighted)..... 56

Table 7. Mediation of the Effect of Neighborhood Percent Latino on Individual BMI Through Social Capital (Indirect Effects)..... 57

Table 8. Variables Used in Parks Analysis..... 66

Table 9. Descriptive Statistics for Sample of Tracts (n=2,315)..... 70

Table 10. Mean Number of Park Features by Latino Quartile. 72

Table 11. Demographic Statistics by Latino Quartile..... 74

Table 12. Results of Zero-Inflated Negative Binomial Regression Analysis for Total Park Features..... 76

Table 13. Results of Zero-Inflated Negative Binomial Regression Analysis for Developed and Natural Park Features..... 77

Table 14. Counts of Parks for Each Level of Latino Immigrant Neighborhood Factor Score 78

Table A- 1. Comparison of Latino Neighborhood Measures Used in Sensitivity Analysis. 90

Table A- 2. Results from Sensitivity Analysis Comparing Different Latino Neighborhood Measures on BMI..... 91

Table B- 1. Mediation of The Effect of Neighborhood Percent Latino on Individual BMI Through Alternative Mediators (Indirect Effects). 97

Table D- 1. Description of Census Tract that were Dropped from the Parks Analysis. 99

Table E- 1. Correlation Matrix for Latino Immigration Related Variables. 100

Table E- 2. Factor Analysis of Latino Immigrant Variables (n=2,315)..... 101

Table E- 3. Results from Diagnostic Tests of Collinearity. 101

Table E- 4. Comparison of Count Model Diagnostic Tests. 103

Acknowledgments

There are many people who have helped me complete this dissertation. I am indebted to my dissertation committee members, Anne Pebley, May Wang, and Vilma Ortiz, whose guidance and thoughtful input on my research has helped me to become a better scientist. Also, I am deeply grateful to my chair, Gilbert Gee, for sharing his research expertise, and for his continued mentorship and encouragement.

The RAND Corporation and the California Center for Population Research (CCPR) provided both administrative and technical support for this project. Thank you to Dave Ash, Andrew Hicks, Lucy Shao, and Wendy Tieu at CCPR for your help. A special thanks to my colleague, Malia Jones, for creating the parks dataset that I use in this dissertation. I am also thankful to the UCLA Statistical Consulting Group for their advice about statistical methods.

I am fortunate to have an amazing group of scholars and friends at UCLA and beyond. Hsin-Chieh Chang, Mekeila Cook, Cricel Molina deMesa, Rennie Lee, November McGarvey, Eunice Muthengi, Angie Denisse Otiniano, Cindy Sangalang, Janira Teague, and Kiyomi Tsuyuki, have provided intellectual, social, and emotional support throughout my graduate school journey; Anna Alves, Erica Morales, and La'Tonya Rease Miles from the OG GMP Crew—thank you for being incredible role models and friends, and for reminding me to keep fighting the good fight; Natasha Olmos and Tanya Brown—thanks for listening; and a heartfelt thank you to Allyson Washburn, for reading my dissertation and providing constructive and insightful feedback.

My family and friends deserve special recognition for their generosity, humor, and support. Thank you Nick, Allie, Elias and Annabel Garcia for helping me find balance and reminding me what is really important. Also, thank you Danielle Gonzales for your

encouragement at every step along the way. What up to the homies Ray Lie, Francine Molina, and Antonio Rodriguez—sincere thanks for making me laugh and helping me stay grounded throughout this experience. Also, I am eternally grateful to the Write or Die Crew—thank you for holding me accountable and helping me become a better writer, but more importantly, thanks for being super-dope friends! Thank you to my family in the San Francisco Bay Area for your unconditional love and support. Lastly, thanks Mom and Dad! I cannot adequately express how much your encouragement and love mean to me. You are my biggest cheerleaders and I am lucky to have you. We did it!

VITA

Education

M.P.H. Department of Health Behavior and Health Education, School of Public Health University of Michigan, Ann Arbor	2003
B.A., Magna Cum Laude Department of Psychology San Diego State University	1999

Awards and Fellowships

Quality of Graduate Education Program, University of California, Los Angeles	2008
California Endowment Fellowship, University of California, Los Angeles	2007-2008
Bixby Program Doctoral Fellow, University of California, Los Angeles	2006-2007
Eugene Cota-Robles Fellowship, University of California, Los Angeles	2005-2009

Professional Experience

Graduate Student Researcher Department of Community Health Sciences, School of Public Health University of California, Los Angeles	2008-2009
Graduate Mentor/Program Coordinator Graduate Mentoring Programs, Academic Advancement Program University of California, Los Angeles	2006-2009

Teaching Experience

Special Reader Community Health Sciences 286: Doctoral Roundtable University of California, Los Angeles	2012-2013
Instructor of Record General Education 20CW: Race and Health University of California, Los Angeles	2010-2012

Teaching Fellow General Education 20A: Interracial Dynamics in American Society & Culture University of California, Los Angeles	2009-2011
Instructor Ronald E. McNair Program, Summer Research Institute: Academic Writing University of California, Los Angeles	2009-2010
Teaching Assistant Honors Collegium 193: Community Development & Social Justice Scholars University of California, Los Angeles	2007-2009

Conference Presentations

"Strategies for building a diverse public health pipeline: The Community Development and Social Justice Scholars Program," oral presentation, the American Public Health Association Annual Meeting in Philadelphia, PA, November 7-11, 2009.

"Interdisciplinary approaches: A student-initiated course on Critical Race Theory," poster presentation, the American Public Health Association Annual Meeting in San Diego, CA, October 25-29, 2008.

Leadership Experience

Founding member and co-chair, Graduate Students of Color, University of California, Los Angeles	2006-2009
Collaborator, Critical Race Theory Working Group, University of California, Los Angeles, School of Public Affairs	2006-2007

Chapter 1. Introduction

Theories about Latino[1] neighborhood contexts suggest that differential exposure to harmful or protective environmental features may contribute to health disparities (Mair, et al., 2010). Latinos suffer disproportionately from overweight and obesity, and neighborhood environments play an important role in obesity risk (Black & Macinko, 2008; Flegal, Carroll, Kit, & Ogden, 2012). For example, neighborhoods with limited availability of parks and recreation facilities restricts opportunity for physical activity (Black & Macinko, 2008; Booth, Pinkston, & Poston, 2005). On the other hand, neighborhoods with social networks and cohesive communities can support mental health and facilitate access to information and resources that reduce obesity risk (Cohen, Finch, Bower, & Sastry, 2006; Moore, 2010). Therefore, an important avenue of obesity disparities research is to investigate the health risks and benefits within Latino neighborhoods.

Obesity is a major public health concern in the United States (Pan, et al., 2009). The obesity epidemic contributes to increased morbidity, premature mortality and overall reduced quality of life (Sherry, et al., 2010). In 2009, 27% of American adults were obese, putting them at increased risk for a number of serious chronic illnesses including type-2 diabetes, cardiovascular disease, hypertension, stroke and certain types of cancer (Sherry, et al., 2010). Although the prevalence of obesity has increased over the past three decades for all American adults and children, it disproportionately affects poor people and people of color (Black & Macinko, 2008; Flegal, et al., 2012). In 2009-2010 the overall obesity prevalence for whites was 34.9% compared to 37.9% for Hispanics (Flegal, et al., 2012).

[1] I use the terms *Latino* and *Hispanic* interchangeably.

At the most basic level, obesity is caused by an energy imbalance—too many calories consumed and not enough exercise leads to excess weight gain (Weinsier, Hunter, Heini, Goran, & Sell, 1998). The explanations for the obesity epidemic however are more complicated and involve a complex interaction of both individual and environmental factors (Hill & Peters, 1998; Poston & Foreyt, 1999; WHO, 2000). For example, although there is some genetic component to obesity, the rate at which obesity has risen in the population appears to be faster than would be expected by heritability alone (Park, Neckerman, Quinn, Weiss, & Rundle, 2008). In other words, genes cannot explain the rapid increase of obesity in the population. Changes to diet and physical activity patterns are more plausible explanations for the rise in obesity; however, these individual-level behaviors are influenced by environmental factors. For example, broad societal and lifestyle changes over the past three decades, such as larger portion sizes and sedentary jobs, have led to changes in individual behaviors that contribute to increased obesity risk (WHO, 2000).

Multilevel Approach to Studying Obesity

Not surprisingly, efforts to reduce obesity that focus solely on individual diet and exercise habits have been unable to curb population trends in obesity (Huang & Glass, 2008). A multilevel approach, one that considers other levels of influence outside of the individual, such as environmental and social factors, may be more effective at reducing obesity in the population than individual behavior change approaches alone (Leroux, Moore, & Dubé, 2013; Sallis, Floyd, Rodríguez, & Saelens, 2012; Wang & Brownell, 2005; Wang & Beydoun, 2007). For example, features of the neighborhood environment such as the availability of food and physical activity resources can support or hinder individual efforts at behavior change (Lopez, 2007; Sallis, et al., 2012).

A multilevel approach may also help explain racial/ethnic disparities in obesity because neighborhood segregation concentrates risks and resources (Gee & Payne-Sturges, 2004; Williams & Collins, 2001). The residential segregation hypothesis argues that minority concentrated neighborhoods contend with numerous structural disadvantages that may contribute to obesity risk, including crime and safety concerns, lack of healthcare and social services, and limited access to grocery stores and exercise facilities (Morello-Frosch & Lopez, 2006; Williams & Collins, 2001). However, the ethnic enclave hypothesis posits that certain social and cultural aspects of Latino neighborhoods, such as social support and the maintenance of healthy cultural norms, can help mitigate the otherwise harmful effects of neighborhood economic disadvantage (Eschbach, Ostir, Patel, Markides, & Goodwin, 2004; Mair, et al., 2010; Osypuk, Diez Roux, Hadley, & Kandula, 2009). Thus, segregated neighborhoods can create differential exposure to risks (i.e., harmful neighborhood features) and resources (i.e., protective neighborhood features).

Latino Neighborhoods and Obesity

Consistent with the general finding that structural deprivation in minority neighborhoods can contribute to poor health, there is evidence that Latino-concentrated neighborhoods are associated with increased obesity risk (Corral, Landrine, & Zhao, 2013; Do, et al., 2007; Wen & Maloney, 2011). Do (2007) found that a higher proportion of Hispanics in the neighborhood was associated with an increase in Body Mass Index (BMI) for Mexican Americans. Similarly, Corral (2013) reports that Hispanic adults living in high-segregated areas had a 26.4% higher odds of being obese compared with those in low-segregated areas.

However, not all studies find that Latino neighborhoods are harmful for health. Some studies report health benefits of living in Latino-concentrated neighborhoods for a range of health outcomes including asthma, mortality, and depression (Cagney, Browning, & Wallace,

2007; Eschbach, et al., 2004; Gerst, et al., 2011). There is also some empirical evidence of a negative association between Latino neighborhoods and obesity risk. Kershaw (2013) found that Mexican American women living in isolated Mexican American neighborhoods had lower obesity prevalence compared to those who were living in racially mixed neighborhoods. Similarly, living in immigrant neighborhoods was associated with lower BMI among Hispanics in a national study of adults (Park, et al., 2008).

Of course there is variation across Latino neighborhood contexts and not all neighborhoods can be characterized as either protective or harmful. For example, Nobari (2013) found a curvilinear relationship between neighborhood concentration of Latinos and BMI among children. This relationship suggests that the beneficial effects of living in Latino enclaves become apparent above a certain concentration of Latino residents. Also, Wen and Maloney (2011) found that isolated Latino neighborhoods were characterized by both high social capital and high obesity risk for Latino men and women living in Salt Lake City, Utah. They conclude that, for obesity risk, the structural disadvantages outweigh the social benefits present in these neighborhoods.

Purpose of Dissertation

It remains unclear whether the high prevalence of obesity among Latinos is attributable in part to their neighborhood environment or to other factors. The conflicting findings from studies on Latino neighborhoods and obesity suggest that there are likely multiple and complex pathways that operate between Latino neighborhood environments and obesity risk. For example, both the physical and social features of neighborhoods can influence behaviors that affect weight gain (Franzini, et al., 2009; Schulz, et al., 2005). The purpose of this dissertation is to examine different obesity-related aspects of Latino neighborhoods.

First, I examine social capital as a possible protective feature of Latino neighborhood social environments that might buffer against harmful or unhealthy neighborhood conditions. Some forms of social capital have been associated with lower obesity risk (Moore, 2010). In addition, studies that find general health benefits of Latino neighborhood residence, the so-called barrio advantage, assert that the protective mechanisms of co-ethnic residence include aspects of the social environment, including social capital (Cagney, et al., 2007; Eschbach, et al., 2004). Therefore, I investigate the mediating role of social capital for obesity risk in Latino neighborhoods. Second, I examine the availability of parks in Latino neighborhoods through an environmental justice lens. Prior work has shown that parks are related to a lower prevalence of obesity within communities (Kaczynski & Henderson, 2007; Sallis & Glanz, 2009). Further, a separate line of research suggests that the availability of parks and other green spaces vary by race/ethnicity (Duncan, Kawachi, White, & Williams, 2012; Sister, Wolch, & Wilson, 2010). Accordingly, I investigate disparities in park availability by Latino neighborhood composition.

Social Capital

Social capital, defined as the features and resources of social life, may indirectly affect weight status through two main channels: (a) influences psychological processes and (b) facilitates access to information and resources (Kim, Subramanian, & Kawachi, 2008; Legh-Jones & Moore, 2012; Moore, 2010). Therefore, neighborhoods with high social capital may help to alleviate stress and encourage healthy norms and behaviors that protect against obesity (Cohen, et al., 2006; Moore, 2010). There is some empirical evidence that bears this out. Neighborhoods with high social capital were associated with higher levels of physical activity and lower levels of obesity (Poortinga, 2006). One study of community involvement found that

individuals who participated in voluntary associations had significant lower odds of being overweight (Veenstra, et al., 2005).

The health advantages of living in Latino-concentrated neighborhoods, including lower mortality and higher self-rated health, are often attributed to social aspects of the neighborhood environment including social capital and related constructs (i.e., social cohesion, social ties, social support) (Eschbach, et al., 2004). Although social capital has been hypothesized as a health protective feature of Latino-concentrated neighborhoods, few studies have directly tested this hypothesis (Almeida, Kawachi, Molnar, & Subramanian, 2009). For example, some Hispanic and/or immigrant neighborhoods report low social cohesion, which contradicts what other research purports about the social benefits found in Latino enclaves (Almeida, et al., 2009; Osypuk, et al., 2009; Rios, Aiken, & Zautra, 2012). Therefore further research is required to flesh out the connections between Latino neighborhoods, social capital and obesity risk.

Parks

The physical design of neighborhoods can support or hinder physical activity (Sallis, et al., 2012). For example, interconnected streets and bike lanes encourage walking and cycling, whereas limited access to parks and recreation programs discourage regular exercise (Black & Macinko, 2008; Booth, et al., 2005). In their review of the literature on obesity and the built environment, Sallis and Glanz (2009) conclude that "having parks and other recreation facilities nearby has been consistently associated with higher levels of physical activity…and lower risk of overweight and obesity" (p.133).

However, not all neighborhoods have physical activity resources such as parks (Abercrombie, et al., 2008; Boone, Buckley, Grove, & Sister, 2009). For example, low-income and minority communities in Los Angeles have less access to both parks and recreation courses

than white neighborhoods (Dahmann, Wolch, Joassart-Marcelli, Reynolds, & Jerrett; Wolch, Wilson, & Fehrenbach, 2005). Furthermore, a national study of park and recreation availability found that park availability alone (i.e., the study did not measure park access or quality) was associated with increased physical activity and decreased overweight status among adolescents (Gordon-Larsen, Nelson, Page, & Popkin, 2006). The lack of parks in some neighborhoods is an environmental justice concern because it signifies a disparity in the availability of a health promoting neighborhood resource (Sister, et al., 2010; Taylor, Floyd, Whitt-Glover, & Brooks, 2007).

Structure of the Dissertation

I have identified social capital and parks as two aspects of Latino neighborhoods that may indirectly impact obesity risk. The dissertation investigates two hypotheses: first, I hypothesize that social capital acts as a buffer against obesogenic, or obesity-conducive neighborhood conditions. I examine the potential mediating role of social capital in the relationship between Latino neighborhoods and BMI. Second, I hypothesize that there are disparities in park availability by race/ethnicity. I will examine whether Latino neighborhood composition is associated with park availability in Los Angeles. These two hypotheses are addressed in separate empirical chapters. This dissertation comprises a theoretical framework and conceptual model (Chapter 2), methods and results for Latino neighborhoods, obesity and social capital analysis (Chapter 3), methods and results for Latino neighborhoods and parks analysis (Chapter 4), and finally a discussion of key findings and implications (Chapter 5).

The ability to identify features of Latino neighborhoods that contribute to or protect against obesity will enable public health researchers, practitioners, policymakers and activists to direct resources and develop appropriate policy to help curb obesity trends. This dissertation is

part of recent scholarly interest that focuses on the health aspects of Latino neighborhood contexts (Lee & Ferraro, 2007; Mair, et al., 2010; Osypuk, et al., 2009; Wen & Maloney, 2011). Because Latino neighborhoods have features that are both harmful and protective for obesity, more research is needed to understand the complex interplay between Latino neighborhood environments and obesity.

Chapter 2. Conceptual Framework

The causes of obesity are multifactorial and include genetic, metabolic, psychosocial and environmental influences (Hill & Peters, 1998; Poston & Foreyt, 1999). Weight gain is the result of a positive energy balance—that is, energy intake exceeds energy expenditure, which leads to excess weight (Weinsier, et al., 1998). Biological factors help govern how an individual responds to his or her environment, whereas the environment influences behaviors that are crucial to the energy balance equation including diet and physical activity (Hill & Peters, 1998). Despite scientific advancements in understanding the role that genes play in the etiology of obesity, the environment is the primary explanation for the current obesity epidemic (Björntorp & Rosmond, 2000; Hill & Peters, 1998; Weinsier, et al., 1998). In fact, obesity researchers underscore the importance of obesogenic, or obesity-conducive, environments that promote excessive food intake and discourage physical activity, as key factors that contribute to obesity (Giles-Corti, Macintyre, Clarkson, Pikora, & Donovan, 2003; Hill & Peters, 1998; Wright & Aronne, 2012).

Given the importance of the environment for obesity risk, the conceptual framework for this dissertation is based on a social-ecological perspective that argues individual health is subject to multiple levels of influence including neighborhood environments (Bronfenbrenner, 1992; Sallis, Owen, & Fisher, 2008). For example, the food access, physical activity resources and social norms in a neighborhood can influence individual behaviors that directly affect weight gain (Poston & Foreyt, 1999). The influence of neighborhood environments on weight status might also help to explain the stark racial disparities in obesity (Boardman, Onge, Rogers, & Denney, 2005). Living in segregated neighborhood environments means that racial/ethnic groups have differential exposure to harmful or protective neighborhood features (Gee & Payne-Sturges, 2004). The degree to which Latino neighborhoods are obesogenic may be related to the high

prevalence of obesity among Latino populations. The conceptual framework incorporates competing theoretical perspectives—the residential segregation and ethnic enclave theories—about the health effects of living in Latino-concentrated neighborhoods.

Based on theoretical interest in the contribution of upstream factors to health disparities, I focus on the role of two neighborhood-level features—social capital and parks—that may indirectly influence behaviors related to obesity risk. First, although the relationship between the physical environment (i.e., availability of grocery stores, walkable streets, etc.) and obesity risk is well established, less is known about how social influences might also factor into the neighborhood-obesity equation (Broyles, Mowen, Theall, Gustat, & Rung, 2011). Therefore, I investigate social capital as a potential mediator in the relationship between Latino neighborhoods and obesity. Second, although parks are recognized as an important neighborhood resource that promotes healthy lifestyles, there are considerable disparities in the availability of parks for residents of many major metropolitan areas (Harnik, 2012). Therefore, I investigate the unequal distribution of park resources in Los Angeles because it is a potential contributor to obesity disparities.

Conceptual Framework

The conceptual framework presented in Figure 1 is adapted from Black and Macinko (2008) and Northridge, et al. (2003). The model shows how obesity is determined by a complex system of both individual- and neighborhood-level factors. The constructs included in my analysis are denoted in bold text. Similarly, the arrows represent hypothesized pathways, although only the numbered arrows are tested in my analysis. Boxes with dashed lines and non-bolded words are not included in my analysis, but are shown in the model because they are related to obesity. The conceptual model is organized in five columns and represent, from left to

right, distal to proximate influences on obesity. The neighborhood columns include social factors (macro level) and neighborhood features (meso level). The individual columns include biological and psychological factors, sociodemographic variables, behaviors that regulate energy balance, and the health outcome obesity.

The bidirectional arrows between macro and meso columns depict an association without indicating a causal order. For example, although I expect Latino neighborhoods will have fewer parks than non-Latino neighborhoods, I cannot say for certain that the presence of Latinos in the neighborhood is the reason there are few parks. As the meso-level box shows, I focus on social capital and parks but recognize that there are additional environmental features that contribute to obesity risk. Also, the neighborhood environment is only one box in a long chain of factors that contribute to obesity. The next column shows there are many factors at the individual level that I did not directly measure (dashed boxes), but that are related to obesity nonetheless. For example, the arrows from biology to obesity and biology to energy balance recognize that individual variation in genetics, physiology and metabolism contributes to obesity risk. Biology also has a reciprocal relationship with psychology because there is some biological component to mood and stress (Roberts, Troop, Connan, Treasure, & Campbell, 2007). Psychological factors also have a reciprocal relationship with behaviors that affect energy balance because mood influences diet and physical activity and vice versa (Luppino, et al., 2010; Torres & Nowson, 2007). In addition, emerging research on epigenetics suggests environmental factors may affect individual gene expression related to obesity (Kuzawa & Sweet, 2009). Finally, the sociodemographic box has double-headed arrows to indicate that these individual-level factors are associated with BMI and neighborhood features. The sociodemographic variables are important confounders to control for in my model (Wang & Beydoun, 2007).

Arrow #1 represents the main effect of Latino neighborhood composition on BMI, which suggests that the conditions of Latino neighborhoods contribute to obesity. Arrow #2 represents a mediation relationship where social capital helps explain the association between Latino neighborhood composition and BMI. These arrows pass through neighborhood and individual levels indicating a multilevel relationship (Chapter 3). Arrow #3 represents the relationship between Latino neighborhood composition and parks, which is the meso-level neighborhood feature that I test as part of the ecological analysis (Chapter 4). In the discussion that follows I define each box shown in Figure 1, describe how the individual constructs are related to obesity, integrate relevant theories, and provide empirical examples from the literature on neighborhoods and obesity.

Macro. Beginning at the far left of the model, the macro column represents the historical, political and social factors that produce Latino neighborhoods, including housing discrimination and immigrant settlement patterns (Charles, 2003; Massey & Denton, 1993). Segregated neighborhoods contain both stressors and resources related to obesity risk (Gee & Payne-Sturges, 2004).

There are different theoretical perspectives as to the causes of neighborhood segregation. On the one hand, the *residential segregation perspective* points to institutional racism evidenced by policies such as Jim Crow laws and de facto segregation that limited access to specific neighborhoods for non-white groups (Massey & Denton, 1993). The residential segregation perspective highlights the neighborhood's role in restricting assimilation, integration and upward mobility. On the other hand, the *ethnic enclave perspective* states that the spatial clustering of ethnic groups comes as a result of residents' own preferences for living among co-ethnics and familiar cultural institutions (Clark, 1991; Logan, Zhang, & Alba, 2002). The ethnic enclave

perspective views the neighborhood's primary function as aiding in the assimilation process, by providing social support, ethnic community groups and appropriate language resources. The framework for this dissertation incorporates both the residential segregation and ethnic enclave theories to understand how Latino neighborhoods impact health (Mair, et al.).

Residential segregation. The residential segregation perspective calls attention to the social marginalization of residents that comes as a consequence of the imposed nature of the neighborhood physical boundaries (Marcuse, 2005). Latino *barrios* are often described in terms of their spatial and social isolation that limits upward mobility and access to resources that aid in assimilation, such as employment and education (Vigil, 2008). From this standpoint, the benefits of the neighborhood (i.e., group solidarity, cultural ties, etc.) are offset by poverty, substandard schools, and poor infrastructure (Molina, 2006). This theoretical perspective considers barrios as the Latino parallel to African American ghettos because both are characterized by neighborhood poverty, concentrated racial group residence, and inner city location (Vigil, 2008). Not only does this process of *barrioization* keep Latinos spatially separate but it also effectively excludes them from larger political, social and economic processes (Molina, 2006).

The residential segregation hypothesis posits a negative association between Latino neighborhood composition and health status. That is, neighborhoods with a high proportion of Latino residents will have worse health outcomes. In this case, the concentration of Latinos serves as a proxy for poor neighborhood conditions, which contribute to the poor health of residents. Williams and Collins (2001) describe residential segregation as a fundamental cause of health disparities because concentrated poverty leads to a number of unhealthy neighborhood features including safety concerns, limited access to healthcare resources, and chronic stress. In addition, living in poverty contributes to social disorganization and strained social environments

that erode trust and make it difficult to establish strong social connections or beneficial social norms (Yen & Syme, 1999).

Ethnic enclaves. Close to two-thirds of Latinos in the U.S. are foreign born so immigration is a stressor that is especially salient for many Latino communities (Gallo, Penedo, Espinosa de los Monteros, & Arguelles, 2009). The immigration experience often includes social marginalization, racial discrimination, acculturative stress, and language barriers. The ethnic enclave perspective follows the traditional Chicago school emphasis on the role of immigrant neighborhoods in helping residents transition to their new society by providing economic and social support (Marcuse, 2005). Economic support can come in the form of job opportunities through informal employment networks and access to cultural or ethnic businesses (Waldinger & Bozorgmehr, 1996; Zhou, 1992). The social support provided by ethnic enclaves includes enhanced group solidarity, protection against racial discrimination and harassment, and resources and services available in the appropriate language (Pickett & Wilkinson, 2008). Immigrant communities in particular are believed to have strong social ties and social cohesion as a result of kinship networks and common immigration experiences (Osypuk, et al., 2009; Portes, 2000). Of course not all Latino communities are immigrant communities and as group density theory suggests, living among co-ethnics can promote strong social connections due to a shared cultural background, regardless of foreign-born status (Pickett & Wilkinson, 2008).

The ethnic enclave hypothesis posits a positive association between Latino neighborhood composition and health status. Immigrant enclaves are believed to help maintain healthy norms typical of their native country including high-fiber diets and low rates of alcohol consumption and smoking (Bates, Acevedo-Garcia, Alegría, & Krieger, 2008; Park, et al., 2008). In addition, ethnic enclaves provide social support that benefits psychological well-being (Bécares, et al.,

2012). Social networks can also affect health by facilitating the spread of information, improving access to services, and providing support and a sense of belonging to members of a social group (Moore, 2010).

A brief history of Latino settlement in Los Angeles illustrates how aspects from both the residential segregation and ethnic enclave perspectives are relevant for understanding the development of Latino neighborhoods. In addition, both perspectives address how spatially separate living arrangements result in differential access to resources and opportunities, which have consequences for health (Gee & Payne-Sturges, 2004).

Early Mexican neighborhoods in Los Angeles were plagued by conditions familiar to poor immigrants such as crowded housing conditions, police harassment, and inferior schools (Acuña, 1988). However, they also functioned as a protected spaces against outside discrimination as residents formed their own community organizations, Spanish language newspapers, and local ethnic businesses (Acuña, 1988). The rapid development of Mexican-American neighborhoods in Los Angeles can be traced back to industrialization at the turn of the 20th century. The poor economy in Mexico coupled with industrialization in the U.S. created the right push/pull conditions for large scale immigration to the Los Angeles region during the first part of the 20th century (Acuña, 1988; Romo, 1983). Mexican workers who came to fill labor shortages began settling in Los Angeles (Acuña, 1988). Between 1900 and 1930, the area east of downtown near the Los Angeles River experienced rapid development as established Mexican communities in downtown Los Angeles were pushed east (Vigil, 2008). This area was appealing to the growing Mexican population in part because other sections of the city were off limits due to racial segregation and also because the available old housing left by earlier European

immigrants had lower rent than other parts of the city (Katz, 2010). Mexican neighborhoods at this time included Boyle Heights, East Los Angeles, and Pico-Union (Acuña, 1988).

Yet as more and more Mexican families began to settle permanently in Los Angeles and purchase homes they encountered dual housing markets, racial covenants and active resistance from both politicians and citizens (Molina, 2006). In the 1960s Los Angeles was predominantly white—Latino (and Asian) migration did not occur in large numbers until after 1970 (Waldinger & Bozorgmehr, 1996). In the 1970s and 1980s there was large scale immigration from countries in Central America due to political turmoil and war, contributing to the Latino diversity in Los Angeles (Katz, 2010). New settlement spread throughout the city in primarily industrial and unincorporated areas south of Los Angeles including Bell Gardens, Cudahy, Huntington Park, South Gate, Maywood, and South Los Angeles (Katz, 2010). The availability of jobs, affordable housing, public transportation, kinship connections and cultural services produced these Latino immigrant pockets in what were at the time, predominantly African American neighborhoods (Katz, 2010). Despite the diverse migration and settlement histories of Latino subgroups in Los Angeles many older Mexican American families and newer Central American immigrants reside in the same segregated neighborhoods (Charles, 2000; Katz, 2010).

Consistent with both, the residential segregation and ethnic enclave theories, a combination of macro-level social, political, and historical factors contributes to the creation of Latino neighborhoods. For example, residents of Latino neighborhoods may have higher BMI due to limited health services and poor social resources (residential segregation perspective) compared to residents of non-Latino neighborhoods, or lower BMI due to the presence of ethnic-specific resources and strong social connections (ethnic enclave perspective) compared to residents of non-Latino neighborhoods. A third possibility is that the conflicting effects of the

respective neighborhood environments could cancel each other out in which case residents of Latino neighborhoods would have the same BMI as residents in non-Latino neighborhoods. The box in the macro column includes characteristics of Latino neighborhoods: poverty, immigrant concentration, and residential instability. Latino neighborhood is the main independent variable for all empirical analyses.

Meso. The meso column includes three neighborhood-level determinants of individual factors that affect weight status: the food environment, physical activity environment, and social environment. First, the food environment refers to neighborhood features (e.g., supermarkets, fast food restaurants) that encourage or discourage healthy diets. Second, the physical activity environment refers to neighborhood features (e.g., parks, safety) that encourage or discourage physical activity. The food and physical activity environments are mediators in the conceptual model because they directly affect diet or physical activity (Lovasi, Hutson, Guerra, & Neckerman, 2009; Sallis & Glanz, 2009). A third aspect is the social environment, which includes neighborhood social structures (e.g., cultural norms, social capital) that support or hinder both psychological factors and behaviors related to obesity. Psychological factors such as stress can affect weight through behavioral pathways (i.e., alter diet and/or physical activity patterns) and biological pathways (i.e., increase cortisol) (Roberts, et al., 2007; Torres & Nowson, 2007). Therefore the social environment is included in the conceptual model because it indirectly affects the psychological and behavioral factors involved in the energy balance equation (Moore, 2010; Poortinga, 2006).

Although the connections between the food environment and diet, and the physical activity environment and physical activity are intuitive, the influence of the social environment on obesity is less obvious (Broyles, et al., 2011; Kremers, et al., 2006; Sallis, et al., 2006).

However, the food, physical activity and social environments are interrelated. For example, a neighborhood with parks that are clean, safe and user-friendly can encourage social interaction (Bedimo-Rung, Mowen, & Cohen, 2005; McCormack, Rock, Toohey, & Hignell, 2010). Furthermore, neighborhoods with strong social connections may be more likely to utilize community spaces, such as parks, and help to maintain park resources for the good of the neighborhood (Plane & Klodawsky, 2013). Similarly, eating is oftentimes a social activity, and the social norms around food traditions and preferences can influence not only dietary habits, but also the demand for certain types of food (i.e. ethnic, non-processed, etc.) in neighborhood retail establishments (Wang, Kim, Gonzalez, MacLeod, & Winkleby, 2007). Therefore, social capital is included as a mediator in the conceptual model because it may indirectly influence factors related to obesity including psychological processes (e.g., stress, norms), neighborhood services and resources (e.g., food and physical activity environments), and behaviors (e.g., diet and physical activity).

Food environment. The food environment refers to neighborhood features that influence diet, and includes retail food stores (e.g., grocery stores) and restaurants (e.g., fast food). The food environment is typically assessed in terms of the accessibility (i.e., proximity or density of food outlets), affordability (i.e., cost), acceptability (i.e., cultural preference), and quality (i.e., nutritional value) of food available in a community (Holsten, 2009; Wang, et al., 2007). An obesogenic food environment is one that encourages excessive unhealthy food consumption—for example, a neighborhood with convenience stores and fast food restaurants, but no supermarkets (Giskes, Van Lenthe, Avendano-Pabon, & Brug, 2011). Supermarkets offer better quality and a wider selection of healthy foods such as fresh fruits and vegetables, compared to convenience stores, which typically offer high fat, calorie dense, processed foods that have low nutritional

value (Brown, Vargas, Ang, & Pebley, 2008; Morland, Wing, Diez Roux, & Poole, 2002; Papas, et al., 2007; Zenk, et al., 2005).

Low-income and minority neighborhoods tend to have fewer supermarkets but more convenience stores and fast food restaurants than higher income, white neighborhoods (Morland, Diez Roux, & Wing, 2006; Powell, Slater, Mirtcheva, Bao, & Chaloupka, 2007; Walker, Keane, & Burke, 2010). Dietary choices may be determined in part by the type of food resources available in the neighborhood (Morland, et al., 2002). For example, residents who have access to supermarkets in their neighborhood tent to have healthier diets and lower risk for obesity compared to those living in neighborhoods without supermarkets (Morland, et al., 2002), although there are exceptions to this pattern (Sallis & Glanz, 2009; Wang, et al., 2007). Overall, minority and low income neighborhoods are disadvantaged in terms of healthy food resources (Larson, Story, & Nelson, 2009; Walker, et al., 2010).

Physical activity environment. The physical activity environment refers to aspects of the natural and built environments that support leisure-time physical activity and active lifestyles in general (Giles-Corti, Timperio, Bull, & Pikora, 2005). The neighborhood determinants of physical activity include neighborhood safety, built design features, and parks and recreation facilities. These neighborhood features may directly influence physical activity, an important part of the energy balance equation, and a proximate behavior that affects weight status.

Neighborhood safety refers to unsafe physical and social conditions that may discourage physical activity and increase stress. For example, residents are at greater risk for injury or death in neighborhoods with high crime rates and gang activity (Sampson, Raudenbush, & Earls, 1997). Physical disorder such as dilapidated buildings and graffiti contribute to safety concerns in the neighborhood (Cohen, et al., 2003; Ross & Mirowsky, 2001). Physical features such as

cracked sidewalks, poorly lit streets, and heavy traffic, may put residents at risk for accident or injury. Awareness of these risks and perceived physical disorder can deter residents from leaving the house to exercise for fear of harm or injury, which reinforces a sedentary lifestyle (Burdette, Wadden, & Whitaker, 2006; Fish, Ettner, Ang, & Brown, 2010; Saelens, Sallis, Black, & Chen, 2003a) found that adults who perceived their neighborhood as unsafe had significantly higher BMI than those who perceived their neighborhoods as safe. There are also mental health effects of living in unsafe neighborhoods that contribute to obesity. An indirect consequences of unsafe neighborhoods is the stress associated with living in a high crime area—and stress is directly related to obesity (Aneshensel & Sucoff, 1996; Sampson, Morenoff, & Gannon-Rowley, 2002). For example, physical disorder indicates neglect, which can prompt feelings of despair and hopelessness among residents (Ross & Jang, 2000). In addition, social disorder such as fear of crime or violence has been linked to reduced physical activity (Roman & Chalfin, 2008). Poor and racially isolated neighborhoods are more likely to experience neighborhood disorder than non-poor, white neighborhoods (Chang, Hillier, & Mehta, 2009; Ross & Jang, 2000).

Built design refers to manmade or modifiable aspects of the urban form such as sprawl, land use, and transportation infrastructure (Lopez & Hynes, 2006). From a physical activity standpoint, these built design features are important because they influence the walkability of a neighborhood. Neighborhoods that are more conducive to active lifestyles are ones that are less reliant on cars for everyday activities and provide safe paths for pedestrians, such as sidewalks. For example, sprawl, defined as low residential density contributes to dependence on automobiles for transportation because destinations are too far apart to walk to (Ewing, Schmid, Killingsworth, Zlot, & Raudenbush, 2003; Lopez, 2004). By contrast, designs that contribute to more active communities include residential density and street connectivity, which facilitate

walking and biking (Papas, et al., 2007; Saelens, Sallis, & Frank, 2003b). Land-use mix refers to neighborhoods that include commercial and residential zoning (Frank, et al., 2006). Residents of mixed land use neighborhoods can walk or bike rather than relying on cars for short trips (Lopez, 2004; Saelens, et al., 2003a). Transportation infrastructure includes sidewalks, bike lanes, and public transit options that support alternatives to automobiles (Saelens, et al., 2003b). An additional benefit of well-designed neighborhoods is that they encourage interaction among residents, which has social and psychological benefits (Lopez, 2004). Although many poor, urban neighborhoods have built-design features that encourage active lifestyles, such as connected street layouts, residents of disadvantaged neighborhoods still suffer disproportionately from obesity (Lopez, 2004). This indicates that there are other neighborhood features, beyond walkability, that affect physical activity levels. Poverty, safety, and social influences may offset the positive benefits of walkable built designs (Lopez & Hynes, 2006).

Parks refer to public parks and recreation facilities. Parks have a variety of features that support different types of play and exercise activities such as baseball fields, basketball and tennis courts, swimming pools, playgrounds, and trails for hiking and biking (Bedimo-Rung, et al., 2005). In addition, parks and recreation departments typically offer free or low cost programs for team sports and instructional classes such as swimming, dance, martial arts, yoga, and aerobics (Dahmann, et al., 2010). Beyond the physical activity benefits, park use can support psychological health by reducing stress and improving moods, and encouraging social interactions, which can enhance group cohesion and social capital in the community (Bedimo-Rung, et al., 2005).

Despite the importance of parks for individual and community well-being, there are notable disparities in park use, access, and availability by neighborhood SES and racial/ethnic

composition (Boone, et al., 2009; García & White, 2006; Wolch, et al., 2005). For example, certain populations are less likely to use parks, including inner-city residents, poor people, and racial/ethnic minorities (Bedimo-Rung, et al., 2005). In addition, leisure studies and park management research find that preferences for specific types of park features and activities differ by racial/ethnic group (Baas, Ewert, & Chavez, 1993; Chavez, 2001; Gobster, 2002; Ho, et al., 2005; Sasidharan, And, & Godbey, 2005). Examples of racial/ethnic park-use patterns are that Latinos and Asians tend to use parks for group and social events such as family gatherings, parties and picnics, whereas whites use parks for individual activities such as hiking and biking (Gobster, 2002). Also, non-white groups prefer developed park features, such as playgrounds or sports fields, but whites prefer natural park features, such as hiking trails or nature preserves (Baas, et al., 1993; Chavez, 2001; Cronan, Shinew, Schneider, Stanis, & Chavez, 2008; Ho, et al., 2005).[2]

That said, reporting trends as a matter of group preference highlights group differences, masks within group variation and can engender racial stereotypes (Byrne, 2012; Gobster, 2002). Further, recommendations from studies of differential park use typically center on "serving the needs of diverse park users" through cultural sensitivity training for park management (Gobster, 2002). These conclusions are problematic because they assume that the primary reason for differential park use is culturally rooted. Missing from this perspective is serious consideration of the personal, institutional and structural barriers to park use faced by communities of color that might shape preferences for certain activities or contribute to underutilization of certain park

[2] Leisure studies describes park features in terms of the level of land development—*developed park features* are built or manmade elements of parks, and *natural park features* by contrast are less developed and closer to the natural habitat (Harnik, 2012).

features (Byrne, 2012; Cutts, Darby, Boone, & Brewis, 2009; Floyd, 2007; Godbey, Caldwell, Floyd, & Payne, 2005; Gómez & Malega, 2007).

Common constraints and barriers to park use include lack of time and money, lack of information about park facilities, discrimination and feeling unwelcome at parks, limited transportation, and safety concerns (Bedimo-Rung, et al., 2005). For example, Byrne reports that his Latina focus group respondents living in Los Angeles faced barriers to accessing natural park features including not knowing where natural habitats were located, feeling unwelcomed, and having limited transportation options to parks that were not located nearby (Byrne, 2012).

Underlying the issues of park use and access is the question of park availability. The impact of historical segregation patterns is important for understanding and interpreting where parks are located (Boone, et al., 2009). Discriminatory policies and exclusionary practices were not limited to housing. Despite laws against discrimination, people of color were excluded from parks, pools, and beaches (García & White, 2006). Furthermore, parks, like neighborhoods, were developed as racialized projects and can be thought of as "spatial expressions of racial discrimination" (Byrne & Wolch, 2009). The inequitable distribution of parks and recreation facilities illustrates an environmental injustice because it indicates that certain communities do not have health-promoting resources (Boone, et al., 2009; Sister, et al., 2010; Taylor, Poston, Jones, & Kraft, 2006). In fact, Gorden-Larsen et al., (2006) suggest that "inequality in the built environment might underlie important ethnic and sociodemographic health disparities." Specifically, the lack of parks in some communities may be a contributing factor to disparities in physical inactivity and obesity (Boone, et al., 2009; Moore, Diez Roux, Evenson, McGinn, & Brines, 2008).

Of course parks are not the only neighborhood feature that supports active lifestyles. The general walkability, aesthetics and safety of the neighborhood encourage other physical activities that are not structured exercise activities (i.e., running errands), but that contribute to active lifestyles nonetheless (Giles-Corti, et al., 2003). Also, private gyms or fitness clubs offer alternatives to public parks, and activities such as jogging do not require specialized facilities. However, these resources vary by neighborhood—not all neighborhoods have private fitness facilities (or residents who can afford private gym memberships); also not all neighborhoods have streets that are safe for jogging (e.g., cracked sidewalks, poorly lit streets, etc.) (Bedimo-Rung, et al., 2005; Cutts, et al., 2009). Public parks by contrast are free, available for public use, and support a variety of activities. Parks are especially important in dense, urban settings where open recreational space and green space are limited (Duncan, et al., 2012). Therefore, public parks remain a key feature of the physical activity environment that support exercise and active lifestyles, and may protect against obesity.

Social environment. The social environment refers to the social processes and relationships that take place within neighborhood contexts. The social environment includes various social features of neighborhoods including cultural norms, family and peer influences and social capital. Examples of weight-related cultural norms include ideal body weight and preferred forms of social engagement and activities, such as physical activity or television viewing. The social environment contains elements that can be both harmful and beneficial for obesity risk. For example, unhealthy social norms about diet and acceptable overweight status can de-incentivize healthy eating or exercise (Leahey, LaRose, Fava, & Wing, 2012). Christakis and Fowler (2007) found that obesity spread through social contacts and suggest that higher weight status is an acceptable norm in some social circles. For example, Hispanic women may be

more accepting of heavier weight status due to cultural or racial preferences for larger body size (Fitzgibbon, Blackman, & Avellone, 2000). There is evidence that such "weight-related subcultural orientation" may operate in neighborhood contexts as well (Boardman, et al., 2005; Chang, 2006; Wen & Maloney, 2011).

However, there are also health-promoting aspects of the social environment, namely social capital. Emerging research suggests that certain forms of social capital, including social cohesion and group participation, affect both psychological and physical health (Kawachi, Subramanian, & Kim, 2008; Moore, 2010). In this dissertation, social capital is broadly defined and refers to the features and resources of social life. There are different interpretations of social capital, but the public health application of social capital typically focuses on (a) the features of social networks that facilitate action and the potential for mutual benefit including trust, social cohesion and social norms (Putnam, 1993), and (b) the resources that can be accessed through a social network such as money, social support, or social influence (Bourdieu, 2008; Carpiano, 2006; Kawachi, et al., 2008; Moore, Shiell, Hawe, & Haines, 2005). A neighborhood characterized by socially cohesive, trusting relationships (i.e., social capital features) is able to make use of social and tangible support (i.e., social capital resources). Therefore, I hypothesize that social capital may offer some protection against obesity through the development of supportive relationships and the availability of tangible resources. The two forms of social capital that have been linked to obesity are social cohesion and group participation (Carpiano, 2006; Kawachi, et al., 2008; Moore, et al., 2005).

Social cohesion can be defined simply as group solidarity (Lochner, Kawachi, & Kennedy, 1999). Social cohesion is typically measured in public health studies by how well members of a group get along and trust each other (Lochner, et al., 1999). Social cohesion may

play an important role in influencing psychological processes related to obesity (Reidpath, Burns, Garrard, Mahoney, & Townsend, 2002). For example, social cohesion can help mitigate stress and depressed mood by fostering socially supportive relationships, encouraging social interaction among neighbors, and reducing social isolation (Kawachi & Berkman, 2000). Residents of disorganized and impoverished neighborhoods often report low levels of trust and experience greater daily stressors (Sampson, et al., 2002). Therefore, social cohesion may help to attenuate some of the negative effects of living in a chronically stressful environment. There is some evidence that social cohesion may influence obesity-related behaviors too, although the mechanisms are not entirely clear (Cohen, et al., 2006; Moore, 2010). Neighborhood trust was associated with increased likelihood of engaging in physical activity and lower likelihood of obesity (Addy, et al., 2004; Poortinga, 2006).

Group participation refers to participation in voluntary associations or other community organizations. This is a measure of social connectedness and social integration and is believed to affect health through enhancing social ties and networks, and broadening access to information and resources (Harpham, 2008; Lochner, et al., 1999). Various types of associational involvement may have protective effects for obesity risk (Moore, 2010). Not surprisingly this effect was stronger when the group was a sports club or involved some other type of physical activity (Moore, 2010; Veenstra, et al., 2005). However, the fact that even general (i.e., not fitness related) group participation was associated with reduced risk for overweight or obesity suggests that there may be other socially derived benefits from participating in formal group activities, such as reduced social isolation, increased social support, and access to important health resources. For example, Marcelli (2004) found that Mexican immigrants in California who were involved in civic groups were more likely to receive medical care and access to public

health insurance programs. Though the extent, nature, and intensity of group participation will vary, these types of formal network associations are potentially important sources of information, social support and instrumental support (Harpham, 2008).

Biological components. The biological components related to obesity include genetics, physiology and metabolism (Hill & Melanson, 1999). The components of the energy balance equation are: resting metabolic rate, the thermic effect of food, and the energy expended in physical activity (Hill & Melanson, 1999). All three of these factors are influenced by genetic traits to varying degrees (Weinsier, et al., 1998). Individual variation in physiology and metabolism also help determine obesity risk (Weinsier, et al., 1998). Ongoing research on genetic susceptibility, gene-environment interaction, and epigenetics contribute to our understanding of obesity etiology (Jackson, Niculescu, & Jackson, 2013; Kuzawa & Sweet, 2009). However, from a population perspective, the genetic components likely play a small role in the rapid rise in obesity or the racial/ethnic and socioeconomic disparities in obesity (Poston & Foreyt, 1999). Also, although genetic factors may make some individuals more susceptible to developing obesity, other determinants must also be present for obesity to develop including psychological, cultural, and environmental factors (Poston & Foreyt, 1999).

Psychological components. The psychological components related to obesity include stress, depression, behavioral intentions, and body image. Chronic stress affects different biologic pathways (e.g., Hypothalamic-Pituitary-Adrenal Axis, cortisol) and increases hormones that regulate appetite (Björntorp, 2001; Roberts, et al., 2007). Elevated cortisol levels are associated with both stress and abdominal obesity (Björntorp & Rosmond, 2000). Also, stress-induced eating of comfort foods high in sugar and fat contributes to weight gain over time (Björntorp, 2001; Torres & Nowson, 2007). Depression and obesity have a bidirectional

association, and there may be both biological (e.g., inflammation) and psychological (e.g., distress) mechanisms at play (Luppino, et al., 2010). Behavioral intentions refer to an individual's attitude, knowledge, and self-efficacy regarding diet and exercise (Leahey, et al., 2012; Mohnen, Volker, Flap, & Groenewegen, 2012; Sallis, et al., 2008). Behavioral intentions precede the weight-related behavior itself; that is, a belief that exercise will be beneficial may prompt a sedentary individual to engage in physical activity. Lastly, body image is another psychological factor that can affect diet and physical activity (WHO, 2000). Individual body image is influenced by social and cultural norms about preferred body size (Fitzgibbon, et al., 2000).

Sociodemographic characteristics. The individual-level determinants of obesity include the following sociodemographic characteristics: age, race/ethnicity, female, U.S. born, family income, and education. Older age is associated with an increase in BMI. Race/ethnicity is associated with BMI. In the U.S., blacks and Latinos have the highest prevalence of obesity compared with other groups (Flegal, et al., 2012). Racial/ethnic disparities in obesity have been attributed to cultural differences with regard to food, exercise and body image, low socioeconomic status and limited access to health promoting resources (Wang & Beydoun, 2007). Females are at greater risk for obesity in part due to physiological differences—women have increased storage of fat compared to men (Ali & Lindström, 2006). Gender may also interact with other social influences that affect weight gain, including neighborhood stressors (Ellaway & Macintyre, 2001; Matheson, Moineddin, & Glazier, 2008; Stafford, Cummins, Macintyre, Ellaway, & Marmot, 2005). Foreign born residents have a health advantage over U.S. born residents for a number of health outcomes including obesity (Buttenheim, Pebley, Hsih, Chung, & Goldman, 2012). The better health status of foreign born residents may be a result of

healthy behavioral norms (i.e., low fat diet, low tobacco use) from the home country, whereas U.S. born residents have higher obesity risk due to an unhealthy American lifestyle (i.e., fast food, sedentary lifestyle). Finally, the socioeconomic status (SES) indicators are family income and education, which have an inverse association with BMI. The SES variables represent the well-established social gradient of health where higher SES confers protection against poor health because of increased access to health-promoting resources.

Behaviors. The health behaviors column highlights the most proximate determinant of obesity—the balance between calorie consumption (diet) and energy expenditure (physical activity). Although there are metabolic and genetic components that affect the energy balance equation, diet and physical activity play a crucial role in this process (Poston & Foreyt, 1999; WHO, 2000). In addition, these behaviors can be modified, which is one reason that much of the public health intervention for obesity is focused on improving unhealthy diets and reducing sedentary behaviors (WHO, 2000).

Dependent variable. Finally, the health outcome in the far right column, obesity, is affected by a complex pathway of both neighborhood and individual influences. Obesity is operationalized as Body Mass Index (BMI= kg/m^2), which is a measure of weight-for-height used to classify underweight, normal weight, overweight, and obesity in adults (Deurenberg, Weststrate, & Seidell, 1991; WHO, 2000). The standard BMI categories are normal weight (18.5-24.9), overweight (25-29.9), and obese (30 or greater) (WHO, 2000). Technically, BMI is not a measure of fatness or adiposity. BMI does not distinguish between fat and muscle nor does it account for individual variation in body composition or other individual physiological differences (Burkhauser & Cawley, 2008). Nevertheless, it remains a useful tool for estimating

the prevalence of obesity in the population because it relies on weight and height data that are easy to collect, nonintrusive, and cost sensitive (WHO, 2000).

Research Questions

Altogether this conceptual model integrates theories and hypotheses about how Latino neighborhoods are related to obesity risk. Specifically, I focus on social capital as a feature of Latino neighborhood social environments that may indirectly affect individual BMI. I also investigate disparities in park availability for Latino neighborhoods because parks are an important resource for obesity prevention. The theoretical framework outlined in this chapter applies an upstream approach to studying obesity disparities and highlights how macro, meso, individual and behavioral factors are interrelated. Based on this approach I have developed the following research questions about Latino neighborhoods and obesity risk:

1. Is neighborhood percent Latino associated with individual BMI, over and above individual-level determinants?
2. Does social capital explain (i.e., mediate) the relationship between neighborhood percent Latino and BMI?
3. Are Latino immigrant neighborhood characteristics associated with park availability?
4. Are Latino immigrant neighborhood characteristics associated with different park feature types (natural or developed)?

Questions 1 and 2 are addressed in Chapter 3 as part of a multilevel analysis using data from a sample of Los Angeles neighborhoods. Questions 3 and 4 are addressed in Chapter 4 as part of an ecological analysis using data for all neighborhoods in Los Angeles County.

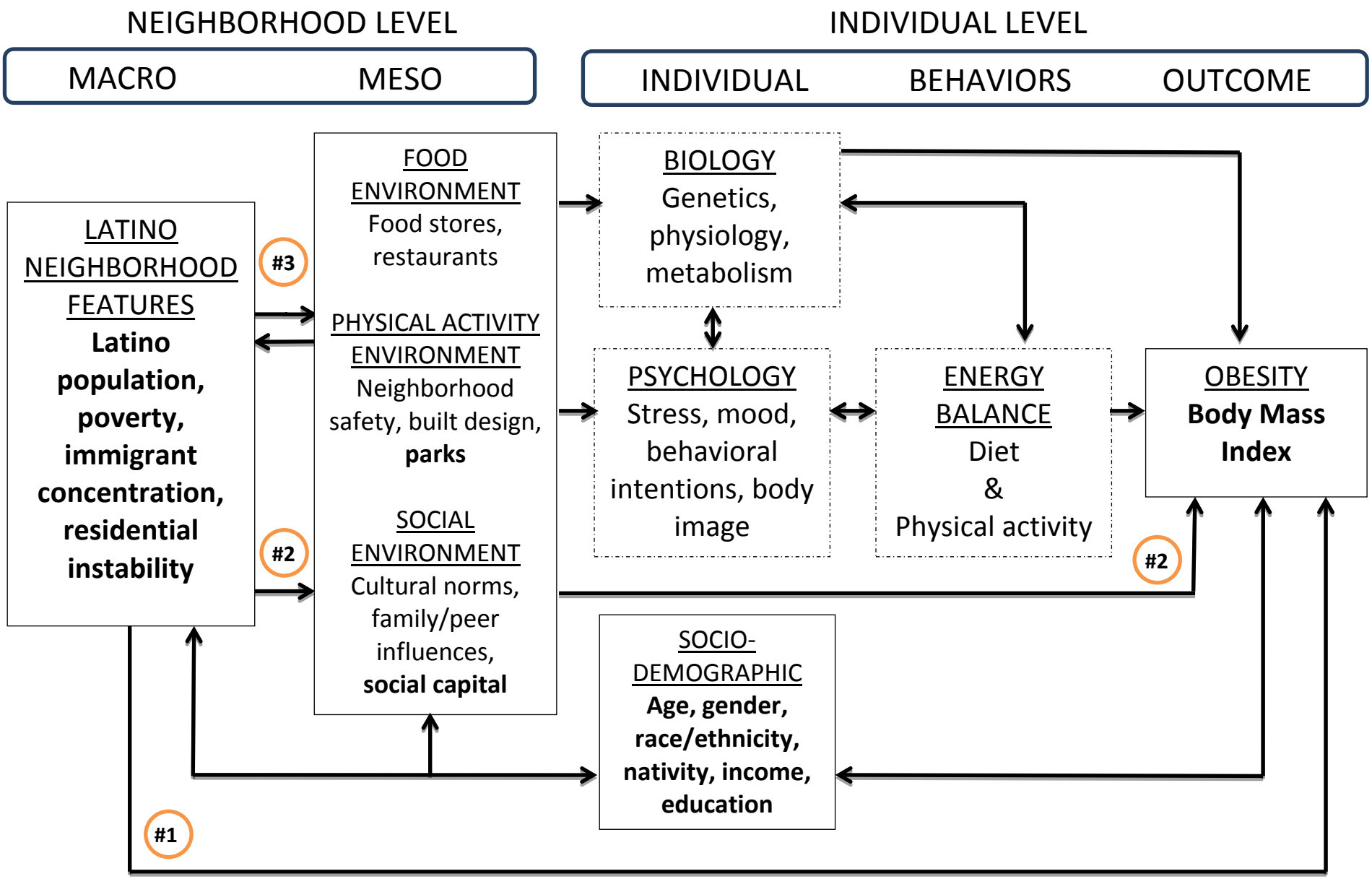

Figure 1. Model of Theoretical Framework.

Chapter 3. Latino Neighborhoods, Social Capital, and Body Mass Index (Multilevel Analysis)

Latino neighborhood composition may be associated with higher BMI and higher odds of obesity (Corral, et al., 2013; Do, et al., 2007). Findings of a positive association between Latino neighborhood composition and obesity support a residential segregation interpretation of neighborhood effects—that is, neighborhood features such as poverty and limited resources that are associated with minority concentration are harmful to health (Williams & Collins, 2001). However, there is also evidence of a negative association between Latino neighborhood composition and obesity, but it is not entirely clear how Latino neighborhood contexts might protect against obesity (Kershaw, et al., 2013; Park, et al., 2008).

One possibility is that social resources in the neighborhood can buffer against unhealthy features of Latino neighborhood environments. Neighborhood social capital can support healthy lifestyles by mitigating stress, indirectly influencing weight-related behaviors, and providing access to health information and resources. For example, neighborhood social cohesion and group participation are associated with walking for exercise and lower BMI (Echeverría, Diez-Roux, Shea, Borrell, & Jackson, 2008; Moore, 2010). These findings raise the possibility that social capital in Latino neighborhoods may act as a protective buffer against obesity risk. Whether or not Latino neighborhoods, specifically, have high social capital is an open question and likely depends on the type of social capital. Almeida et al., (2009) found that Mexican neighborhoods in Chicago had large social networks but did not have high social cohesion. Using data from Los Angeles I address two questions:

1. Is neighborhood percent Latino associated with individual BMI, over and above individual-level determinants?

2. Does social capital explain (i.e., mediate) the relationship between neighborhood percent Latino and BMI?

The setting for this study is Los Angeles County, California, a geographically large area that in 2000 included 1,652 census tracts in 88 different cities over 4,083 square miles (Sastry, Ghosh-Dastidar, Adams, & Pebley, 2006). Los Angeles has a large and diverse population, well suited for studying the intersections of race, immigrant communities, and the urban environment. In 2000, the total population of Los Angeles County was 9.5 million, and the racial/ethnic composition was 45% Latino, 31% white, 13% Asian-Pacific Islander, and 10% African American (Sastry, et al., 2006). Los Angeles is also a major immigrant gateway with about 30% of the population born outside of the U.S. (Sastry, et al., 2006).

Data

Data come from two sources, the Los Angeles Family and Neighborhood Survey (L.A. FANS) and its companion dataset, the Los Angeles Neighborhood Services and Characteristics database (L.A. NSC) L.A.NSC, which provide contextual data to compliment the individual level survey data from L.A. FANS.

L.A. FANS. The Los Angeles Family and Neighborhood Survey is a longitudinal study of neighborhoods and households in Los Angeles County conducted by the RAND Corporation and UCLA (RAND/L.A.FANS, 2011). The data for this analysis are from Wave 1, which was collected from 2000-2001. Census tracts were used as the sampling units because they are well defined areas of moderate size (approximately 5,600 residents per tract) for which current population and poverty estimates are available (Sastry, et al., 2006). I will use the terms *neighborhoods* and *census tracts* interchangeably.

L.A.FANS was designed to support multilevel data analysis (Sastry, et al., 2006). A multistage, stratified sampling design was employed to obtain an oversample of poor and very poor census tracts. Non-poor neighborhoods were also included so these data represent a range of neighborhood types across Los Angeles County. The resulting stratified random sample consists of 65 (out of 1,642) census tracts that reflect the diversity found in Los Angeles neighborhoods with respect to geographic location, social conditions, race/ethnicity, socioeconomic status, and immigrant status. With the inclusion of sample weights, L.A. FANS is a representative sample of the Los Angeles County population (Sastry, et al., 2006).

Neighborhoods were stratified by percent of the tract population living in poverty, which yielded three strata: very poor (the top 10% of the poverty distribution), poor (tracts in the 60th to 89th percentiles), and non-poor (tracts in the bottom 60% of the poverty distribution) (Sastry, et al., 2006). Neighborhoods were sampled within each stratum and then 40 to 50 households within each of the 65 neighborhoods were interviewed, resulting in the final sample of 3,085 households (Sastry, et al., 2006).

Trained field interviewers visited the sampled households and used computer assisted personal interviewing (CAPI) software to administer surveys beginning with an initial household roster, followed by individual modules for different household members (Peterson, et al., 2004). Interviews were conducted in English and Spanish depending on the preference of the respondent. One adult respondent was selected by computer at random to serve as the randomly selected adult (RSA) for the household. In households with children under age 17, an RSA, randomly selected child, and their primary caregiver (PCG) were also selected. In just over half of the cases the RSA and the PCG were the same person (RSA/PCG), and in the remaining cases

there were separate RSA (RSA-only) and PCG (PCG-only) respondents in the same household (Peterson, et al., 2004).

Respondent type is important because it determined which of several L.A. FANS modules were administered to which household member. Based on the research questions and outcomes of interest for this study I used data from three separate modules: the roster, the household questionnaire, and the adult questionnaire. The roster includes basic demographic information for all household members, including age, race/ethnicity, gender, and nativity status. The household module asked about household characteristics, including income information for all family members living in the household. The relevant variables from the adult questionnaire include educational attainment, social capital, and self-reported weight and height (used to calculate BMI). The social capital questions were administered to RSA-only and RSA/PCG respondents, but not PCG-only respondents (Peterson, et al., 2004). Some of the social capital questions ask about level-1 (individual-level) constructs such as individual group participation and pertain only to the respondent. Therefore, the question about individual group participation does not apply to PCG respondents because they did not complete the social capital portion of the questionnaire. However, other social capital questions ask about level-2 (neighborhood-level) constructs such as the social cohesiveness of the entire community and, therefore, apply to everyone living in the neighborhood even though they were answered by only a subset of adult respondents. Detailed descriptions of these variables including how they were coded and aggregated are provided in the Measures section below.

L.A. NSC. The Los Angeles Neighborhood Services and Characteristics database was developed for use with L.A. FANS and contains tract-level data for all Los Angeles County census tracts (n=1,642) (Peterson, Pebley, & Sastry, 2007). The L.A. FANS sampling scheme

was designed using 1990 census tract boundaries, but data were collected between 2000 and 2001. L.A. NSC contains data from the 2000 U.S. Census that have been converted to 1990 census tract boundaries, facilitating use with L.A. FANS. The tract-level variables used in this study are: percent Latino, concentrated disadvantage, and residential stability. In addition to providing descriptive measures of Los Angeles neighborhoods, these data will serve as neighborhood-level variables in the multilevel analysis.

Restricted data. I acquired access to L.A FANS restricted data version 2, which includes census tract numbers allowing me to link neighborhood characteristics with individual data. Although this analysis uses secondary data, there is a risk for re-identification given the type and level of data collected (Peterson, et al., 2004). To protect respondent confidentiality, I followed strict data protection protocol approved by RAND.[3] To establish the working dataset, I conducted a number of separate data merges using a 12-digit unique ID number assigned for each household sampled and a 2-digit personal identification number for the household respondent to link individual L.A. FANS modules, and census tract numbers to link the L.A. FANS and L.A. NSC datasets. All data cleaning and analysis was conducted in Stata 12 (StataCorp, 2011a).

Analytic sample. After I completed all of the data merges, the full L.A. FANS sample was 3,423 individuals. To derive my analytic sample, I first limited the sample to the correct respondent type. I dropped 20 cases because they did not have an adult sample weight (i.e., three emancipated minors, nine respondents who were given the adult survey in error, and eight PCG respondents under age 18). The resulting full adult sample consists of RSAs, RSA/PCGs and

[3] Specifically, I conducted all analysis of restricted data in a secure data enclave and did not include case identifiers in any of my files. I received approval to access the restricted data from RAND on February 20, 2012, and approval for my dissertation project from the UCLA Office of the Human Research Protection Program on May 23, 2012 (ID: IRB#12-000646).

PCGs (n=3,403). Next, I dropped cases that were missing information on the individual level variables used in my analysis. The variable that had the most missing cases was BMI (n=308, about 9% of the total missing cases). BMI was derived from self-reported weight and height information and some respondents either did not know (n=159) or refused (n=134) to provide this information. Data were also missing on family income (n=159), education (n=55), and age (n=3). After I dropped the cases with missing data on key variables (n=484), the final analytic sample included 2,919 adult respondents, which is 86% of the full adult sample. The analytic sample steps are summarized in Figure 2.

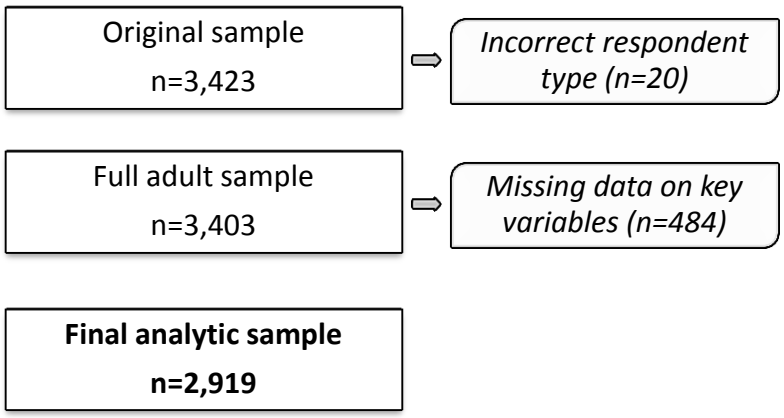

Figure 2. L.A. FANS Analytic Sample Flow Chart.

Measures

Dependent variable. The outcome is a continuous measure of *body mass index (BMI)* (kg/m^2), which is a proxy measure of body fat (Deurenberg, et al., 1991). The distribution for BMI was approximately normal. BMI is commonly used in survey research to estimate obesity in the population (Burkhauser & Cawley, 2008; WHO, 2000). BMI was calculated using self-reported weight and height from the L.A. FANS adult module. There is concern about the validity of self-reported weight and height because of the tendency of respondents to underestimate weight and overestimate height, thereby underestimating the risk of overweight

and obesity (Gillum & Sempos, 2005; Nyholm, et al., 2007; Wen & Kowaleski-Jones, 2012). However, a comparison of anthropometric versus self-reported weight and height measures in a sample of L.A. FANS adults found that the correlation between self-reported and measured data was quite high (Jones, 2011).[4]

Independent variable. The main independent variable of interest is Latino neighborhood composition, which has been theorized as both a harmful factor (residential segregation perspective) and a protective factor (ethnic enclave perspective) for health (Lee & Ferraro, 2007; Mair, et al., 2010; Osypuk, et al., 2009; Viruell-Fuentes, Ponce, & Alegría, 2012). Because there are numerous ways to operationalize Latino neighborhoods, I conducted a sensitivity analysis that compared four different measures of Latino neighborhood composition: continuous, dichotomous, quartiles, and a composite score. The results of the sensitivity analysis indicated that there was little difference between the measures, so my dissertation reports the findings from the continuous measure, neighborhood percent Latino. The details of the sensitivity analysis are reported in Appendix A.

Mediator variables. Social capital is hypothesized to mediate the relationship between Latino neighborhoods and BMI (Kim, et al., 2008; Legh-Jones & Moore, 2012; Moore, Daniel, Paquet, Dubé, & Gauvin, 2009). The social capital variables were created from questions included in the adult module in L.A. FANS. The level-2 social capital construct *social cohesion* assesses what people think and feel about their neighborhood on the whole (Harpham, 2008). Accordingly, the survey items ask about individual perceptions of neighborhood-level processes. I generated a social cohesion scale by summing individual survey item scores and then calculated the scale mean for each neighborhood. Thus, social cohesion has been aggregated to the

[4] Anthropometric measures of weight and height data were collected in Wave 2 of L.A. FANS but not Wave 1, so I was not able to make use of these more reliable measures.

neighborhood level and is treated as a level-2 variable in the regression model. The census tracts had sufficient sample sizes to derive reliable aggregate estimates. The top panel of Table 1 reports the response coding, mean values, standard deviations and reliability scores (Cronbach's alpha) for the social cohesion scale, and the means and standard deviations for the corresponding individual survey items used to generate the scale. Higher scores indicate greater neighborhood social cohesion.

Social cohesion represents the degree of mutual trust and connectedness within a community (Lochner, et al., 1999; Sampson, Morenoff, & Earls, 1999; Sampson, et al., 1997). Neighborhood cohesion may help to cultivate social relationships that provide psychological or emotional support and allow for the exchange of health information and tangible resources (Echeverría, et al., 2008; Franzini, et al., 2009; Kawachi & Berkman, 2000). Therefore, I expect neighborhoods with high social cohesion will have low BMI because the availability of social and tangible resources may help residents deal with stress and support healthy living. Respondents were asked how much they agreed with the following statements on a 5-point Likert scale: (a) This is a close-knit neighborhood, (b) People around here are willing to help their neighbors, (c) People in this neighborhood generally don't get along with each other, (d) People in this neighborhood do not share the same values, (e) People in this neighborhood can be trusted. Items 3 and 4 were reverse coded. The social cohesion scale has a mean score of 2.62 and Cronbach's alpha of 0.69.

The other social capital measure is group participation, which is a measure of individual formal group affiliations and is operationalized at the individual level (Harpham, 2008). Unlike social cohesion, group participation is not a construct that reflects the broader neighborhood but refers to the social network of an individual respondent. Therefore, the sample size for the group

participation score is smaller than for the level-2 mediator because it only applies to those individuals who answered the group participation question and cannot be applied to the whole neighborhood. The bottom panel of Table 1 shows the means and standard deviations for the total number of groups and for each type of group activity that respondents participated in during the previous year. Higher scores indicate broader social networks of individual residents in the neighborhood.

Group participation indicates the extent to which the respondent is integrated in his or her community and has access to a broad social network. Formal group participation can help group members access health-related information and resources (Greiner, Li, Kawachi, Hunt, & Ahluwalia, 2004; Legh-Jones & Moore, 2012). Therefore, I expect neighborhoods with high mean group participation scores will have low BMI because residents benefit from the resources (both social and tangible) available through their network. Group participation was calculated as the total number of formal groups the respondent participated in during the past 12 months. Respondents chose from the following activities: neighborhood or block organization meeting, business or civic group (for example, Masons, Elks, Rotary Club), nationality or ethnic pride club, local or state political organization, volunteered in a local organization, veterans' group, labor union, literary, art, study, or discussion group, and fraternity, sorority, or alumni group. The mean group participation score for the sample was 0.61.

Table 1. Survey Items Used to Create Social Capital Measures.[a]

	Mean	SD	Cronbach's Alpha
Level-2 social capital measure[b]			
Social cohesion scale (1-Never , 4- Often):	2.62	0.31	0.69
This is a close-knit neighborhood	2.85	1.14	
People around here are willing to help their neighbors.	2.33	0.94	
People in this neighborhood generally don't get along with each other.[c]	2.41	0.95	
People in this neighborhood do not share the same values.[c]	2.90	1.06	
People in this neighborhood can be trusted.	2.58	1.02	
Level-1 social capital measure[d]			
Group participation	0.61	0.45	
In the past 12 months, have you yourself participated in the following activities?			
Neighborhood or block organization meeting	0.12	0.32	
Business or civic group (for example, Masons, Elks, Rotary Club)	0.06	0.23	
Nationality or ethnic pride club	0.05	0.21	
Local or state political organization	0.05	0.21	
Volunteered in a local organization	0.17	0.37	
Veterans' group	0.02	0.13	
Labor union	0.04	0.21	
Literary, art, study, or discussion group	0.09	0.29	
Fraternity, sorority, or alumni group	0.04	0.19	

Source: L.A. FANS, 2000-2001.
[a] All social capital measures were derived from a smaller sample (n= 2,220) of those adults who completed the neighborhood section of the adult survey (RSAs and RSA/PCGs). [b] Because this is a level-2 construct, individual responses were aggregated to the neighborhood-level and apply to the neighborhood sample as a whole (n= 65). [c] Items were reverse coded. [d] The mean scores for the sample are presented here as a summary measure, but because this is a level-1 construct, only applies to the individuals who answered this question (n= 2,220).

Control variables (neighborhood). The neighborhood characteristics included as neighborhood-level control variables are concentrated disadvantage and residential stability. Both concepts are measured as factor scores created from the Census 2000 SF-3 variables using the principal-factor method in Stata 11 (Peterson, et al., 2007).[5] The *concentrated disadvantage* score is based on percent living in poverty, percent of female-headed households, male

[5] The factor scores were created by the L.A. FANS project and included as part of the L.A. NSC data file.

unemployment rate, and percent of families receiving public assistance. Disadvantaged neighborhoods are associated with conditions that would be detrimental to health such as lack of safety and a poor food environment that would increase BMI (Lopez, 2007). *Residential stability* is a factor score based on percent of dwellings in multi-unit housing, percent of owner-occupied housing, percent living at the same address for the past five years, and the percent of non-family households. Stable neighborhoods are believed to foster a strong social environment, reduce stress, and increase trust among neighbors (Sampson, et al., 1997; Yang & Matthews, 2010).

Control variables (individual). Models also controlled for individual-level sociodemographic characteristics associated with BMI: age, race/ethnicity, female gender, nativity status, family income and education. Because age and weight status are positively correlated, *age* is included in the model, both as a continuous variable and as an *age-squared* term to account for a curvilinear relationship between age and weight (Nobari, et al., 2013). BMI increases through adulthood but then declines at older ages (Boardman, et al., 2005; Ferraro, Thorpe, & Wilkinson, 2003). *Race/ethnicity* is measured as a categorical variable with Latino as the reference group (Latino=0, white=1, black=2, Asian=3, and other=4). Latino and black race/ethnicity are risk factors for obesity (Flegal, et al., 2012; Wang & Beydoun, 2007). *Female* is included as a dummy variable (female=1, male=0). Women are at greater risk for overweight and obesity compared to men (Flegal, et al., 2012). *U.S. born* is included as a dummy variable (U.S. born=1, foreign born=0). Individuals born in the U.S. are at greater risk for obesity compared to foreign born individuals (Barrington, Baquero, Borrell, & Crawford, 2010).

Socioeconomic status has an inverse association with BMI for whites, but a positive association for blacks and Latinos (Wang & Beydoun, 2007; Zhang & Wang, 2004). I included two SES variables—level of median family income and education. *Family income* is the sum of

earnings, transfers, and assets from all family members. Income was based on imputed income data for the family unit (the imputed income variable was provided by L.A. FANS) (Bitler & Peterson, 2004).[6] Table 2 summarizes all of the variables used in these analyses and their hypothesized role in the conceptual model. *Education* is a dichotomous measure of the number of years of school completed: less than high school (reference group) and completed high school or above.

[6] There were 47 families that had zero values for income. To make sure these were legitimate zeros, I checked whether the respondent worked in the past year or not. Of the 47 families that had no income, 25 said they worked in the past year. I considered these "questionable zeros" because they reported in a different module that they worked for pay in the past year, but when asked separately about income they said they did not receive any income. Because I could not be sure that they had no income I dropped these from the analysis. I kept the cases where income was zero and they did not work in the past year (n=22).

Table 2. Operationalization of Variables Used in L.A. FANS Analysis.

Construct	Operationalization	Role in the model
Obesity	Body Mass Index (BMI) = kg/m^2	*Dependent variable (L1)*[*]: BMI is influenced by both individual- and neighborhood-level factors.
Latino neighborhoods	% Latino in the census tract	*Independent variable (L2):* Latino neighborhoods are associated with obesity.
Social capital	Social capital measures: social cohesion, and group participation	*Mediator (L2/L1):* Social cohesion can mitigate stress and support healthy behaviors; group participation can facilitate access to information and resources.
Neighborhood disadvantage	Factor score: % living in poverty, % of female-headed households, male unemployment rate, and % of families receiving public assistance.	*Control (L2)*: Disadvantaged neighborhoods may have more social disorder and fewer health-promoting resources.
Residential stability	Factor score: % of dwellings in multi-unit housing, % of owner-occupied housing, % living at the same address for the past five years, and the % of non-family households.	*Control (L2)*: High residential stability contributes to a strong and supportive social environment; conversely low stability can disrupt social networks and erode trust.
Age	Years (continuous; age-squared)	*Control (L1):* Age and BMI have a curvilinear relationship.
Race/ethnicity	1=Latino, 2=white, 3=black, 4=Asian , 5= other	*Control (L1):* Latinos (and blacks) are at increased risk for obesity compared to other racial groups.
Gender	1=female, 0=male	*Control (L1)*: Females are at greater risk for obesity than males.
Nativity	1= U.S. born, 0= foreign born	*Control (L1)*: Individuals born in the U.S. are at increased risk for obesity compared to foreign born.
Family income	Median family income (continuous)	*Control (L1):* Higher income is associated with lower BMI.
Education	1= completed high school and above, 0= less than high school	*Control (L1):* Higher levels of education are associated with lower BMI.

[*] L1= level one (individual); L2= level two (neighborhood).

Analytic Approach

Survey weights and scaling. Survey weights are used to approximate a representative sample when analyzing survey data that used a non-random sample design. A survey weight represents the individual respondent's probability of inclusion in the sample from the entire

population (Carle, 2009; RAND/L.A.FANS, 2011). However, with multilevel data, weighted sampling can take place at more than one level (StataCorp, 2011b). Therefore, multilevel analysis of the L.A. FANS data needs to account for the probability of the tract being selected from the three poverty strata (i.e., very poor, poor, and non-poor) in the first stage of sampling, and the probability of the individual respondent being selected from the tract in the second stage of sampling, conditional upon their tract being selected in the first stage. I included appropriate weights to account for this multistage sampling scheme.[7]

A related issue when using multilevel techniques with complex survey data is rescaling of the individual-level weights. As is typical of complex survey designs, the L.A. FANS sample has an unequal probability of selection, which if unaccounted for can lead to biased parameter estimates (Peterson, et al., 2007; StataCorp, 2011b). In order to appropriately include design weights in the estimation process, analysts recommend rescaling the weights to make the magnitude of the individual-level weights consistent across clusters (Carle, 2009; StataCorp, 2011b). There are several rescaling methods available to researchers and I used the *sum of scale* method for my final analyses per the recommendations in the literature (Carle, 2009).[8]

Multilevel regression analysis. As noted in the theoretical framework (Chapter 2), there are sorting or selection processes at play that contribute to segregated neighborhoods. These

[7] L.A. FANS provides an adult sample weight that accounts for the different sampling stages. However, the Stata `xtmixed` command that I used for the regression analysis requires separate tract- and individual-level weights. To create separate weights that could be used with the Stata syntax, I split the adult overall inclusion weight into two parts: I divided the adult weight by the tract-level weight, which produces an individual-level weight that accounts for the clustering at the second stage of sampling (RAND, 2010; StataCorp, 2011b).

[8] The choice of scaling method depends on a number of factors including cluster size, interest in parameter estimates versus variance components, and the form of the mixed-model itself. Currently, there is no agreed upon gold standard for scaling weights and this is typically something that cannot be determined a priori. Therefore, a general best practice is to conduct a sensitivity test to arrive at a decision most appropriate given the data and research interests (Carle, 2009; StataCorp, 2011b). I compared results based on the three scaling methods available in Stata (`pwscale(size, effective, gk)`) with unweighted data but the model parameters did not vary considerably. I chose the sum of scale method because it typically produces the least biased parameters when cluster size is sufficiently large, and I was equally interested in the coefficients and variance components (Carle, 2009).

theoretically relevant selection processes pose analytical challenges (Diez Roux & Mair, 2010). For example, spatial clustering typically occurs by individual-level features such as race/ethnicity and income, which means that individuals from the same neighborhood are more similar than individuals from different neighborhoods (Merlo, Chaix, Yang, Lynch, & Råstam, 2005). The clustering of similar people by neighborhood is a concern because traditional ordinary least squares (OLS) regression models assume that individual observations are independent, which is most likely not the case if the individuals selected are from the same neighborhood (Snijders & Bosker, 1999). In this situation, the use of multilevel regression analysis is more appropriate than single-level regression analysis because multilevel models account for the clustering of individuals within neighborhoods, which produces more accurate estimates and smaller standard errors (Raudenbush & Bryk, 2002; Snijders & Bosker, 1999). In addition, multilevel models allow for the simultaneous investigation of neighborhood- and individual-level processes, which is consistent with my conceptual framework that emphasizes the multiple levels of influence on obesity (Blakely & Subramanian, 2006).

Given the methodological challenges that clustered data pose and my theoretical interest in neighborhood and individual effects on obesity, I use multilevel regression analysis. Using data for 2,919 adults nested in 65 L.A. FANS neighborhoods, I examine the relationship between neighborhood percent Latino, social capital, and BMI. Next, I outline the research questions and model building steps.

Research question 1: Is neighborhood percent Latino associated with individual BMI, over and above individual-level determinants? The first step in multilevel regression analysis is to estimate the null, or empty, model which is a multilevel model of BMI with no independent variables. The null model will show whether BMI varies across neighborhoods, specifically how

much an individual's BMI differs from the mean of his or her neighborhood, and how much the neighborhood mean differs from the overall average BMI for the population. Using the total variation at both the individual and neighborhood levels I calculate the intraclass correlation (ICC), which is the proportion of observed variation in BMI that is attributable to neighborhood- versus individual level characteristics. This step will determine whether there are neighborhood-level effects on BMI and how large those effects are in comparison to individual-level effects.

The next step in multilevel model building is the random intercept model that tests for neighborhood effects on BMI, controlling for individual- and neighborhood-level factors. I add the main independent variable, percent Latino to assess the focal relationship of interest. Then I introduce level-1 and level-2 variables separately to control for factors that are associated with BMI. The following equation[9] specifies the full random intercept model:

$$BMI_{ij} = \gamma_{00} + \gamma_{10}X_{ij} + \gamma_{01}W_j + \mu_{0j} + r_{1j}$$

Fixed effects

BMI_{ij} = BMI of a given individual (*i*) in a given neighborhood (*j*)

γ_{00}= average BMI for neighborhood *j*

X_{ij} = Level-1 variables: age, age^2, race/ethnicity, female, U.S. born, family income, and education

W_j= Level-2 variables: percent Latino, neighborhood disadvantage, and residential stability

Random effects

μ_{oj}= neighborhood error term

r_{1j}= individual error term

[9] I use notation from Raudenbush and Bryk (2002).

Research question 2: Does social capital explain (i.e., mediate) the relationship between neighborhood percent Latino and BMI? After I establish a main effect of Latino neighborhood on BMI, I test the hypothesis that social capital mediates the relationship between percent Latino and BMI. This mediational relationship is depicted by arrow #3 in the conceptual model (Figure 1). Specifically, I propose that the independent variable (X), percent Latino, affects the mediator variable (M), social capital, which in turn affects the dependent variable (Y), BMI. In other words, the effect of X on Y operates through M which is called the indirect effect (Bauer, Preacher, & Gil, 2006; UCLA: Statistical Consulting Group, 2013b). Classic mediation analysis attempts to identify the underlying mechanism, or mediator, that explains the relationship between the independent and dependent variables by testing different parts of the mediation pathway separately (c path and ab path) and then testing the full mediation pathway (c' path) (Bauer, et al., 2006; Hayes, 2009; Krull & MacKinnon, 2001).

Testing for mediation effects in clustered data poses unique problems (Hayes, 2009; Krull & MacKinnon, 2001). First, using OLS regression with clustered data violates the assumption of independence, which can result in inflated Type I errors. In addition, mediators can occur at either level-1 or level-2, making the models computationally more complex than single-level mediation (Hayes, 2009; Krull & MacKinnon, 2001). Therefore, multilevel mediation modeling approaches need to account for the clustering of nested data and test for mediation effects across multiple levels (Krull & MacKinnon, 2001).[10] In the mediation analysis,

[10] Multilevel mediation analysis is not a well-established practice, and there is on-going debate about which of the numerous approaches is best. I use the method proposed by Krull and MacKinnon (2001) that is a hybrid of single-level classical mediation analysis and multilevel analysis for nested data. This is not the only method for testing multilevel mediation, and in fact this approach has been criticized for possible within-group and between-group confounding (Zhang, Zyphur, & Preacher, 2009). However, this approach is preferred over single-level regression models, and simulation studies have produced generally accurate standard errors (Krull & MacKinnon, 2001). Because there is no agreement on a standard approach for tests of multilevel mediation, these analyses should

the social capital variables are mediators of the relationship between percent Latino and BMI. Social cohesion is a level-2 mediator and group participation is a level-1 mediator.

The multilevel mediation analysis involves estimating three separate regression equations[11] that parse out the direct, indirect, and total effects of the mediation model. The first equation is a multilevel equation that predicts BMI, similar to the random intercept equation used in the main effect model. The second equation is a single-level equation where the outcome is the mediator—this model involves only the neighborhood-level predictor. This equation establishes that percent Latino is associated with social capital. The third equation is a combination of equations 1 and 2, and it includes the direct and indirect effects of social capital on BMI. This is a 2→2→1 model[12] in which both the independent variable and mediator are level-2 variables, but the outcome is a level-1 variable:

Equation 1: $Y_{ij} = \gamma_{00} + \gamma_c X_j + u_{0j} + r_{ij}$

Equation 2: $M_j = \beta_0 + \beta_a X_j + r_j$

Equation 3: $Y_{ij} = \gamma_{00} + \gamma_{c'} X_j + \gamma_b M_{ij} + u_{0j} + r_{ij}$

Mediation pathways

c = (c path) is the total effect Y on X (without the mediator)

ab = (ab path) is the indirect or mediated effect

c' = (c-prime path) is the direct effect of Y on X (with the mediator)

---

be interpreted with caution. I used a Stata program called `ml_mediation`, developed by the UCLA Statistical Consulting Group (2013b).

[11] I use simplified notation based on Krull and MacKinnon.

[12] Because I test two different mediators at different levels, this requires the specification of two separate mediation models. I also test a 2→1→1 model where the mediator is a level-1 variable. The model steps are the same except equation 2 would predict M_{ij}= group participation (level-1 mediator).

Results

Univariate statistics. Table 3 presents demographic information for 1,642 Los Angeles County tracts and the 65 tracts included in L.A. FANS. The L.A. FANS data are weighted to account for the sampling design that oversampled poor and very poor tracts, and households with children. The mean characteristics for the entire County and the sampled tracts correspond well when sample weights are used (Peterson, et al., 2004). L.A. FANS tracts had a mean population size of 7,735 residents and a population density of 14,836 residents per square mile, which are slightly higher than the County means. The median household income for L.A. FANS tracts was $40,433 and 22% of L.A.FANS residents live in poverty. The percent of residents who were non-citizens, born outside of the U.S., and Spanish speakers was higher in the L.A. FANS sample compared to the County. Hispanics are overrepresented in the L.A. FANS sample, whereas whites, Asians, blacks, and other were underrepresented.

Table 3. Comparison of Tract Characteristics for L.A. County and L.A. FANS (Weighted).

	L.A. County tracts (n=1,642)		**L.A. FANS tracts (n=65)**	
	Mean or %	S.D.	Mean or %	S.D.
Tract population	5,797	3,008	7,735	4,175
Pop. density	11,691	9,615	14,836	10,461
Median household income	47,716	25,022	40,433	22,317
Poverty, %	17.2	12.6	22.9	13.9
Non-citizen, %	20.1	13.3	27.3	14.8
Foreign born, %	34.6	15.6	40.2	15.4
Spanish speaking, %	34.2	25.9	47.2	27.6
Race/ethnicity				
Hispanic/Latino, %	41.1	28.7	55.1	29.6
White, %	34.0	28.6	23.8	25.6
Asian, %	12.0	13.5	10.1	11.3
Black, %	9.8	16.5	8.3	10.0
Other, %	3.2	2.4	2.6	2.1

Sources: L.A. NSC, 2000 and L.A. FANS, 2000-2001.

Table 4 presents descriptive statistics for the L.A. FANS sample. The unweighted statistics describe the analytic sample (n=2,919). The weighted statistics are representative of L.A. County population and are included for comparison. The mean BMI for the sample is 26.79, which is in the overweight range.[13] The sample is mostly female (67%) and the mean age is 39 years old. The median family income was $52,111 and less than half of respondents (44%) have more than a high school education. Over half of the sample population is Latino (56%).

Table 4. Unweighted and Weighted L.A. FANS Sample Characteristics (n= 2,919 Adults).

	Unweighted		**Weighted**	
	Mean or %	S.D.	Mean or %	S.D.
Body Mass Index (kg/m^2)	26.79	5.62	26.24	5.14
Age (years)	38.99	13.45	42.96	16.98
Female, %	67		50	
Family Income ($)	52,111	68,262	55,172	65,262
Education above high school, %	44		55	
Race/ethnicity				
Latino, %	56		35	
White, %	26		39	
Asian, %	8		14	
Black, %	8		10	
Other, %	2		2	

Source: L.A. FANS, 2000-2001.

Bivariate statistics. Table 5 describes the relationship between select sample characteristics (aggregated to the neighborhood level) and Latino neighborhood quartile categories (very low, low, medium, and high percent Latino neighborhoods). Consistent with the residential segregation hypothesis that posits a positive association between the proportion of Latinos in the neighborhood and poor health, mean BMI increases for each level of Latino neighborhood quartile. Put another way, neighborhoods with a higher proportion of Latino

[13] The standard BMI categories are normal weight (18.5-24.9), overweight (25-29.9), and obese (30 or greater).

residents also had higher mean BMI scores. The mean BMI for the very low Latino neighborhood quartile is just outside the normal weight range (24.99), and the mean BMI for the remaining Latino neighborhood quartiles falls in the overweight category.

The distribution of racial/ethnic groups by Latino quartile shows that an increase in the proportion of Latinos is accompanied by a steady decrease in the proportion of whites and Asians. There were very few blacks in both the lowest and highest Latino quartiles. The most integrated neighborhoods are found in the low percent Latino quartile (43% Latino, 30% white, 14% Asian, 10% black, and 4% other). The SES characteristics follow the expected direction, with low Latino neighborhoods having low proportions of families living in poverty and foreign born residents. By contrast, over a quarter of residents in medium and high Latino neighborhoods live in poverty and close to half of the population in medium and high Latino neighborhoods were born outside of the U.S.

Some interesting patterns emerged among the social capital measures. The level-2 social capital measure, social cohesion, was generally higher in neighborhoods with a greater proportion of Latino residents. The highest social cohesion scores (2.75) were found in the medium percent Latino neighborhoods. This lends moderate support to the ethnic enclave perspective and the literature that suggests Latino-concentrated neighborhoods have high social capital (Aranda, Ray, Snih, Ottenbacher, & Markides, 2011; Rios, et al., 2012). However, the pattern was the opposite for the level-1 social capital measure, group participation—as percent Latino increased, group participation decreased. Residents of low percent Latino neighborhoods participated in an average of 1.11 formal group activities. By contrast, residents of high percent Latino neighborhoods participated in only 0.35 group activities. This implies that residents of high Latino neighborhoods have smaller or more limited social networks than those who live in

low Latino neighborhoods, and therefore may miss out on resources that are available as part of a broad social network (Marcelli, 2004).

Interestingly, low percent Latino neighborhoods (i.e., majority white) had the lowest social cohesion scores but the highest group participation scores. The distinction between the level-2 collective measures and the level-1 individual activities may also correspond to socioeconomic resources. Only 8% of residents in very low Latino neighborhoods live in poverty compared to 26% of the high Latino quartile. This might explain the discrepancies in group participation scores particularly if the groups require fees or dues.

Table 5. Mean Values for Select Characteristics by Latino Quartile (Weighted).

	Latino quartile categories			
	Very low % Latino	Low % Latino	Medium % Latino	High % Latino
Body Mass Index	24.99	26.45	26.88	27.67
Racial/ethnic groups				
Latino, %	0.13	0.43	0.70	0.89
White, %	0.58	0.30	0.12	0.05
Asian, %	0.19	0.14	0.09	0.02
Black, %	0.05	0.10	0.07	0.03
Other, %	0.04	0.04	0.02	0.01
Socioeconomic characteristics				
Living in poverty, %	0.08	0.18	0.27	0.26
Foreign-born, %	0.27	0.33	0.46	0.49
Tract disadvantage score	-0.89	0.18	0.91	0.98
Residential stability score	0.03	0.00	-0.33	-0.05
Immigrant concentration score	-0.71	0.06	1.01	1.29
Social capital measures				
Social cohesion	2.23	2.61	2.75	2.70
Group participation (tract mean)	1.11	0.69	0.42	0.35

Source: L.A. FANS, 2000-2001 and L.A. NSC, 2000.

Multilevel regression results. The multilevel data structure includes 2,919 individuals nested within 65 neighborhoods, and the average cluster size is 44.9 adults per neighborhood. Table 6 presents results from the regression models based on weighted and scaled data. Model 1,

the empty model, shows the average BMI across individuals and neighborhoods is 26.20, which falls into the overweight category on the BMI scale. Based on results from the likelihood ratio test ($p<0.001$), I reject the null hypothesis that between-subject variance is equal to zero. This means that the differences in BMI are greater among individuals within the neighborhood than between neighborhoods, and therefore the use of a multilevel model over single-level regression model is justified. Based on results from Model 1, I calculated an intraclass correlation (ICC) of 0.05, which means that 5% of the total variability in BMI was due to variations between neighborhoods, and the remaining portion is due to individual differences. Although it is not a very large effect, the empty model confirms that BMI does vary by neighborhood.

The finding that BMI varies more among individuals within the same neighborhood than it does between different neighborhoods is expected given that BMI is primarily a function of individual factors (i.e., behavior, biology, etc.) that affect weight. However, the ICC of 0.05 also suggests that there are factors outside of the individual, such as neighborhood features, that contribute to the observed differences in BMI. The subsequent regression models include individual- and neighborhood-level factors that are expected to influence BMI.

Next, I fit a series of random intercept models that include covariates at both levels. Model 2 tests the focal relationship between neighborhood percent Latino and individual BMI, which is statistically significant at the $p<0.001$ level. There is almost a 2-point reduction in mean BMI (24.63) with the inclusion of percent Latino. Model 2 establishes that there is a strong association between percent Latino and BMI, however, there is no longer any significant neighborhood variation in BMI. For a one-unit increase in neighborhood percent Latino, there is a corresponding 3.50 point increase in BMI. In Model 3, I include only the level-1 variables to control for individual characteristics that are correlated with BMI (age, age-squared, female,

race/ethnicity, median family income, U.S. born, and education). The adjusted mean BMI (20.72) in Model 3 decreased by over 5 points, which indicates that the inclusion of level-1 covariates accounts for more of the variation in BMI than Model 2, the model with only percent Latino. All variables in Model 3 were significant except for family income.

Model 4 is the full random intercept model that includes both level-1 and level-2 variables. The adjusted mean BMI for the sample is now 19.12 and percent Latino remains statistically significant at the $p<0.001$ level but has reduced in magnitude to 2.75. This means that for each 1-unit increase in neighborhood percent Latino, the mean BMI score for an individual living in the neighborhood will increase by 2.75 points, controlling for all the individual-level variables. All racial groups had statistically significant lower BMI values compared to Latinos and except for the other group. Female had a small negative association with BMI, which means that women had a mean BMI score that was 0.74 points lower than men. Consistent with literature that shows immigrant health advantages, being born in the U.S. was positively associated with BMI, corresponding to a 1.54 higher BMI compared to those born outside the U.S. (Buttenheim, et al., 2012; Creighton, Goldman, Pebley, & Chung, 2012; Park, et al., 2011; Viruell-Fuentes & Schulz, 2009). Neither of the level-2 covariates (residential stability and concentrated disadvantage) were significant and were left out of subsequent models. Overall, I find a significant effect of neighborhood percent Latino on individual BMI after controlling for individual factors.

Table 6. Multilevel Regression Model on BMI (Weighted).

	Model 1	**Model 2**	**Model 3**	**Model 4**
Fixed effects				
Percent Latino		3.50***		2.75***
		(0.46)		(0.63)
Age			0.30***	0.29***
			(0.05)	(0.05)
Age-Squared			-0.00***	-0.00***
			(0.00)	(0.00)
Latino (Ref.)				
White			-1.99***	-1.55**
			(0.46)	(0.50)
Black			-1.50**	-1.29*
			(0.56)	(0.57)
Asian			-2.18**	-1.84**
			(0.63)	(0.66)
Other			-1.60	-1.30
			(0.84)	(0.86)
Female			-0.75*	-0.74*
			(0.30)	(0.30)
U.S. born			1.51**	1.54***
			(0.43)	(0.42)
Family income			-0.02	0.01
			(0.02)	(0.02)
Completed high school or above			-0.39	-0.23
			(0.45)	(0.45)
Intercept	26.20***	24.63***	20.72***	19.12***
	(0.21)	(0.27)	(1.14)	(1.26)
Random effects				
Level-2 variance				
var(u_{0j})	1.84**	0.77	0.99	0.61
	(0.34)	(0.26)	(0.28)	(0.21)
Level-1 variance				
var(r_{ij})	24.33***	24.33***	22.96***	22.92***
	(1.58)	(1.58)	(1.54)	(1.54)

Source: L.A.FANS, 2000-2001
Standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Multilevel mediation results. Table 7 summarizes the mediation findings for each social capital mediator that was tested. I ran separate models to test the hypotheses that the two social capital measures (level-2: social cohesion; level-1: group participation) mediate the relationship between Latino neighborhood composition and BMI. The mediation models controlled for age, age-squared, race/ethnicity, female, U.S. born, median family income, and education. All formal tests of mediation were non-significant. Specifically, when the mediating effects of social capital were tested, the relationship between percent Latino and BMI remained statistically significant. If mediation were present, then we would expect the percent Latino coefficient to become non-significant, which would indicate that the social capital measure accounts for some of the focal relationship. In addition, as Table 7 shows, the coefficients—representing the indirect effects for the social capital variables—were all very small (close to zero), which indicates that the social capital variables had little effect on the focal relationship. In short, the social capital measures do not explain the connection between percent Latino and BMI and my social capital hypotheses were not supported. I also tested alternative social capital constructs but none of the alternative measures were significant. Details of the alternative tests are reported in Appendix B.

Table 7. Mediation of the Effect of Neighborhood Percent Latino on Individual BMI Through Social Capital (Indirect Effects).

Mediator	Coeff.	SE	Z	p	Percentile 95% CI[a]
Social cohesion	-0.01	0.08	-0.09	0.932	-0.13, 0.21
Group participation	-0.03	0.03	-0.81	0.42	-0.12, 0.02

Source: L.A. FANS, 2000-2001.
[a] Note: percentile CI bootstrap- based on 2,000 replications.

There are theoretical and methodological explanations for the non-significant mediation findings. As I noted, studies of social capital and obesity have produced mixed findings and the

mechanisms remain unclear (Moore, 2010). From a theoretical standpoint, it could be that the mediation mechanism I proposed is incorrect. It is also possible that I misspecified the role of social capital in the neighborhood-obesity pathway. For example, social capital may be a confounding variable and, therefore, would not explain the relationship between Latino neighborhoods and obesity. Or perhaps social capital is a moderator rather than a mediator (i.e., effects on BMI only occur in neighborhoods with high social capital). It is also likely that the mechanisms are more complex than my regression model accounted for (i.e., it involves multiple mediating relationships). For example, I was unable to measure diet and physical activity, which are key components of the mediation pathway that I describe in my conceptual model.

There are also methodological explanations for my null findings. First, my operationalization of social capital focuses on the so-called communitarian aspects of neighborhoods such as social cohesion (Carpiano, 2006; Moore, et al., 2005). Social cohesion may be more relevant for mental health and self-rated health, but only distally related to obesity (Rios, et al., 2012). Also, my measure of group participation was a proxy for network size and degree of integration. Alternative methods of studying social capital consider different relational aspects of social networks and the actual resources available to network members, but this was not something I could investigate with the current data (Moore, et al., 2009). Finally, as noted in the methods section, multilevel mediation analysis is an active area of research, and there is disagreement in the field about best practices for testing mediation across levels (Bauer, et al., 2006; Zhang, et al., 2009). The Stata program that I used to carry out the mediation analysis is considered to be experimental and the author advises caution when interpreting the results (UCLA: Statistical Consulting Group, 2013b).

Chapter 4. Latino Neighborhoods and Park Availability (Ecological Analysis)

Public parks are ideal resources for encouraging physical activity and combating obesity because they are free, available for public use, and offer a variety of services and programs that support active lifestyles (Bedimo-Rung, et al., 2005; Crespo, 2000; National Physical Activity Plan, 2010; 2013). Park availability has been found to be associated with increased physical activity and decreased obesity (Gordon-Larsen, et al., 2006), and living within walking distance (¼ mile) of urban parks has been found to be associated with a three times greater likelihood of meeting the recommended amount of daily physical activity (Giles-Corti, et al., 2005). Given the physical activity benefits that parks provide, a concern among health disparities researchers is the unequal distribution of park resources (RWJF, 2013). A structural barrier to park access that some communities face, and the focus of this chapter, is a lack of parks in minority and low-income neighborhoods (Wolch, et al., 2005).

A related issue is racial/ethnic differences in park use and park preferences (Baas, et al., 1993; Gobster, 2002). For example, some studies report that Latinos and other non-white groups prefer developed or manmade park features over natural park features (Cronan, et al., 2008; Ho, et al., 2005). However, a qualitative study of park users in Los Angeles finds that Latina focus group respondents highly valued nature, but faced institutional and structural barriers to accessing natural park features (Byrne, 2012). This suggests that differences in park use or park preference may stem from larger structural patterns of park availability.

Neighborhood disparities in park availability are an environmental justice concern because it may contribute to racial/ethnic disparities in park access and use, physical activity, and related health outcomes including obesity (Gordon-Larsen, et al., 2006; Taylor, et al., 2006).

This chapter investigates the availability of parks and recreation resources for Latino neighborhoods in Los Angeles. Using data from Los Angeles I address two questions:

1. Are Latino immigrant neighborhood characteristics associated with park availability?
2. Are Latino immigrant neighborhood characteristics associated with different park feature types (natural or developed)?

Data

Data come from two sources, the Los Angeles County Location Management System (LMS) and the American Community Survey (ACS). Both datasets use 2010 census tract boundaries and all analyses take place at the tract level.

Location Management System (LMS). The parks and recreation variables come from the Loa Angeles County Location Management System (LMS) (http://egis3.lacounty.gov/lms/), a publicly available database of locations and points of interest in Los Angeles County (Los Angeles County GIS Data Portal, 2013). The LMS is a project of the Los Angeles County GIS Data Portal (County of Los Angeles, Chief Information Office) and serves as a central web-based repository for L.A. County location information. Although the data are housed in LMS, individual agencies are responsible for maintaining their own location information as part of this collaborative countywide system (Greniger, 2010). For example, the L.A. City Recreation and Parks Department would ensure that location information for a city managed recreation center is current. The dataset includes information on over 66,000 locations of interest such as churches, parks, hospitals, and police stations (Greniger, 2010). For the purposes of this dissertation, only a small subset of relevant LMS parks and recreation data were used. Details on the creation of this smaller parks and recreation dataset are described in Appendix C.

American Community Survey. Tract-level demographic data come from the American Community Survey (ACS) Summary File Estimates.[14] ACS Summary File Estimates are available as a series of frequency tables of individual characteristics or as cross-tabulations of two or more characteristics (U.S. Census Bureau, 2009). ACS releases Summary Files as 1-year, 3-year, and 5-year estimates. I used the 5-year estimates because this is the only option for data at the census tract level. These data represent pooled estimates across 60 months, which produces more precise estimates than the shorter time-period estimates (U.S. Census Bureau, 2009). In addition, the longer time period has the advantage of a larger sample size, greater reliability, and smaller sampling error compared to the shorter time-period estimates (U.S. Census Bureau, 2009). Therefore, summary estimates represent the average characteristics (i.e., demographic, social, and economic) for Los Angeles County across the 5-year period between 2006 and 2010.

Census tracts are statistical geographic areas defined for data tabulation purposes (U.S. Census Bureau, 2010a). Census tracts are roughly equivalent to neighborhoods and the population size can vary between 1,200 and 8,000 people (U.S. Census Bureau, 2010a). The spatial size of tracts will also vary depending on population density. The U.S. Census Bureau defines census tracts as "small, relatively permanent statistical subdivisions of a county or equivalent entity" although boundaries can be redrawn (split or merged) as a result of population growth or decline (U.S. Census Bureau, 2010a). For the ACS multiyear estimates, the Census Bureau uses boundaries as of January 1st of the last year of the multiyear period—this means that the 2006-2010 estimates were tabulated using boundaries that were in effect on January 1,

[14] The ACS replaced the decennial long-form in 2010 (ACS Summary Files are analogous to the Census Summary File 3). Similar to the old long-form, the ACS collects detailed information on demographic, social, economic, financial and housing characteristics however, the census has a narrow time frame and estimates represents a "point in time" (i.e., snapshot of April 1st) whereas the ACS has a longer time frame and the estimates produced represent "period estimates" (i.e., 5-year estimates represent population characteristics over a 60-month time period).

2010. These are the same boundaries used to generate the parks data. All data analysis were done in Stata 12.

Analytic sample. I merged the LMS (containing the dependent variables) and ACS (containing all other variables) datasets to create the full sample which had 2,346 census tracts. I dropped 31 tracts from the analysis that were missing data on some or all of the independent variables. Typically, data were missing because the population was 0 in these tracts and, therefore, no survey information was collected. Tracts with no respondents (n=22) included airports, the ocean, and industrial sites. Nine remaining tracts did have respondents, but were missing information on the ACS economic questions. In this situation, the number of respondents per tract was too low to produce reliable estimates (U.S. Census Bureau, 2009). Also because only a small portion (1%) of the overall sample was missing, I opted to use listwise deletion rather than impute the missing data. The final analytic sample consists of 2,258 census tracts in Los Angeles County. Appendix D contains detailed information on the tracts that were dropped from the final sample.

Measures

Dependent variables. Parks and recreation features are measured as counts and include ten park feature sub-categories: beaches and marinas, campgrounds, golf courses, natural areas and wildlife sanctuaries, parks or gardens, picnic areas, pools, recreation centers, recreation program, and trails.[15] I use the sub-categories in my descriptive analysis. The *total park features* variable, which is the sum of all the park feature sub-categories is the main dependent variable for my regression analysis.

[15] I opted to exclude ski areas because they require a substantial fee to access the facility and there are only a few (all located in the same tract).

In addition, I grouped the ten sub-categories according to the level of land development required for different park features. *Developed park features* are built or manmade and include golf courses, parks and gardens, pools, recreation programs, and recreation centers. *Natural park features* by contrast are less developed and closer to the natural habitat, and include beaches, campgrounds, natural areas and wildlife sanctuaries, picnic areas, and trails.

Because the park features counts were derived from point data, the aggregate *total park features* variable has some unconventional interpretations. For example, in the case of a picnic area located inside a park and garden, this would be counted as 2 park features rather than 1 because each sub-category is counted. Therefore, the total park features variable is a count of all the park feature sub-categories. For example, Burton Chace Park, a large park in Marina del Rey has a number of features from multiple sub-categories including beaches and marinas, parks and gardens, picnic areas, recreation centers, recreation programs, and trails. Although all of these features are in the same geographic location, each individual feature of Burton Chace Park is accounted for in my data. Another way to think about this is that a larger count means more park features (not more parks) in the tract.

Independent variables. *Latino immigrant neighborhood* is the main independent variable. I created a factor score to represent Latino immigrant neighborhood features—percent Latino,[16] percent non-citizen, percent Spanish speaking, and percent foreign born. I opted to use the factor score for two reasons: first, immigrant neighborhoods may be different from non-immigrant neighborhoods with regard to park availability. For example, native born residents may be more politically active and able to advocate for park resources than foreign born

[16] Latino includes all races that checked Hispanic/Latino ethnicity on the ACS, and the remaining groups are all "non-Hispanic/Latino." For the purposes of this paper, I have defined race/ethnicity such that, Hispanic/Latino ethnicity trumps race. I used the term race/ethnicity because the racial/ethnic categories can include both racial and/or ethnic identities.

residents. Second, the collinearity checks indicated that the Latino immigrant variables were highly correlated. By using the factor score, I can account for the relevant immigrant constructs but still produce stable estimates in my regression models. I use the individual variables that comprise the factor score (i.e., percent Latino, non-citizen, Spanish speaking, foreign born) in the descriptive analysis and the Latino immigrant neighborhood factor score in the regression analysis. The other neighborhood racial-composition variables are measured as the *percent black* and *percent Asian*. I excluded percent white and percent other from the analysis due to problems with linear dependency.

Control variables. *Percent living in poverty*[17] is included in the model as a control variable to account for the role that neighborhood disadvantage has on the relationship between race/ethnicity and parks. Poor neighborhoods have fewer resources to build and maintain parks, or to support a variety of park features. Poverty can also be thought of as a measure of park need because poor households would be more reliant on free or low-cost parks and recreation programs than households not living in poverty (Sister, et al., 2010).

Two variables are included in the model to account for park need: *total population* and *population density*. The total population variable is a count of the total number of people per tract. Population density is the number of people per square mile. Both are indicators of park need and possibly park usage. Tracts with more people presumably require more parks; however, there may be less physical space for parks in densely populated areas (Moore, et al., 2008; Sister, et al., 2010; Wolch, et al., 2005).

[17] Poverty is measured as percent of the population whose income falls below the poverty threshold. According to the Census Bureau, the poverty threshold is defined as "money income before taxes and does not include capital gains or noncash benefits (such as public housing, Medicaid, and food stamps)" and varies by family size and composition (U.S. Census Bureau, 2010b).

Other independent variables. The *total land area* available in a tract may determine whether or not parks are present. For example, tracts with limited land area may not have the physical space to accommodate a park (Sister, et al., 2010). Conversely, tracts with large land area have more space for different park features. Land area is measured as total square miles.

Land use can also influence the availability of parks and park features. For example, in urban, dense neighborhoods, there is less open space available for parks (Duncan, et al., 2012; Sister, et al., 2010). I operationalize land use as the *percent of attached housing* in the neighborhood. Attached housing such as attached single-family houses (e.g., duplex) and apartment buildings do not typically have yards, or if they do, they are a shared space for the entire building. By contrast, detached single family houses may have front and or backyards, which provide space for play and exercise, and make reliance on parks less crucial for physical activity. Therefore, I expect attached housing to be negatively associated with total park features and natural park features. The amount of attached housing is also a proxy for the need for parks (Dahmann, et al., 2010). The attached housing variable includes single family houses (attached), small apartment buildings (less than 10 units), medium apartment buildings (10-49 units), and large apartment buildings (50 or more units).

Table 8 summarizes all of the variables used in the parks analysis and their hypothesized role in the conceptual model.

Table 8. Variables Used in Parks Analysis.

Construct	Operationalization	Role in the model
Park availability	Count of total park features in tract	*Dependent variable:* Park availability depends on adequate space (more urban/dense neighborhoods have less space for parks) AND neighborhood SES (poor neighborhoods have less resources to build/maintain parks).
Type of park features	Developed v. natural	*Dependent variable*: Latino neighborhoods will have less natural park features such as nature trails, and more developed features such as recreation centers.
Latino immigrant neighborhoods	Latino immigrant neighborhood factor score	*Independent variable*: Factor score accounts for Latino immigrant neighborhoods—percent Latino, percent non-citizen, percent Spanish speaking, and percent foreign born; these are typical sociodemographic variables used in studies of Latinos.
Race/ethnicity	% black, Asian	*Independent variable*: Minority neighborhoods are under-resourced, densely populated, and in poor, urban areas so they have less space for park features that require a lot of area (e.g., hiking trails); used to test for racial/ethnic disparities in park availability.
Neighborhood disadvantage	% Poverty	*Control:* Poverty is related to both the independent and dependent variables; poor neighborhoods have fewer resources to build and maintain parks.
Park need	Total population (people per tract)	*Control*: Total population is an indicator of park need because there are more potential park users.
Park need	Population density (people per square mile)	*Other independent variable:* Population density is an indicator of park need—dense neighborhoods need more parks.
Land area	Total land area (square miles)	*Other independent variable:* Total land area in a tract may determine whether there is room for a park.
Land use	% Attached housing	*Other independent variable*: Attached housing represents greater need for parks because apartment complexes typically do not have yard space; also, another indicator of population density and neighborhood disadvantage.

Analytic Approach

Research question 3: Are Latino immigrant neighborhood characteristics associated with park availability at the ecological level? I used an elaboration model approach to conduct the regression analysis, which begins by isolating the race/ethnicity and immigrant variables to see if there is an association with parks (Aneshensel, 2002). Model 1 includes the independent

variables, Latino immigrant neighborhood factor score, percent black, and percent Asian to see if there are differences in the number of park features by neighborhood racial/ethnic and immigrant composition.

Model 2 includes only the exclusionary control variable, percent poverty, to exclude alternative hypotheses. This step is to establish that neighborhood disadvantage (operationalized as percent poverty) is associated with parks because I want to rule out the possibility that the focal relationship is actually being driven by the economic status of the neighborhood. Theoretically, percent poverty could explain the relationship between Latino immigrant neighborhoods and parks because I would expect poor neighborhoods to have fewer resources such as parks, than wealthy neighborhoods. Therefore, Model 3 combines Models 1 and 2, and includes Latino immigrant neighborhood factor score, percent black, percent Asian, and percent poverty to rule out spuriousness. In other words, Model 3 is to make sure the relationship between the neighborhood composition variables and parks is not due to their shared relationship with poverty.

Model 4 includes additional control variables to account for park need: total population and population density, because neighborhoods with fewer residents have less of a need for park area. Lastly, Model 5 included measures of land area and land use to test an alternate theory that more total land area means there is more space to accommodate a park, holding population density constant. Land use and total land area are related because land that is used for residential buildings will have less space for parks. The attached housing measure indicates greater park need because attached housing typically does not have private yard space.

Research question 4: Are Latino immigrant neighborhood characteristics associated with different park feature types (natural or developed) at the ecological level? To address the

second research question regarding park development type, I tested the full model with all the control variables (Model 5) using developed and natural park features as the dependent variables. The literature on park preferences indicates that Latinos do not prefer natural park features (Baas, et al., 1993; Chavez, 2001; Cronan, et al., 2008); however, I hypothesize that personal preferences may be in part driven by limited availability of natural park features present in Latino neighborhoods. I expect the Latino immigrant neighborhood factor score to have a negative association with parks (specifically, natural park features) because Latino immigrant neighborhoods tend to be more urban and densely populated, leaving little space for natural features (Cutts, et al., 2009).

Diagnostic tests. Multicollinearity was a concern with these data because race/ethnicity and immigrant status are highly correlated with other social class variables including poverty and income. I ran a series of collinearity diagnostics on all the independent variables in my model (e.g., variance inflation factor, condition number, eigenvalues). The collinearity checks indicated that some of the social and economic variables were highly correlated. To address the multicollinearity, concern I created a factor score to represent Latino immigrant neighborhoods, and I dropped median property value and percent youth from the analysis because they were causing the model to be unstable.

Next, I identified the correct model specification for count data. Traditional ordinary least squares (OLS) regression is inappropriate for analyzing count data because certain assumptions are violated, namely the outcome is discrete (not continuous) and the residuals do not follow a normal distribution (Atkins & Gallop, 2007). The count data distribution showed high over-dispersion and a large amount of zero values. These features of the data suggest the use of a zero-inflated negative binomial regression model (ZINB). I confirmed that ZINB was the

preferred approach to model the parks count data based on descriptive analysis (e.g., descriptive statistics and plots of the distribution) and two model selection tests (e.g., the likelihood-ratio test of alpha and the Vuong test). Details from the collinearity and count data diagnostic tests are reported in Appendix E.

Results

Descriptive statistics. Table 9 shows the distribution for detailed park feature subcategories and sociodemographic information for all tracts in the sample. The mean number of park features per tract is 1.05 and the large range (0-152) indicates that there were many tracts containing zero park features and one tract with 152 park features.

Table 9. Descriptive Statistics for Sample of Tracts (n=2,315).

	Mean	**SD**	**Min**	**Max**
Total park features	1.07	4.21	0	152
Beaches and marinas	0.03	0.76	0	34
Campgrounds	0.12	2.11	0	90
Golf courses	0.04	0.21	0	3
Natural areas and wildlife sanctuaries	0.04	0.51	0	16
Parks and gardens	0.54	0.91	0	8
Picnic areas	0.02	0.37	0	12
Swimming pools	0.03	0.21	0	2
Recreation centers	0.11	0.37	0	3
Recreation programs	0.09	0.33	0	3
Trails	0.03	0.52	0	16
Race/ethnicity				
Latino, %	0.47	0.30	0	1
White, %	0.29	0.27	0	1
Non-Latino Black, %	0.08	0.14	0	0.91
Non-Latino Asian, %	0.13	0.16	0	0.97
Non-Latino Other, %	0.02	0.02	0	0.25
Immigration related factors				
Non-citizen, %	0.20	0.13	0	0.65
Spanish speaking, %	0.40	0.29	0	0.98
Foreign born, %	0.36	0.15	0	0.87
Neighborhood disadvantage				
Households in poverty, %	0.16	0.12	0	0.79
Population				
Total population	4,205.07	1,443.39	36	11,534
Population density (per sq. mile)	13,237.88	11,170.97	1.97	109,518.2
Land use				
Land area (square miles)	1.69	13.11	0.03	397.25
Attached housing, %	0.45	0.30	0	1

Source: Location Management System, 2010; American Community Survey, 2006-2010

Figure 3 shows a bar chart of the count of disaggregated park features. There are a total of 2,483 park features in Los Angeles County. Parks and gardens represent the largest category of park features (n=1,245). Campgrounds, recreation centers, and recreation programs were well represented, with over 200 of each. There were also a surprisingly high amount of natural areas

(n=101) and golf courses (n=91) in Los Angeles County. Finally, the remaining categories are pools (n=70), beaches (n=70), trails (n=63), and picnic areas (n=54).

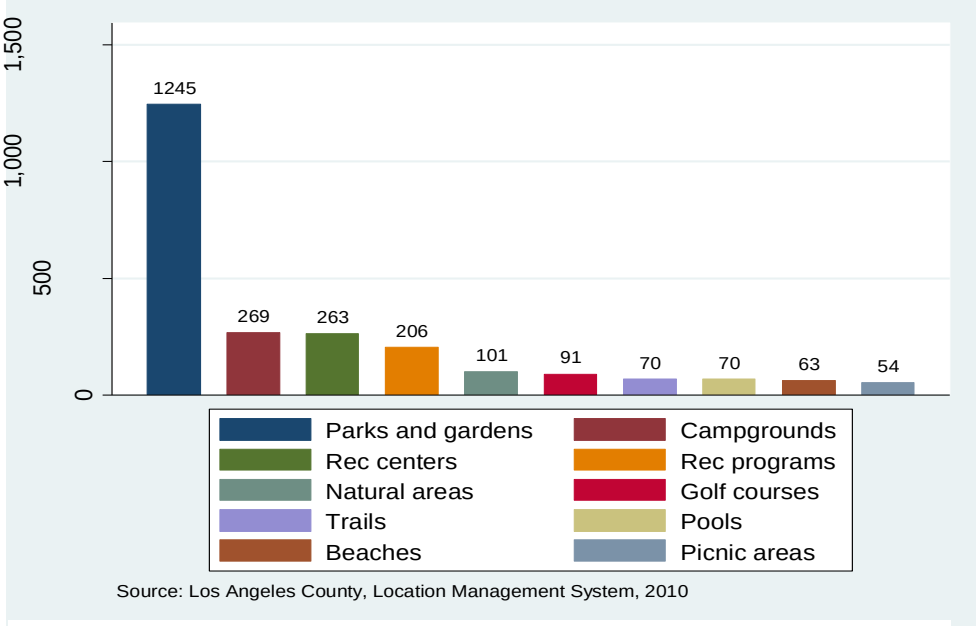

Figure 3. Count of Disaggregated Park Features for Los Angeles County.

Demographic information for Los Angeles County is also included in Table 9. Latinos (47%) comprise the largest racial/ethnic group in Los Angeles County, followed by whites (29%), Asians (13%), blacks (8%), and other (2%). Forty percent of Los Angeles County residents speak Spanish at home. Over a third of Los Angeles County residents are foreign-born, and 20% are not U.S. citizens. Sixteen percent of households live below the Federal Poverty Line. The mean total population is 4,205 residents per tract, and Los Angeles County is densely populated with over 13,000 people per square mile on average. The mean tract size is 1.69 square miles, and the mean percent of attached housing in Los Angeles is 45%.

Table 10 presents the park and demographic information by Latino quartile. The bivariate statistics show a clear pattern of park availability—as percent Latino increases, the mean number of parks decreases. This provides preliminary support for my main hypothesis that Latino neighborhoods will have fewer available park features than non-Latino neighborhoods. The high

Latino tracts have a mean of 0.65 total park features per tract, whereas the tracts with the lowest percent Latino have 1.54 park features. High Latino neighborhoods have no campgrounds, trails, beaches, or picnic areas. Recreation centers and programs appear to be evenly distributed across Latino quartiles.

Table 10. Mean Number of Park Features by Latino Quartile.

	Very Low Latino	Low Latino	Medium Latino	High Latino	Total
Developed park features	1.10	0.83	0.68	0.64	0.81
Golf courses	0.09	0.03	0.02	0.02	0.04
Parks and gardens	0.76	0.58	0.44	0.37	0.54
Swimming pools	0.03	0.02	0.03	0.04	0.03
Recreation centers	0.11	0.10	0.11	0.13	0.11
Recreation programs	0.10	0.10	0.08	0.07	0.09
Natural park features	0.41	0.46	0.08	0.01	0.24
Beaches and marinas	0.11	0.01	0.01	0.00	0.03
Campgrounds	0.15	0.28	0.03	0.00	0.12
Natural areas and wildlife sanctuaries	0.07	0.07	0.03	0.01	0.04
Trails	0.03	0.06	0.01	0.00	0.03
Picnic areas	0.05	0.04	0.00	0.00	0.02
Total park features	1.54	1.34	0.77	0.65	1.07

Source: Location Management System, 2010.

Figure 4 illustrates the disparity in park type by Latino quartile category. Overall, there is a decrease in park features as percent Latino increases, which mirrors the results shown in Table 10. The bar chart highlights the difference between the developed features represented by the dark blue bars and natural features shown in red. There is a sharp drop in natural park features from low- to medium-Latino category. These park distribution patterns offer an alternative explanation for why Latinos might prefer developed park features, and underutilize natural park features (Gobster, 2002). This graph illustrates that there are almost no natural park features in neighborhoods with a high percent of Latino residents.

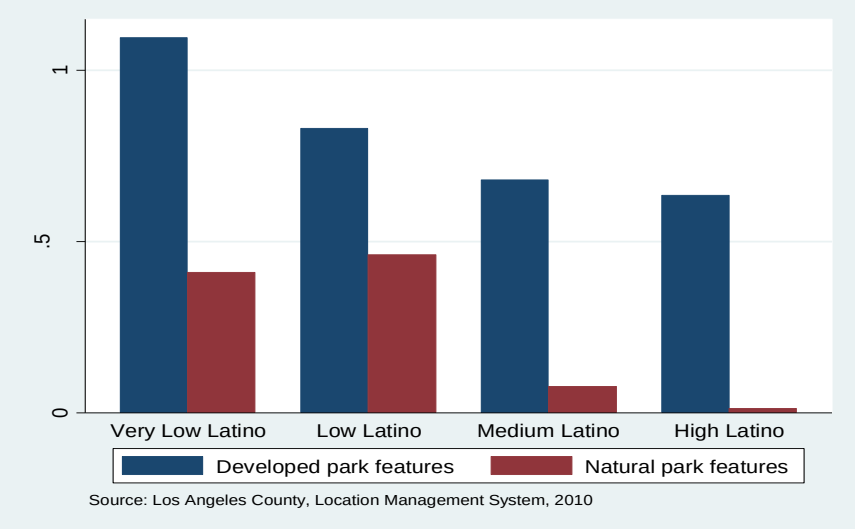

Figure 4. Mean Number of Developed Versus Natural Park Features by Latino Quartile Category.

Table 11 reports demographic statistics by Latino quartile and shows the expected relationship with the SES variables—that is, high-Latino neighborhoods have the lowest mean property value, lowest median household income, and highest rate of poverty. The high-Latino quartile is also twice as dense as the very low Latino quartile.

Table 11. Demographic Statistics by Latino Quartile.

	Very Low Latino	Low Latino	Medium Latino	High Latino
Race/ethnicity				
Latino, %	0.10	0.30	0.59	0.87
White, %	0.61	0.36	0.16	0.05
Black, %	0.07	0.10	0.12	0.04
Asian, %	0.18	0.20	0.11	0.04
Population density				
Population density (per sq. mile)	8,917	10,418	14,588	16,917
Latino immigrant variables				
Non-citizen, %	0.10	0.14	0.23	0.31
Spanish speaking, %	0.07	0.22	0.5	0.78
Foreign born, %	0.27	0.32	0.38	0.45
Neighborhood disadvantage				
Median household income ($)	89,723	64,264	48,388	41,409
Households in poverty, %	0.08	0.12	0.19	0.23
Land use				
Attached housing, %	0.43	0.41	0.47	0.45

Source: American Community Survey, 2006-2010.

Regression results. The ZINB regression results from both the logistic portion and the negative-binomial portion of the model are presented in Table 12. The logistic portion—the model that states land area is driving the excess zeros—shows a significant negative relationship between total land area and zero counts. This finding means there is a greater likelihood that smaller tracts have zero parks, which supports my assertion that limited land area might explain the excess zeros in the data. Results from the logistic or zero portion of the model are presented in the top panel of Table 12.

The results from the negative-binomial portion of the model, presented in the bottom panel of Table 12, address my research question about Latino immigrant neighborhoods and park availability. Model 1 shows that Latino immigrant neighborhood score, percent black, and percent Asian have significant negative relationships with the number of park features in the

neighborhood. Model 2 tested the bivariate association between percent poverty and parks and the results show a significant negative association. However, when poverty was added to the model with the race/ethnicity variables and Latino immigrant neighborhood factor score in Model 3, the association between poverty and parks became positive. This means that as percent poverty increases, so does the number of park features, holding percent black, Asian and Latino immigrant neighborhood score constant. Model 4 introduces the population variables, total population and population density, which both had very small effects. Although total population was not significant in this model, population density accounts for some of the relationship between Latino immigrant neighborhoods and total park features because the Latino immigrant neighborhood factor score decreases, but remains statistically significant.

Model 5 introduces the land area variables, and they both have a small, positive association with parks. The negative association between the race variables and parks remains, but percent Asian becomes non-significant. Interestingly, total population is now significant, which means the land area and land use variables appear to mediate the relationship between total population and parks. Also, the coefficient for percent living in poverty dropped between Models 4 and 5, indicating that some of the effect of poverty was captured by the inclusion of the land variables in the model. Although the Latino immigrant neighborhood factor score coefficient has decreased, it remains statistically significant controlling for population, land area, and economic status of the neighborhood. This lends support to my hypothesis that Latino immigrant neighborhoods will have fewer available total park features, holding other sociodemographic, population, and land use variables constant.

Table 12. Results of Zero-Inflated Negative Binomial Regression Analysis for Total Park Features.

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Zero-inflated model (Logistic portion)					
Land area (square miles)	-7.39***	-7.61***	-7.73***	-5.15***	-5.04***
	(1.24)	(1.08)	(1.27)	(1.50)	(1.18)
Constant	1.19***	1.48***	1.30***	-0.18	0.27
	(0.28)	(0.25)	(0.28)	(0.50)	(0.38)
Negative binomial model (Count portion)					
Latino immigrant neighborhood factor score	-0.41***		-0.51***	-0.31***	-0.15***
	(0.04)		(0.05)	(0.05)	(0.05)
Black, %	-0.97***		-1.25***	-0.95***	-0.51*
	(0.28)		(0.29)	(0.28)	(0.25)
Asian, %	-1.20***		-1.17***	-0.86***	-0.33
	(0.23)		(0.23)	(0.23)	(0.21)
Households in poverty, %		-0.81**	1.39***	2.19***	1.21***
		(0.30)	(0.39)	(0.41)	(0.37)
Total population				0.00	0.00***
				(0.00)	(0.00)
Population density (per sq. mile)				-0.00***	-0.00***
				(0.00)	(0.00)
Land area (square miles)					0.02***
					(0.00)
Percent attached housing					0.87***
					(0.13)
Constant	0.42***	0.46***	0.21**	0.52***	-0.30*
	(0.06)	(0.06)	(0.08)	(0.12)	(0.13)

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

I also ran separate models with developed park features and natural park features as dependent variables to test the hypothesis that Latino immigrant neighborhoods lack natural park features. These models include all of the same controls as the full model (Model 5). The results in Table 13 provide support for my hypothesis and show that the Latino immigrant neighborhood factor score is negatively associated with natural park features. The Latino immigrant neighborhood factor score has a significant negative relationship (p>.01) with natural park

features. The Latino immigrant neighborhood factor score was also negative in the model of developed park features, but not significant at the p<.05 level.

Table 13. Results of Zero-Inflated Negative Binomial Regression Analysis for Developed and Natural Park Features

	Developed Park Features	**Natural Park Features**
Zero-inflated model		
Land area (square miles)	-4.50***	-0.71***
	(0.93)	(0.18)
Constant	0.53	2.73***
	(0.31)	(0.40)
Negative binomial model		
Latino immigrant neighborhood factor score	-0.08	-0.87**
	(0.04)	(0.27)
Black, %	-0.32	-0.06
	(0.24)	(1.78)
Asian, %	-0.02	-3.93*
	(0.20)	(1.68)
Households in poverty, %	1.24***	0.06
	(0.34)	(2.58)
Total population	0.00***	0.00
	(0.00)	(0.00)
Population density (per sq. mile)	-0.00***	-0.00**
	(0.00)	(0.00)
Land area (square miles)	0.00**	0.02**
	(0.00)	(0.01)
Percent attached housing	0.77***	2.89***
	(0.13)	(0.63)
Constant	-0.42***	-1.11*
	(0.12)	(0.49)

Standard errors in parentheses.
* p < 0.05, ** p < 0.01, *** p < 0.001

Predicted counts. Based on the ZINB model, I calculated predicted counts of park features. For increasing levels on the Latino immigrant neighborhood score, the corresponding count of park features drops (Table 14). Specifically, neighborhoods with few Latino immigrant neighborhood features (i.e., low percent Latino, low non-citizen, low Spanish speaking, and low foreign-born) had 6.77 park features per tract whereas neighborhoods with a high Latino

immigrant neighborhood factor score (i.e., had high percentages of all these variables) had on average only 3.66 park features per tract. These predicted counts illustrate the magnitude of the disparity in park availability for Latino immigrant neighborhoods and lends further support to the notion that Latino immigrant neighborhoods lack park resources.

Table 14. Counts of Parks for Each Level of Latino Immigrant Neighborhood Factor Score

Factor Score	**Predicted Count of Parks**
-2	6.77
-1	5.81
0	4.98
1	4.27
2	3.66

Chapter 5. Discussion

The goal of this dissertation was to examine the relationship between Latino concentrated neighborhoods and obesity-related factors at the neighborhood level. Overall, I found some support for the residential segregation perspective but not for the ethnic enclave perspective. Consistent with previous work that shows a positive relationship between Latino-concentrated neighborhoods and obesity risk (Do, et al., 2007; Wen & Maloney, 2011), I find that the proportion of Latinos in the neighborhood was associated with higher BMI, among a representative sample of adults in Los Angeles. I also find that foreign born individuals had significantly lower BMI scores compared to U.S. born individuals, which is in line with other studies that report immigrant health advantages for obesity (Bates, et al., 2008; Buttenheim, et al., 2012). As expected, whites and Asians had significantly lower BMI scores compared to Latinos (Flegal, Carroll, Ogden, & Curtin, 2010). However, some of the control variables included in my study did not behave as expected. For example, none of the SES measures were significant in the regression models, which suggest problems with the way I operationalized SES. Also, females in this sample had lower BMI scores than men, which indicate a possible interaction between gender and neighborhood racial/ethnic composition (Matheson, et al., 2008).

Various forms of neighborhood-based social capital have been hypothesized to indirectly affect obesity-related outcomes (Kim, et al., 2008; Moore, 2010). I tested two different forms of social capital—social cohesion and group participation—but neither was significant in the mediation model. I also tested related social capital forms (informal social control, collective efficacy, and reciprocity) but again found no evidence of mediation. This was somewhat surprising given that Rios (2012) found social cohesion mediated the relationship between neighborhood percent Hispanic and self-rated mental and physical health. In addition, other

studies have found significant direct effects of social cohesion, group participation, and collective efficacy on obesity (Carpiano, 2006; Cohen, et al., 2006; Kawachi, et al., 2008; Moore, et al., 2005). The null findings from my study, coupled with the significant findings from other studies of neighborhood social capital, indicate that the pathways operate differently from what I hypothesized. For example, it could be that social cohesion mediates the relationship between Latino neighborhoods and general health outcomes, but not obesity, specifically. Social cohesion is a measure of trust among neighbors so its effect on self-rated health might speak to a general sense of well-being, whereas the connection to obesity likely involves another mediation pathway that includes behaviors specific to weight gain (Moore, et al., 2009). Also, although the results from the bivariate analysis confirm that Latino neighborhoods and social capital are both related to obesity, the relationship between Latino neighborhoods and obesity may be explained by something other than social capital. That is, omitted variables, such as cultural norms, the food environment, or neighborhood safety, may be more salient for overweight and obesity than social capital (Hammond, 2010; Lopez, 2007).

Using recent data from Los Angeles County, I found a strong negative association between Latino immigrant characteristics (i.e., percent Latino, non-citizen, Spanish speaking, and foreign born) and the number of park features in the neighborhood. In fact, neighborhoods with few Latino immigrant characteristics had more than twice as many park features per tract than neighborhoods with many Latino immigrant characteristics. This finding is consistent with my hypothesis that Latino immigrant neighborhoods would have limited park availability. A lack of parks in some neighborhoods may contribute to disparities in physical activity and related health consequences, such as obesity (Abercrombie, et al., 2008; Bedimo-Rung, et al., 2005). I also found support for my hypothesis that Latino immigrant neighborhoods would have fewer

natural park features (i.e., beaches, campgrounds, natural areas and wildlife sanctuaries, picnic areas, and trails), but more developed park features (i.e., golf courses, parks and gardens, pools, recreation programs, and recreation centers) per tract, compared with non-Latino, non-immigrant neighborhoods. This finding provides the basis for an alternative explanation for what other studies describe as preferences among Latino park users for developed, rather than, natural park settings (Baas, et al., 1993; Chavez, 2001; Gobster, 2002). For example, the presence of developed park features in Latino immigrant neighborhoods may be related to Latino preferences for those same features. More work is needed to determine if there is a connection between the availability of parks features and preferences among park users.

Strengths and Limitations

This dissertation offers important contributions to the literature on Latino neighborhoods and obesity (Corral, et al., 2013; Do, et al., 2007; Mellerson, et al., 2010; Wen & Maloney, 2011). First, I used L.A. FANS, a large population-based survey of families and neighborhoods in Los Angeles, to conduct a multilevel examination of neighborhood contexts on individual obesity outcomes. In addition, I used a unique parks dataset to carry out a county-wide assessment of the availability of different park features at the neighborhood level. Much of the research on obesogenic neighborhood features has focused on the food environment (e.g., fast food versus supermarket accessibility) but other constraints and resources in the physical environment that affect exercise and physical activity are also crucial to understanding obesity risk (Holsten, 2009; Lopez & Hynes, 2006; Sallis & Glanz, 2009).

Despite these strengths, there are limitations to the current research. Like all cross-sectional studies, I cannot infer causality. Also, the data do not directly measure behaviors such as diet, physical activity, or park use, which are important components in the hypothesized link

between neighborhood characteristics and weight status. For example, although my findings about parks are suggestive of risk for obesity, the analyses were performed at the ecological level, limiting any inferences with regard to personal behaviors or weight-related outcomes. Specifically, I was unable to include information on physical activity, so I could not test how park availability is related to behavior. Nevertheless, my findings regarding park availability add to the literature on park disparities and structural barriers to active lifestyles in general.

Another limitation is the use of census tracts to operationalize neighborhoods. A criticism of this approach is what social epidemiologists call the "checkerboard problem" (Reardon, 2006). In this study neighborhoods are treated as unique and distinct entities, like squares on a checkerboard, but census tracts are arbitrary boundaries that residents cross all the time. For example, if a park is located in an adjoining tract, residents can realistically access this park even though it is not located within the neighborhood boundary. This scenario would not be captured in the way I measured park availability. Therefore, census tracts may not be the most appropriate unit of analysis to assess the availability of parks. Future work should consider the use of buffer zones (i.e., within a certain square mile radius) or broadening the operationalization of neighborhood to include adjoining tracts. These alternative approaches to defining neighborhood boundaries might temper my findings of a strong negative association between Latino immigrant neighborhood characteristics and number of park features.

Implications and Future Directions

The findings from this study suggest that Latino neighborhood concentration is associated with obesity risk; however, the mechanisms underlying this relationship remain unclear. I did not find any evidence that social capital mediates the relationship between Latino

neighborhoods and BMI. Findings from the ecological analysis confirm that Latino immigrant neighborhoods in Los Angeles have limited availability of parks.

Important questions remain about Latino neighborhood contexts and obesity risk that warrant further investigation. First, why are some Latino neighborhood environments protective against obesity and others are not? Among my sample of neighborhoods in Los Angeles, Latino neighborhood composition was associated with higher BMI, which is consistent with other studies of Latino neighborhoods and obesity (Corral, et al., 2013; Do, et al., 2007; Wen & Maloney, 2011). However, both Kershaw (2013) and Park (2008) found the opposite—that living in Latino neighborhoods conferred health benefits and was associated with lower BMI and lower obesity prevalence. One possibility for divergent findings is the numerous ways that Latino neighborhoods are operationalized and what these measures represent. Despite the variety of approaches available to researchers, few authors undertake sensitivity analyses to empirically test alternative measures of Latino neighborhoods. As part of the L.A. FANS analysis, I conducted sensitivity tests to determine whether (and to what degree) my conclusions about neighborhoods and obesity differ depending on how the Latino neighborhood measure is operationalized (Appendix A). The results of the sensitivity analysis show a clear gradient between Latino neighborhood composition and BMI, regardless of how Latino neighborhood is measured. Future research should conduct sensitivity tests to determine the measures most appropriate for their population and health outcome and to draw appropriate comparisons across studies.

Second, how is the social environment related to Latino neighborhoods and obesity? Further work is required to flesh out the pathways and theories about neighborhood social contexts and obesity (Macinko & Starfield, 2001). The null findings from the social capital

mediation analysis suggest a few possibilities that can be addressed in future studies: (a) problems with measurement and analysis—it is possible that the measures I included in the mediation models do not adequately capture the constructs of social cohesion and group participation. Future studies should consider different operationalization of social capital constructs (Harpham, 2008) and alternative methods for testing mediation such as path analysis (Rios, et al., 2012) or structural equation models (Franzini, et al., 2009); (b) problems with theory—perhaps my theory about how social capital operates to protect against obesity was incorrect. For example, it is entirely possible that group participation exposes individuals to unhealthy behaviors, or resources that are unrelated to obesity risk. Another possibility is that other, non-social capital, features of the social environment may be more directly relevant to obesity and worth investigating as possible mediators, such as, community and/or cultural norms around body image, social network influences on exercise and diet habits, and the frequency and type of social interactions. More research is needed to determine which aspects of the neighborhood social environment are most salient for obesity risk (Macinko & Starfield, 2001); (c) the third possibility is that there is no mediation relationship between Latino neighborhoods, social capital, and obesity. For example, social capital may operate as a moderator or a confounder, in which case, it would still be correlated with Latino neighborhoods and obesity, but would not explain their relationship. Future studies should continue to develop theoretical explanations about the role of the social environment for obesity risk to help elucidate the relevant pathways and specify relationships among variables (Macinko & Starfield, 2001).

Finally, does park availability affect park use, physical activity, or obesity? Although I did not directly measure park use, Byrne and Wolch (2009) make the case that the distribution of park resources may be tied to racial/ethnic disparities in park use because “the racial ideology of

park provision may significantly affect both the character of park landscapes and how potential users perceive them" (p.752-753). Given my findings of disparities in park availability among Latino immigrant neighborhoods, studies of park use and access should also account for the availability of parks. Future work should link data on parks, with information on health behaviors and health outcomes, to assess how park availability impacts physical activity and obesity. Places to exercise are among the most salient neighborhood features that affect obesity among disadvantaged groups including Latinos (Lovasi, et al., 2009), and parks are an important part of the urban built environment that promotes physical activity—a necessary component to maintaining healthy weight (Lopez & Hynes, 2006). Further, the inequitable distribution of park resources may limit opportunities for physical activity and contribute to disparities in obesity, which are important considerations for urban planners and parks and recreation departments (Lopez & Hynes, 2006).

This dissertation extends scholarly work on Latino neighborhoods and obesity risk (Diez Roux & Mair, 2010; Wen & Maloney, 2011). Consistent with the move among obesity researchers to look upstream for the causes of obesity disparities, this dissertation focused on different features at the neighborhood level that are hypothesized to influence obesity risk (Lopez & Hynes, 2006). A multilevel approach to understanding obesity risk, one that integrates neighborhood and individual factors, will be crucial to identifying root causes of obesity disparities and implementing policies that can effectively fight the obesity epidemic.

APPENDIX A. Sensitivity Analysis for L.A. FANS Neighborhood Measure

There is no consensus among health researchers about how to best measure Latino neighborhoods. The choice of measure is important, but as Kramer and colleagues (2010) point out, this is rarely addressed in segregation studies. Measurement error can lead to incorrect or biased estimates and an incorrectly specified model can miss a relationship that exists (Kramer, et al., 2010). I conducted a sensitivity analysis to ensure that percent Latino is appropriate to use in the L.A. FANS multilevel analysis (Chapter 3). By confirming the appropriateness of the Latino neighborhood measure, I also reduce the possibility of misclassification (measurement error) and produce more reliable estimates. This sensitivity check shows whether the choice of Latino neighborhood measure makes a difference (and if so, how large of a difference) on BMI. The choice of measure depends on a number of factors including the outcome of interest, the population, and the theoretical approach.

Operationalizing Latino Neighborhoods

The most common approach to operationalizing Latino neighborhoods is to use a *continuous measure* of the proportion of Latinos in the neighborhood (Almeida, et al., 2009; Lee, 2009; Reyes-Ortiz, Ju, Eschbach, Kuo, & Goodwin, 2009; Wen & Maloney, 2011). Continuous measures are appealing due to ease of use and interpretation, and because they are commonly used, which allows for comparison across studies (Gerst, et al., 2011). Despite their popularity there are two drawbacks to using a continuous measure. First, a measure of the proportion of the population that is Latino (or Latino sub-group) does not include other neighborhood features that may also be related to health. For example, it is not apparent why the proportion of Latinos in the neighborhood, by itself, should affect health. Neighborhoods are complex, and critics argue that a simple racial/ethnic compositional measure does not capture other potentially health-relevant

dimensions of racially/ethnically concentrated neighborhoods, such as poverty, immigrant population, or linguistic isolation (Kramer, et al., 2010; Kramer & Hogue, 2009; Reardon, 2006). Second, continuous measures do not account for non-linear relationships and, therefore, would not catch threshold effects.

An alternative approach to using a continuous measure is to create a *categorical measure* (Boardman, 2004; Chang, et al., 2009; Eschbach, et al., 2004). A categorical measure is preferred when the continuous racial/ethnic composition variable is skewed or the expected relationship between racial/ethnic composition and health is not continuous (e.g., quadratic). Categorical measures also have intuitive interpretations such as a high/low density or quartile categories. A drawback of the categorical approach is that cut-points are arbitrary (Duncan, et al., 2012). This is especially true for neighborhoods at the margins—one can argue that there is little meaningful difference between a neighborhood that is 59% Latino versus one that is 60% Latino.

A common categorical approach defines a threshold at which a group is considered the dominant group. The cut-point typically used in the neighborhood and health literature is greater than 50% or greater than 60% of a racial/ethnic group (Suro & Tafoya, 2004). A benefit to using this method is the ability to identify relevant tipping points that continuous measures would not capture. For example, in their study of open recreational space in Boston, Duncan and colleagues (2012) used both continuous and categorical measures of black neighborhood composition (neighborhood predominance was defined as greater than 60%). Although they found a significant inverse relationship between black neighborhood composition and open space using both measures, this effect was much larger with the categorical measure compared to the continuous measure. This suggests a threshold effect of 60%, which can be interpreted as the point at which predominantly black neighborhoods drop off in access to recreational open space.

An alternative to the standard cut-point approach is the distributional approach, which bases cut-points on the distribution in the real population. A benefit to this approach is that the resulting cut-points are appropriate for a given regional context. For example, applying the 60% predominance threshold in areas that are multi-ethnic and fairly integrated can obscure other neighborhood configurations that are typical of the region but that do not meet the 60% cutoff.

A third option for operationalizing Latino neighborhoods is to create a *composite score* (i.e., using factor analysis or principal component analysis) that includes various neighborhood sociodemographic features in addition to racial/ethnic composition. Conceptually, this approach accounts for other aspects of the neighborhood environment, beyond race/ethnicity, that may also be related to health. For example, it is not the presence of Latinos per se that make a neighborhood healthy or unhealthy (which is what the continuous and categorical variables measure), but the concentration of immigrants who are thought to retain the health protective behaviors from their home county or the concentration of poverty resulting from residential segregation. A statistical advantage of using a score rather than individual variables in a regression model is that sociodemographic variables are often highly correlated, which introduces the problem of multicollinearity. Factor analysis techniques circumvent this problem by reducing the number of variables to a smaller set of uncorrelated factors.

A drawback of using composite scores and a criticism of factor analysis in general is that it can be difficult to interpret the resulting factors and there is some subjectivity in determining what the factors represent (DiStefano, Zhu, & Mindrila, 2009). To address this concern, I first run the model using the factor score and then run a second model with the individual components that make up the factor score. In this case, I can check the model fit and see if the factor score is

capturing the effects of the individual variables. This step teases out the individual components of the factor score to understand how they are influencing the model.

Choice of Neighborhood Measure

The primary Latino neighborhood measure was *percent Latino* and the alternative measures were a *dichotomous* variable using .60 as the cut-point, a variable divided into *quartiles*, and a *Latino immigrant neighborhood* factor score. All are used in studies of neighborhood racial/ethnic composition and health (Kramer, et al., 2010). The immigrant concentration factor score was created from the Census 2000 SF-3 variables using the principal-factor method in Stata 11 and was provided by the L.A. NSC (Peterson, et al., 2007). The factor score is based on the percent of the population that are non-citizens, percent of population that is foreign born, percent of population post-1990 immigrant, percent of population post-1995 immigrants, percent of adult Spanish speakers, and the percent Latino in 2000.

Table A- 1 compares all the Latino neighborhood measures used in the sensitivity analysis based on the L.A. FANS sample. The mean percent Latino for the L.A. FANS sample is 0.54.

Table A- 1. Comparison of Latino Neighborhood Measures Used in Sensitivity Analysis.

Measurement type	**Operationalization**	**Mean or N (%)**
Continuous	Percent Latino	0.54
Categorical	Dichotomous	
	<.60 non-predominant Latino	1,151 (52.53%)
	>.60 predominantly Latino	1,040 (47.47%)
	Quartiles	
	Q1 – very low Latino	565 (25.79%)
	Q2 – low Latino	557 (25.42%)
	Q3 – medium Latino	529 (24.14%)
	Q4 – high Latino	540 (24.65%)
Composite score	Latino immigrant concentration factor score (score range: -1.22, 3.11)	0.51
Individual variables (used in composite score)	Non-citizens	0.27
	Foreign-born	0.40
	Post-1990 immigrants	0.15
	Post-1995 immigrants	0.07
	Spanish speakers	0.46

Source: L.A. FANS, 2000-2001.

Table A- 2 shows results from the five different models used as part of the sensitivity analysis. All models predict BMI and included all controls from the full random intercepts model described above. Also, all models showed a significant positive relationship between Latino neighborhood and BMI. The mean BMI ranged from 24.74 (Model 1) to 26.44 (Model 4), which is 1.7 points on the BMI scale and the difference between normal and overweight categories. However, when controls were added this difference decreased and both scores were within the normal range (19.18 and 20.45). Based on the mean BMI values alone, it appears that neighborhood effects on obesity differ very little depending on how Latino neighborhood is measured.

Table A- 2. Results from Sensitivity Analysis Comparing Different Latino Neighborhood Measures on BMI.

	Model 1: Continuous	Model 2: Dichotomous	Model 3: Quartiles	Model 4: Composite score	Model 5: Individual variables
Percent Latino	2.73***				1.24
	(4.18)				(0.34)
Predominant Latino		0.96*			
		(2.23)			
Very low Latino			0		
			(ref.)		
Low Latino			0.96*		
			(2.35)		
Medium Latino			1.09*		
			(2.20)		
High Latino			1.96***		
			(3.91)		
Latino immigrant concentration factor score				0.53**	
				(2.78)	
Non-citizens					5.18
					(0.69)
Foreign-born					1.08
					(0.44)
Post-1990 immigrants					-14.04
					(-1.18)
Post-1995 immigrants					8.79
					(0.60)
Spanish speakers					0.69
					(0.15)
Constant	19.18***	20.27***	19.66***	20.45***	19.17***
	(14.82)	(16.13)	(15.83)	(16.84)	(13.38)

Note: All models control for age, age-squared, race/ethnicity, female, U.S. born, household income, and education.
Source: L.A.FANS, 2000-200.1
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

However, the coefficient for the respective Latino neighborhood measures did differ substantially. In Model 1, for each one-unit increase in percent Latino in the neighborhood, there is a corresponding 2.7 point increase in BMI and this was significant at the $p<0.001$ level. Model 2 shows that predominantly Latino neighborhoods (> 60% Latino) had almost 1 point higher

BMI than neighborhoods that were not predominantly Latino. The information from Models 1 and 2 clearly show a gradient where more Latino neighborhoods have higher BMI compared to less Latino neighborhoods. Model 3, which used the Latino quartile variable, provides additional detail about this gradient. For each increasing Latino quartile category, there is about a 1-2 point increase in BMI and this was strongest for the high Latino category. Model 4 states that for each one-unit increase in the Latino immigrant concentration score there is an accompanying 0.53 increase in BMI score. The final model includes the individual variables that comprise the immigrant concentration score; none of the variables in this model were significant. Model 4 is preferred over Model 5 because it addresses the multicollinearity problem. However, the interpretation of the factor score is not intuitive because it has no real world meaning.

Among the remaining three models, the differences were negligible. The preferred measure for the full regression analysis is percent Latino, however, I retained the categorical measures for some of the descriptive analysis. The quartile categories are useful for distinguishing between very low, low, medium, and high Latino proportion neighborhoods. I did not pick the dichotomous measure because there was no evidence of a threshold effect. Overall, I draw the same conclusion about neighborhood effects on obesity if I use continuous, categorical, or composite score versions of Latino neighborhood but the continuous measure provides a more straightforward interpretation. The sensitivity analysis confirms that the percent Latino variable is an appropriate measure for these data.

Studies concerned with racial/ethnic neighborhoods are advised to try different options for operationalizing the neighborhood variable to identify the most appropriate measure that balances theoretical and statistical concerns. In my sample of adults in Los Angeles, there was no threshold effect or “tipping point” for obesity. The results of sensitivity tests may differ

depending on the population, health outcome, and data source. Clear explanation and justification for measurement choices will help to elucidate the pathways that connect Latino neighborhoods and health.

APPENDIX B. Mediation Analysis with Alternative Social Capital Measures

Because my social capital measures did not yield any significant findings, I tried alternative social capital constructs to see if choice of measurement would change the results of the mediation analysis. Specifically, I tested additional level-2 social capital forms that are similar to social cohesion. None of these alternative measurements of social capital were significant mediators. I conclude that various measures of social capital do not mediate the relationship between Latino neighborhood composition and BMI in this sample of adults. I describe the alternative constructs below, and the results from the alternative mediation analysis are reported in

Table B- 1. Mediation of The Effect of Neighborhood Percent Latino on Individual BMI Through Alternative Mediators (Indirect Effects).

.

Informal social control refers to the willingness among neighbors to step in for the greater good of the community (Sampson, et al., 1999; Sampson, et al., 1997). This is relevant to obesity because such controls can directly influence neighborhood safety. For example, residents may intervene to fix a burnt out street light, maintain clean and safe public spaces, or report criminal activity. Residents are more likely to engage in physical activity if they perceive their neighborhood as safe. Neighborhood informal social control may also help to maintain healthy behavioral norms (Cohen, et al., 2006; Kawachi & Berkman, 2000). The informal social control scale asked respondents how likely their neighbors would do something about the following: (a) If a group of neighborhood children were skipping school and hanging out on a street corner, (b) If some children were spray-painting graffiti on a local building, (c) If a child was showing disrespect to an adult. Social cohesion and informal social control are sometimes combined to assess *collective efficacy,* which is the neighborhood's willingness and ability to act for the common good. Collective efficacy has been shown to be protective for health outcomes among adolescents, including obesity (Cohen, et al., 2006; Sampson, et al., 1999). For example, neighborhoods with higher collective efficacy were associated with a lower prevalence overweight in a sample of adolescents (Cohen, et al., 2006) and lower odds of obesity among adults (Bjornstrom, 2011; Ullmann, Goldman, & Pebley, 2013). I also tested for mediation using a combined collective efficacy measure.

Reciprocity refers to the norms in the neighborhood regarding reciprocated exchange such as doing favors for one another (Sampson, et al., 1999). Although reciprocity is not

typically included as a form of social capital that is related to obesity, some have argued that reciprocity is an important and understudied aspect of social capital (Granberry & Marcelli, 2007; Portes, 2000). Reciprocity as it is applied in this context is considered a form of perceived support. Neighborhoods with high levels of support indicate access to material resources or advice which can help maintain healthy lifestyles; conversely, low levels of support or reciprocity make it difficult to maintain healthy behaviors (Ali & Lindström, 2006). The reciprocity scale assessed how frequently neighbors help each other based on the following three items: (a) About how often do you and people in your neighborhood do favors for each other? For example, watch each other's children, help with shopping, and lend gardening or house tools, (b) When a neighbor is not at home, how often do you and other neighbors watch over their property, (c) How often do you and other people in the neighborhood ask each other advice about personal things such as child rearing or job openings? Higher scores represent greater reciprocity because it means neighbors do favors for each other more often.

Table B- 1. Mediation of The Effect of Neighborhood Percent Latino on Individual BMI Through Alternative Mediators (Indirect Effects).

Mediator	Coeff.	SE	Z	p	Percentile 95% CI
Informal social control	0.00	0.07	0.06	0.95	-0.16, 0.15
Reciprocity	-0.09	0.18	-0.52	0.60	-0.47, 0.25
Collective efficacy	-0.01	0.07	-0.11	0.92	-0.14, 0.16

Source: L.A. FANS, 2000-2001.
* Note: percentile CI bootstrap- based on 2,000 replications.

APPENDIX C. Creation of Parks Data

The information used to create the parks and recreation variables come from a subset of the LMS data and Census 2010. LMS data provided location name, service type, and the geo-location (x, y coordinates, which is the real longitude and latitude used to identify the point on the map). Census 2010 Tiger/LINE shapefiles were used to establish census tract boundaries (http://arcdata.esri.com/data/tiger2010/tiger_download.cfm).

The parks and recreation variables were created using ESRI ArcGIS version 10.0.[18] The "select by attribute" tool was used to choose the points in relevant categories based on the Cat1 broad service category (e.g., Arts & Recreation) field and Cat2 specific service category (e.g., Beaches & Marinas) field. For the purposes of this analysis “parks and recreation” were defined as park features that are accessible to the general public and that can be used for recreation and physical activity. Using this criteria, a total of ten specific “parks and recreation” types were selected, all of which fell under the broad service category of “Arts & Recreation” (defined by L.A. County). Then the subset of points was superimposed on the 2010 Census tract shapefile. Data were exported to Stata 12 for data cleaning and analysis.[19]

[18] My colleague Malia Jones created the database.

[19] All shapefiles were projected to NAD1983 State Plane CA-VI.

APPENDIX D. Census Tracts that Were Dropped from the Parks Analysis

Table D- 1. Description of Census Tract that were Dropped from the Parks Analysis.

Tract Number	Description	Reason for Drop
6037207400	Civic Center/Grand Park	Missing: income; poverty
6037265301	Westwood/UCLA	Missing: income; poverty
6037320000	Universal Studios Hollywood	Zero population
6037403200	Diamond Bar (Developmental center)	Missing: income
6037504102	Norwalk (Miscellaneous parks)	Zero population
6037551600	South Gate (Mixed land use)	Missing: income; poverty
6037574601	Long Beach (CSULB)	Missing: income; poverty
6037574700	Long Beach (Veteran's Administration)	Zero population
6037575500	Wilmington/Lower Westside (Miscellaneous industrial land use)	Missing: income
6037901003	Lancaster (Antelope Valley State Prison)	Missing: income; poverty
6037920200	Santa Clarita (Mountains)	Missing: income; poverty
6037980001	Bob Hope International Airport	Zero population
6037980002	Wilmington (Miscellaneous industrial land use)	Zero population
6037980003	Edwards Air Force Base	Zero population
6037980004	Air Force Plant (Palmdale)	Zero population
6037980005	Exxon Mobile Refinery (Torrance)	Zero population
6037980006	El Dorado Park East (Lakewood/Hawaiian Gardens)	Missing: income
6037980007	Marina (Seal Beach)	Zero population
6037980013	Los Angeles International Airport	Zero population
6037980018	Long Beach Airport	Zero population
6037980020	Verdugo Mountain Park/La Tuna Canyon Park	Zero population
6037980021	Hansen Dam	Zero population
6037980022	Van Norman Lakes	Zero population
6037980023	Chatsworth Reservoir	Zero population
6037980025	Carson (Miscellaneous industrial land use)	Zero population
6037980028	Los Angeles International Airport	Zero population
6037980030	Los Angeles International Airport	Zero population
6037980033	Port of Long Beach	Zero population
6037990100	Pacific Ocean	Zero population
6037990200	Pacific Ocean	Zero population
6037990300	Pacific Ocean	Zero population

APPENDIX E. Diagnostic Tests

Collinearity Diagnostics

I ran a number of collinearity diagnostic tests that showed high Variance Inflation Factors (VIF) and high condition numbers among my initial set of variables. The Latino immigrant variables in particular were highly correlated (Table E- 1).

Table E- 1. Correlation Matrix for Latino Immigration Related Variables.

	Percent Latino	Percent non-citizen	Percent Spanish speaking	Percent foreign born
Percent Latino	1			
Percent non-citizen	0.681***	1		
Percent Spanish speaking	0.976***	0.754***	1	
Percent foreign born	0.475***	0.840***	0.538***	1

Source: American Community Survey, 2006-2010.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Based on the results of the tests of collinearity, I decided to create a factor score using principal component factor analysis to reduce multicollinearity but still allow me to account for these constructs in my model. The four Latino immigration related variables: percent Latino, percent non-citizen, percent Spanish speaking, and percent foreign-born and all loaded highly onto one factor, which I interpret as representing Latino immigrant neighborhoods (Table E- 2). Replacing the four individual variables with one factor score made a substantial improvement on the collinearity problem (i.e., VIFs dropped to an acceptable level). I also removed median property value and percent youth from my candidate variables and this further improved the condition number, which is a measure of instability of the regression coefficients (UCLA: Statistical Consulting Group, 2013a).

Table E- 2. Factor Analysis of Latino Immigrant Variables (n=2,315).

Variable	**Rotated Factor Loadings**
	Latino immigrant neighborhood factor
Latino, %	0.89
Non-citizen, %	0.92
Spanish speaking, %	0.93
Foreign born, %	0.79
Eigenvalue	3.14

Note: Principal Components Factor Analysis with Varimax rotation was used.

Table E- 3 shows how the collinearity diagnostics improved between the original set of variables and the reduced set of variables to be used in the regression analysis. I considered including median household income but dropped it from the analysis because it was correlated with percent poverty. Based on my collinearity checks, the variables in my full model are: Latino immigrant neighborhood factor score, percent black, percent Asian, percent poverty, total population, population density, land area, and percent attached housing.

Table E- 3. Results from Diagnostic Tests of Collinearity.

	Mean VIFs	**Condition Number**
Set 1 (candidate variables)	8.26	55.81
Set 2 (final variables)	1.54	11.43

Count Data Diagnostics

A histogram of the count of parks variable shows that data are highly skewed to the right (Figure E- 1), indicating that the unconditional mean is lower than the variance. In fact, the variance is 17 times larger than the mean (mean=1.07; variance=17.76). A Poisson distribution however, assumes that the mean and variance are equal but, as the descriptive statistics suggest, this variable shows overdispersion and does not follow a Poisson distribution. Negative binomial

regression is the preferred method for modeling count variables that are overdispersed, as in the case of the parks data.

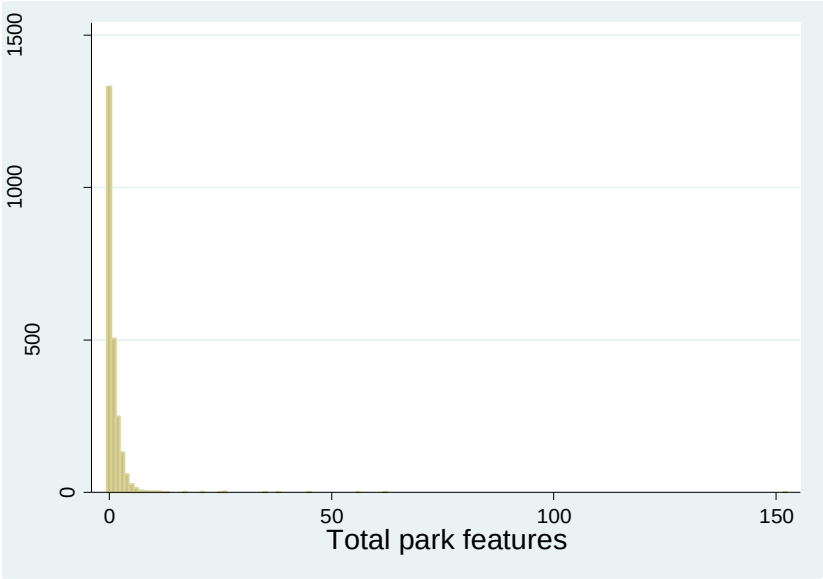

Figure E- 1. Count of Total Park Features by Tract.

Figure E- 2 confirms overdispersion and shows the outcome follows a negative binomial distribution rather than a Poisson distribution.

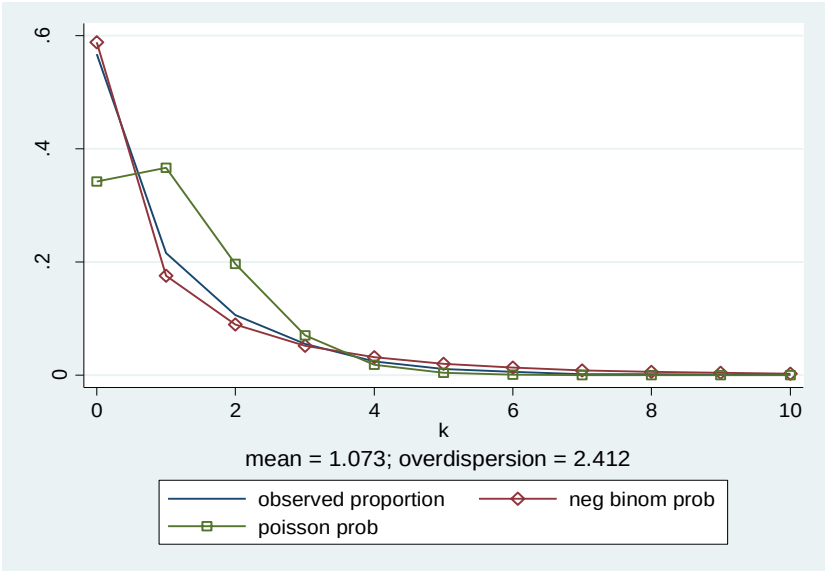

Figure E- 2. Histogram of Park Features with Predicted Probabilities.

Next I used the likelihood-ratio test of alpha, which tests the assumption that the mean and the variance are the same. The results confirm that the mean and the variance are statistically different, which provides further evidence that the data do not follow a Poisson distribution. These results, shown in the top panel of Table E- 4, justify the use of negative binomial regression over Poisson for analyzing the parks count data.

Table E- 4. Comparison of Count Model Diagnostic Tests.

	Diagnostic Test	**Significance**	**Conclusion**
Poisson v. Negative Binomial	Likelihood-ratio test of alpha = 0	p = 0.000	Negative Binomial preferred
Negative Binomial v. ZINB	Vuong test	p = 0.0380	ZINB preferred

Once I ruled out Poisson, another approach I considered was the zero-inflated negative binomial regression model, which is used when there is an excessive amount of zeros in the data. My data has a large amount of zeros (over 50% of tracts had 0 parks), so I ran additional diagnostics to see if the ZINB model is preferred over the regular negative binomial model. ZINB models assume that the reason for the excess number of zeros is because there are two kinds of zeros in the data: true zeros and excess zeros (Atkins & Gallop, 2007). This implies that there are two separate underlying processes producing the zero counts. The ZINB model requires a theoretical rationale to model the two types of zeros. For example, a tract zoned for industrial businesses or a small tract with insufficient land area might both have zero park features, but as a result of different circumstances (i.e., zoning laws versus geographical space). I hypothesize that tracts with limited *land area* may be generating the excess zeros because there is inadequate space for a park.

I ran a zero-inflated negative binomial regression model in which I specified two simultaneous models: one that predicts the true-zero counts (the regular negative binomial

regression model), and a separate model that predicts the excess-zero counts (the zero-inflated model). The regular negative binomial regression model included the variables from my full model (Latino immigrant neighborhood factor score, percent black, percent Asian, percent poverty, total population, population density, land area, and percent attached housing). For the zero-inflated model I specified *land area* as the predictor. The results show that land area was statistically significant, which indicates that land area may be what is producing the excess zeros. In addition, the Vuong test, a post-estimation model comparison statistic, finds the ZINB is a better fit than the standard negative binomial (p-value=0.038). I concluded that the ZINB model is the best choice for modeling the parks count outcome.

REFERENCES

Abercrombie, L. C., Sallis, J. F., Conway, T. L., Frank, L. D., Saelens, B. E., & Chapman, J. E. (2008). Income and racial disparities in access to public parks and private recreation facilities. *American Journal of Preventive Medicine, 34*(1), 9-15.

Acuña, R. (1988). *Occupied America*: Harper & Row.

Addy, C. L., Wilson, D. K., Kirtland, K. A., Ainsworth, B. E., Sharpe, P., & Kimsey, D. (2004). Associations of perceived social and physical environmental supports with physical activity and walking behavior. *Journal Information, 94*(3).

Ali, S. M., & Lindström, M. (2006). Socioeconomic, psychosocial, behavioural, and psychological determinants of BMI among young women: differing patterns for underweight and overweight/obesity. *The European Journal of Public Health, 16*(3), 324-330.

Almeida, J., Kawachi, I., Molnar, B. E., & Subramanian, S. (2009). A Multilevel Analysis of Social Ties and Social Cohesion among Latinos and Their Neighborhoods: Results from Chicago. *Journal of Urban Health, 86*(5), 745-759.

Aneshensel, C. S. (2002). *Theory-based data analysis for the social sciences* (Vol. 464): Sage Publications.

Aneshensel, C. S., & Sucoff, C. A. (1996). The neighborhood context of adolescent mental health. *Journal of health and social behavior*, 293-310.

Aranda, M. P., Ray, L. A., Snih, S. A., Ottenbacher, K. J., & Markides, K. S. (2011). The Protective Effect of Neighborhood Composition on Increasing Frailty Among Older Mexican Americans: A Barrio Advantage? *Journal of Aging and Health, 23*(7), 1189-1217.

Atkins, D. C., & Gallop, R. J. (2007). Rethinking how family researchers model infrequent outcomes: a tutorial on count regression and zero-inflated models. *Journal of Family Psychology, 21*(4), 726.

Baas, J. M., Ewert, A., & Chavez, D. J. (1993). Influence of ethnicity on recreation and natural environment use patterns: Managing recreation sites for ethnic and racial diversity. *Environmental Management, 17*(4), 523-529.

Barrington, D. S., Baquero, M. C., Borrell, L. N., & Crawford, N. D. (2010). Racial/Ethnic Disparities in Obesity Among US-born and Foreign-born Adults by Sex and Education. *Obesity, 18*(2), 422-424.

Bates, L. M., Acevedo-Garcia, D., Alegría, M., & Krieger, N. (2008). Immigration and generational trends in body mass index and obesity in the United States: results of the National Latino and Asian American Survey, 2002-2003. *Journal Information, 98*(1).

Bauer, D. J., Preacher, K. J., & Gil, K. M. (2006). Conceptualizing and testing random indirect effects and moderated mediation in multilevel models: new procedures and recommendations. *Psychological methods, 11*(2), 142.

Bécares, L., Shaw, R., Nazroo, J., Stafford, M., Albor, C., Atkin, K., et al. (2012). Ethnic Density Effects on Physical Morbidity, Mortality, and Health Behaviors: A Systematic Review of the Literature. *American Journal of Public Health, 102*(12), e33-e66.

Bedimo-Rung, A. L., Mowen, A. J., & Cohen, D. A. (2005). The significance of parks to physical activity and public health: a conceptual model. *American Journal of Preventive Medicine, 28*(2), 159-168.

Bitler, M., & Peterson, C. (2004). *LA FANS Income and Assets Imputations: Description of Imputed Income/Assets Data for LAFANS Wave 1*: LA FANS Working Paper.

Bjornstrom, E. E. (2011). An examination of the relationship between neighborhood income inequality, social resources, and obesity in Los Angeles County. *American Journal of Health Promotion, 26*(2), 109-115.

Björntorp, P. (2001). Do stress reactions cause abdominal obesity and comorbidities? *Obesity Reviews, 2*(2), 73-86.

Björntorp, P., & Rosmond, R. (2000). Obesity and cortisol. *Nutrition (Burbank, Los Angeles County, Calif.), 16*(10), 924-936.

Black, J. L., & Macinko, J. (2008). Neighborhoods and obesity. *Nutrition reviews, 66*(1), 2-20.

Blakely, T., & Subramanian, S. (2006). Multilevel studies. *Methods in Social Epidemiology. San Francisco, CA: Jossey-Bass*, 316-340.

Boardman, J. D. (2004). Stress and physical health: the role of neighborhoods as mediating and moderating mechanisms. *Social Science & Medicine, 58*(12), 2473-2483.

Boardman, J. D., Onge, J. M. S., Rogers, R. G., & Denney, J. T. (2005). Race Differentials in Obesity: The Impact of Place. *Journal of health and social behavior, 46*(3), 229-243.

Boone, C. G., Buckley, G. L., Grove, J. M., & Sister, C. (2009). Parks and people: An environmental justice inquiry in Baltimore, Maryland. *Annals of the Association of American Geographers, 99*(4), 767-787.

Booth, K. M., Pinkston, M. M., & Poston, W. S. C. (2005). Obesity and the built environment. *Journal of the American Dietetic Association, 105*(5), 110-117.

Bourdieu, P. (2008). The Forms of Capital. *Readings in economic sociology, 4*, 280.

Bronfenbrenner, U. (1992). *Ecological systems theory*: Jessica Kingsley Publishers.

Brown, A. F., Vargas, R. B., Ang, A., & Pebley, A. R. (2008). The neighborhood food resource environment and the health of residents with chronic conditions. *Journal of general internal medicine, 23*(8), 1137-1144.

Broyles, S. T., Mowen, A. J., Theall, K. P., Gustat, J., & Rung, A. L. (2011). Integrating social capital into a park-use and active-living framework. *American Journal of Preventive Medicine, 40*(5), 522-529.

Burdette, H. L., Wadden, T. A., & Whitaker, R. C. (2006). Neighborhood safety, collective efficacy, and obesity in women with young children. *Obesity, 14*(3), 518-525.

Burkhauser, R. V., & Cawley, J. (2008). Beyond BMI: The value of more accurate measures of fatness and obesity in social science research. *Journal of health economics, 27*(2), 519-529.

Buttenheim, A. M., Pebley, A. R., Hsih, K., Chung, C. Y., & Goldman, N. (2012). The shape of things to come? Obesity prevalence among foreign-born vs. US-born Mexican youth in California. *Social Science & Medicine*.

Byrne, J. (2012). When green is White: The cultural politics of race, nature and social exclusion in a Los Angeles urban national park. *Geoforum, 43*(3), 595-611.

Byrne, J., & Wolch, J. (2009). Nature, race, and parks: past research and future directions for geographic research. *Progress in Human Geography, 33*(6), 743-765.

Cagney, K. A., Browning, C. R., & Wallace, D. M. (2007). The Latino paradox in neighborhood context: the case of asthma and other respiratory conditions. *American Journal of Public Health, 97*(5), 919.

Carle, A. C. (2009). Fitting multilevel models in complex survey data with design weights: Recommendations. *BMC Medical Research Methodology, 9*(1), 49.

Carpiano, R. M. (2006). Toward a neighborhood resource-based theory of social capital for health: Can Bourdieu and sociology help? *Social Science & Medicine, 62*(1), 165-175.

Chang, V. W. (2006). Racial residential segregation and weight status among US adults. *Social Science & Medicine, 63*(5), 1289-1303.

Chang, V. W., Hillier, A. E., & Mehta, N. K. (2009). Neighborhood Racial Isolation, Disorder and Obesity. *Social forces; a scientific medium of social study and interpretation, 87*(4), 2063.

Charles, C. Z. (2000). Residential Segregation in Los Angeles. *Prismatic Metropolis: Inequality in Los Angeles*, 167-219.

Charles, C. Z. (2003). The dynamics of racial residential segregation. *Annual Review of Sociology*, 167-207.

Chavez, D. J. (2001). *Managing Outdoor Recreation in California: Visitor Contact Studies, 1989-1998*: US Department of Agriculture, Forest Service, Pacific Southwest Research Station.

Christakis, N. A., & Fowler, J. H. (2007). The spread of obesity in a large social network over 32 years. *New England Journal of Medicine, 357*(4), 370-379.

Clark, W. A. (1991). Residential preferences and neighborhood racial segregation: A test of the Schelling segregation model. *Demography, 28*(1), 1-19.

Cohen, D. A., Finch, B. K., Bower, A., & Sastry, N. (2006). Collective efficacy and obesity: The potential influence of social factors on health. *Social Science & Medicine, 62*(3), 769-778.

Cohen, D. A., Mason, K., Bedimo, A., Scribner, R., Basolo, V., & Farley, T. A. (2003). Neighborhood physical conditions and health. *American Journal of Public Health, 93*(3), 467-471.

Corral, I., Landrine, H., & Zhao, L. (2013). Residential segregation and obesity among a national sample of Hispanic adults. *Journal of health psychology*.

Creighton, M. J., Goldman, N., Pebley, A. R., & Chung, C. Y. (2012). Durational and generational differences in Mexican immigrant obesity: Is acculturation the explanation? *Social Science & Medicine, 75*(2), 300-310.

Crespo, C. J. (2000). Encouraging physical activity in minorities: Eliminating disparities by 2010. *The Physician and sportsmedicine, 28*(10), 36.

Cronan, M. K., Shinew, K. J., Schneider, I., Stanis, S., & Chavez, D. (2008). Physical activity patterns and preferences among Latinos in different types of public parks. *Journal of physical activity & health, 5*(6), 894.

Cutts, B. B., Darby, K. J., Boone, C. G., & Brewis, A. (2009). City structure, obesity, and environmental justice: an integrated analysis of physical and social barriers to walkable streets and park access. *Social Science & Medicine, 69*(9), 1314-1322.

Dahmann, N., Wolch, J., Joassart-Marcelli, P., Reynolds, K., & Jerrett, M. (2010). The active city? Disparities in provision of urban public recreation resources. *Health & Place, 16*(3), 431-445.

Deurenberg, P., Weststrate, J. A., & Seidell, J. C. (1991). Body mass index as a measure of body fatness: age-and sex-specific prediction formulas. *Br J Nutr, 65*(2), 105-114.

Diez Roux, A. V., & Mair, C. (2010). Neighborhoods and health. *Annals of the New York Academy of Sciences, 1186*(1), 125-145.

DiStefano, C., Zhu, M., & Mindrila, D. (2009). Understanding and using factor scores: Considerations for the applied researcher. *Practical Assessment, Research & Evaluation, 14*(20), 1-11.

Do, D. P., Dubowitz, T., Bird, C. E., Lurie, N., Escarce, J. J., & Finch, B. K. (2007). Neighborhood context and ethnicity differences in body mass index: a multilevel analysis using the NHANES III survey (1988-1994). *Economics & Human Biology, 5*(2), 179-203.

Duncan, D. T., Kawachi, I., White, K., & Williams, D. R. (2012). The Geography of Recreational Open Space: Influence of Neighborhood Racial Composition and Neighborhood Poverty. *Journal of Urban Health*, 1-14.

Echeverría, S., Diez-Roux, A. V., Shea, S., Borrell, L. N., & Jackson, S. (2008). Associations of neighborhood problems and neighborhood social cohesion with mental health and health behaviors: the Multi-Ethnic Study of Atherosclerosis. *Health & Place, 14*(4), 853-865.

Ellaway, A., & Macintyre, S. (2001). Women in their place *Geographies of Women's Health: Place, Diversity and Difference* (Vol. 3, pp. 265).

Eschbach, K., Ostir, G. V., Patel, K. V., Markides, K. S., & Goodwin, J. S. (2004). Neighborhood context and mortality among older Mexican Americans: is there a barrio advantage? *American Journal of Public Health, 94*(10), 1807.

Ewing, R., Schmid, T., Killingsworth, R., Zlot, A., & Raudenbush, S. (2003). Relationship between urban sprawl and physical activity, obesity, and morbidity. *American Journal of Health Promotion, 18*(1), 47-57.

Ferraro, K. F., Thorpe, R. J., & Wilkinson, J. A. (2003). The Life Course of Severe Obesity: Does Childhood Overweight Matter? *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 58*(2), S110-S119.

Fish, J. S., Ettner, S., Ang, A., & Brown, A. F. (2010). Association of perceived neighborhood safety on body mass index. *Journal Information, 100*(11).

Fitzgibbon, M. L., Blackman, L. R., & Avellone, M. E. (2000). The relationship between body image discrepancy and body mass index across ethnic groups. *Obesity Research, 8*(8), 582-589.

Flegal, K. M., Carroll, M. D., Kit, B. K., & Ogden, C. L. (2012). Prevalence of obesity and trends in the distribution of body mass index among US adults, 1999-2010. *JAMA: the journal of the American Medical Association, 307*(5), 491-497.

Flegal, K. M., Carroll, M. D., Ogden, C. L., & Curtin, L. R. (2010). Prevalence and trends in obesity among US adults, 1999-2008. *JAMA: the journal of the American Medical Association, 303*(3), 235-241.

Floyd, M. F. (2007). Research on race and ethnicity in leisure: Anticipating the fourth wave. *Leisure/Loisir, 31*(1), 245-254.

Frank, L. D., Sallis, J. F., Conway, T. L., Chapman, J. E., Saelens, B. E., & Bachman, W. (2006). Many pathways from land use to health: associations between neighborhood walkability and active transportation, body mass index, and air quality. *Journal of the American Planning Association, 72*(1), 75-87.

Franzini, L., Elliott, M. N., Cuccaro, P., Schuster, M., Gilliland, M. J., Grunbaum, J. A., et al. (2009). Influences of Physical and Social Neighborhood Environments on Children's Physical Activity and Obesity. *Am J Public Health, 99*(2), 271-278.

Gallo, L. C., Penedo, F. J., Espinosa de los Monteros, K., & Arguelles, W. (2009). Resiliency in the face of disadvantage: do Hispanic cultural characteristics protect health outcomes? *Journal of personality, 77*(6), 1707-1746.

García, R., & White, A. (2006). Healthy parks, schools, and communities: Mapping green access and equity for the Los Angeles region. *The City Project Policy Report. Accessed online in May, 29*, 2007.

Gee, G. C., & Payne-Sturges, D. C. (2004). Environmental health disparities: a framework integrating psychosocial and environmental concepts. *Environmental Health Perspectives, 112*(17), 1645.

Gerst, K., Miranda, P. Y., Eschbach, K., Sheffield, K. M., Peek, M. K., & Markides, K. S. (2011). Protective neighborhoods: neighborhood proportion of Mexican Americans and depressive symptoms in very old Mexican Americans. *Journal of the American Geriatrics Society, 59*(2), 353-358.

Giles-Corti, B., Macintyre, S., Clarkson, J. P., Pikora, T., & Donovan, R. J. (2003). Environmental and lifestyle factors associated with overweight and obesity in Perth, Australia. *American Journal of Health Promotion, 18*(1), 93-102.

Giles-Corti, B., Timperio, A., Bull, F., & Pikora, T. (2005). Understanding physical activity environmental correlates: increased specificity for ecological models. *Exercise and sport sciences reviews, 33*(4), 175-181.

Gillum, R., & Sempos, C. (2005). Ethnic variation in validity of classification of overweight and obesity using self-reported weight and height in American women and men: the Third National Health and Nutrition Examination Survey. *Nutrition Journal, 4*(1), 27.

Giskes, K., Van Lenthe, F., Avendano-Pabon, M., & Brug, J. (2011). A systematic review of environmental factors and obesogenic dietary intakes among adults: are we getting closer to understanding obesogenic environments? *Obesity Reviews, 12*(5), e95-e106.

Gobster, P. H. (2002). Managing urban parks for a racially and ethnically diverse clientele. *Leisure Sciences, 24*(2), 143-159.

Godbey, G. C., Caldwell, L. L., Floyd, M., & Payne, L. L. (2005). Contributions of leisure studies and recreation and park management research to the active living agenda. *American Journal of Preventive Medicine, 28*(2, Supplement 2), 150-158.

Gómez, E., & Malega, R. (2007). Residential attributes, park use, and perceived benefits: An exploration of individual and neighbourhood characteristics. *Leisure/Loisir, 31*(1), 77-104.

Gordon-Larsen, P., Nelson, M. C., Page, P., & Popkin, B. M. (2006). Inequality in the built environment underlies key health disparities in physical activity and obesity. *Pediatrics, 117*(2), 417-424.

Granberry, P. J., & Marcelli, E. A. (2007). "In the Hood and on the Job": Social Capital Accumulation among Legal and Unauthorized Mexican Immigrants. *Sociological Perspectives, 50*(4), 579-595.

Greiner, K. A., Li, C., Kawachi, I., Hunt, D. C., & Ahluwalia, J. S. (2004). The relationships of social participation and community ratings to health and health behaviors in areas with high and low population density. *Social Science & Medicine, 59*(11), 2303-2312.

Greniger, M. (2010). *Los Angeles County Location Management System*.

Hammond, R. A. (2010). Social influence and obesity. *Current Opinion in Endocrinology, Diabetes and Obesity, 17*(5), 467-471.

Harnik, P., Donahue, R., Weiswerda, L. (2012). *2012 City Park Facts*.

Harpham, T. (2008). The measurement of community social capital. In I. Kawachi, S. V. Subramanian & D. Kim (Eds.), *Social capital and health*: Springer.

Hayes, A. F. (2009). Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. *Communication Monographs, 76*(4), 408-420.

Hill, J. O., & Melanson, E. L. (1999). Overview of the determinants of overweight and obesity: current evidence and research issues. *Medicine and science in sports and exercise, 31*(11 Suppl), S515-521.

Hill, J. O., & Peters, J. C. (1998). Environmental contributions to the obesity epidemic. *Science, 280*(5368), 1371-1374.

Ho, C.-h., Sasidharan, V., Elmendorf, W., Willits, F. K., Graefe, A., & Godbey, G. (2005). Gender and ethnic variations in urban park preferences, visitation, and perceived benefits. *Journal of leisure research, 37*(3), 281-306.

Holsten, J. E. (2009). Obesity and the community food environment: a systematic review. *Public health nutrition, 12*(03), 397-405.

Huang, T. T.-K., & Glass, T. A. (2008). Transforming research strategies for understanding and preventing obesity. *JAMA: the journal of the American Medical Association, 300*(15), 1811-1813.

Jackson, F. L., Niculescu, M. D., & Jackson, R. T. (2013). Conceptual Shifts Needed to Understand the Dynamic Interactions of Genes, Environment, Epigenetics, Social Processes, and Behavioral Choices. *American Journal of Public Health, 103*(S1), S33-S42.

Jones, M. (2011). *Self-assessing weight status: a comparison of self-assessment and measurement of weight among Los Angeles County adults*. Paper presented at the The annual meeting of the American Public Health Association.

Kaczynski, A. T., & Henderson, K. A. (2007). Environmental correlates of physical activity: a review of evidence about parks and recreation. *Leisure Sciences, 29*(4), 315-354.

Katz, J. (2010). Time for new urban ethnographies. *Ethnography, 11*(1), 25-44.

Kawachi, I., & Berkman, L. (2000). Social cohesion, social capital, and health. *Social epidemiology*, 174-190.

Kawachi, I., Subramanian, S. V., & Kim, D. (2008). Social capital and health: A decade of progress and beyond. In I. Kawachi, S. V. Subramanian & D. Kim (Eds.), *Social capital and health*: Springer.

Kershaw, K. N., Albrecht, S. S., & Carnethon, M. R. (2013). Racial and ethnic residential segregation, the neighborhood socioeconomic environment, and obesity among blacks and Mexican Americans. *American journal of epidemiology, 177*(4), 299-309.

Kim, D., Subramanian, S. V., & Kawachi, I. (2008). Social capital and physical health: A systematic review of the literature. In I. Kawachi, S. V. Subramanian & D. Kim (Eds.), *Social capital and health*: Springer.

Kramer, M. R., Cooper, H. L., Drews-Botsch, C. D., Waller, L. A., & Hogue, C. R. (2010). Do measures matter? Comparing surface-density-derived and census-tract-derived measures of racial residential segregation. *International journal of health geographics, 9*(1), 29.

Kramer, M. R., & Hogue, C. R. (2009). Is segregation bad for your health? *Epidemiologic reviews, 31*(1), 178-194.

Kremers, S., de Bruijn, G.-J., Visscher, T., van Mechelen, W., de Vries, N., & Brug, J. (2006). Environmental influences on energy balance-related behaviors: A dual-process view. *International Journal of Behavioral Nutrition and Physical Activity, 3*(1), 9.

Krull, J. L., & MacKinnon, D. P. (2001). Multilevel modeling of individual and group level mediated effects. *Multivariate behavioral research, 36*(2), 249-277.

Kuzawa, C. W., & Sweet, E. (2009). Epigenetics and the embodiment of race: Developmental origins of US racial disparities in cardiovascular health. *American Journal of Human Biology, 21*(1), 2-15.

Larson, N. I., Story, M. T., & Nelson, M. C. (2009). Neighborhood environments: disparities in access to healthy foods in the US. *American Journal of Preventive Medicine, 36*(1), 74-81. e10.

Leahey, T. M., LaRose, J. G., Fava, J. L., & Wing, R. R. (2012). Social Influences Are Associated With BMI and Weight Loss Intentions in Young Adults. *Obesity, 19*(6), 1157-1162.

Lee, M. A. (2009). Neighborhood residential segregation and mental health: A multilevel analysis on Hispanic Americans in Chicago. *Social Science & Medicine, 68*(11), 1975-1984.

Lee, M. A., & Ferraro, K. F. (2007). Neighborhood residential segregation and physical health among Hispanic Americans: Good, bad, or benign? *Journal of health and social behavior, 48*(2), 131.

Legh-Jones, H., & Moore, S. (2012). Network social capital, social participation, and physical inactivity in an urban adult population. *Social Science & Medicine, 74*(9), 1362-1367.

Leroux, J. S., Moore, S., & Dubé, L. (2013). Beyond the "I" in the Obesity Epidemic: A Review of Social Relational and Network Interventions on Obesity. *Journal of obesity, 2013*.

Lochner, K., Kawachi, I., & Kennedy, B. P. (1999). Social capital: a guide to its measurement. *Health & Place, 5*(4), 259-270.

Logan, J. R., Zhang, W., & Alba, R. D. (2002). Immigrant enclaves and ethnic communities in New York and Los Angeles. *American Sociological Review*, 299-322.

Lopez, R. (2004). Urban sprawl and risk for being overweight or obese. *Journal Information, 94*(9).

Lopez, R. (2007). Neighborhood Risk Factors for Obesity. *Obesity, 15*(8), 2111-2119.

Lopez, R., & Hynes, H. (2006). Obesity, physical activity, and the urban environment: public health research needs. *Environmental Health, 5*(1), 25.

Los Angeles County GIS Data Portal (2013). Location/Points of Interest (LMS Data). Retrieved December 17, 2013: http://egis3.lacounty.gov/dataportal/2011/03/24/locationspoints-of-interest-lms-data/

Lovasi, G. S., Hutson, M. A., Guerra, M., & Neckerman, K. M. (2009). Built environments and obesity in disadvantaged populations. *Epidemiologic reviews, 31*(1), 7-20.

Luppino, F. S., de Wit, L. M., Bouvy, P. F., Stijnen, T., Cuijpers, P., Penninx, B. W., et al. (2010). Overweight, obesity, and depression: a systematic review and meta-analysis of longitudinal studies. *Archives of general psychiatry, 67*(3), 220.

Macinko, J., & Starfield, B. (2001). The utility of social capital in research on health determinants. *Milbank Quarterly, 79*(3), 387-427.

Mair, C., Diez Roux, A. V., Osypuk, T. L., Rapp, S. R., Seeman, T., & Watson, K. E. (2010). Is neighborhood racial/ethnic composition associated with depressive symptoms? The multi-ethnic study of atherosclerosis. *Social Science & Medicine, 71*(3), 541-550.

Marcelli, E. A. (2004). The unauthorized residency status myth: Health insurance coverage and medical care use among Mexican immigrants in California. *Migraciones Internacionales, 2*(4), 5-35.

Marcuse, P. (2005). Enclaves yes, ghettos no. *Desegregating the city: Ghettos, enclaves, and inequality*, 15–30.

Massey, D. S., & Denton, N. A. (1993). *American apartheid: Segregation and the making of the underclass*: Harvard Univ Pr.

Matheson, F. I., Moineddin, R., & Glazier, R. H. (2008). The weight of place: a multilevel analysis of gender, neighborhood material deprivation, and body mass index among Canadian adults. *Social Science & Medicine, 66*(3), 675-690.

McCormack, G. R., Rock, M., Toohey, A. M., & Hignell, D. (2010). Characteristics of urban parks associated with park use and physical activity: a review of qualitative research. *Health & Place, 16*(4), 712-726.

Mellerson, J., Landrine, H., Hao, Y., Corral, I., Zhao, L., & Cooper, D. L. (2010). Residential segregation and exercise among a national sample of Hispanic adults. *Health & Place, 16*(3), 613-615.

Merlo, J., Chaix, B., Yang, M., Lynch, J., & Råstam, L. (2005). A brief conceptual tutorial of multilevel analysis in social epidemiology: linking the statistical concept of clustering to the idea of contextual phenomenon. *Journal of Epidemiology and Community Health, 59*(6), 443-449.

Mohnen, S., Volker, B., Flap, H., & Groenewegen, P. (2012). Health-related behavior as a mechanism behind the relationship between neighborhood social capital and individual health - a multilevel analysis. *BMC Public Health, 12*(1), 116.

Molina, N. (2006). *Fit to be citizens?: public health and race in Los Angeles, 1879-1939* (Vol. 20): Univ of California Pr.

Moore, L. V., Diez Roux, A. V., Evenson, K. R., McGinn, A. P., & Brines, S. J. (2008). Availability of recreational resources in minority and low socioeconomic status areas. *American Journal of Preventive Medicine, 34*(1), 16-22.

Moore, S. (2010). Social Networks, Social Capital and Obesity: A Literature Review. In L. Dubé, A. Bechara, A. Dagher, A. Drewnowski, J. LeBel, P. James & R. Y. Yada (Eds.), *Obesity prevention: the role of brain and society on individual behavior* (pp. 673-696): Elsevier.

Moore, S., Daniel, M., Paquet, C., Dubé, L., & Gauvin, L. (2009). Association of individual network social capital with abdominal adiposity, overweight and obesity. *Journal of Public Health, 31*(1), 175-183.

Moore, S., Shiell, A., Hawe, P., & Haines, V. A. (2005). The privileging of communitarian ideas: citation practices and the translation of social capital into public health research. *American Journal of Public Health, 95*(8), 1330-1337.

Morello-Frosch, R., & Lopez, R. (2006). The riskscape and the color line: examining the role of segregation in environmental health disparities. *Environmental research, 102*(2), 181-196.

Morland, K., Diez Roux, A. V., & Wing, S. (2006). Supermarkets, other food stores, and obesity: the atherosclerosis risk in communities study. *American Journal of Preventive Medicine, 30*(4), 333-339.

Morland, K., Wing, S., Diez Roux, A., & Poole, C. (2002). Neighborhood characteristics associated with the location of food stores and food service places. *American Journal of Preventive Medicine, 22*(1), 23-29.

National Physical Activity Plan (2010). Parks, Recreation, Fitness, and Sports. Retrieved June 27, 2013, from http://www.physicalactivityplan.org/parks.php

Nobari, T. Z., Wang, M.-C., Chaparro, M. P., Crespi, C. M., Koleilat, M., & Whaley, S. E. (2013). Immigrant enclaves and obesity in preschool-aged children in Los Angeles County. *Social Science & Medicine*.

Northridge, M. E., Sclar, E. D., & Biswas, M. P. (2003). Sorting out the connections between the built environment and health: a conceptual framework for navigating pathways and planning healthy cities. *Journal of Urban Health, 80*(4), 556-568.

Nyholm, M., Gullberg, B., Merlo, J., Lundqvist-Persson, C., Råstam, L., & Lindblad, U. (2007). The Validity of Obesity Based on Self-reported Weight and Height: Implications for Population Studies. *Obesity, 15*(1), 197-197.

Osypuk, T. L., Diez Roux, A. V., Hadley, C., & Kandula, N. R. (2009). Are immigrant enclaves healthy places to live? The Multi-ethnic Study of Atherosclerosis. *Social Science & Medicine, 69*(1), 110-120.

Pan, L., Galuska, D., Sherry, B., Hunter, A., Rutledge, G., Dietz, W., et al. (2009). Differences in prevalence of obesity among black, white, and Hispanic adults—United States, 2006–2008. *MMWR Morb Mortal Wkly Rep, 58*, 740–744.

Papas, M. A., Alberg, A. J., Ewing, R., Helzlsouer, K. J., Gary, T. L., & Klassen, A. C. (2007). The built environment and obesity. *Epidemiologic reviews, 29*(1), 129-143.

Park, Y., Neckerman, K., Quinn, J., Weiss, C., Jacobson, J., & Rundle, A. (2011). Neighbourhood immigrant acculturation and diet among Hispanic female residents of New York City. *Public health nutrition, 14*(9), 1593.

Park, Y., Neckerman, K., Quinn, J., Weiss, C., & Rundle, A. (2008). Place of birth, duration of residence, neighborhood immigrant composition and body mass index in New York City. *International Journal of Behavioral Nutrition and Physical Activity, 5*(1), 19.

Peterson, C., Sastry, N., Pebley, A., Ghosh-Dastidar, B., Williamson, S., & Lara-Cinisomo, S. (2004). The Los Angeles Family and Neighborhood Survey: Codebook.

Peterson, C. E., Pebley, A. R., & Sastry, N. (2007). The Los Angeles neighborhood services and characteristics database: Codebook. *Santa Monica, CA: RAND*.

Pickett, K. E., & Wilkinson, R. G. (2008). People like us: ethnic group density effects on health. *Ethnicity & Health, 13*(4), 321-334.

Plane, J., & Klodawsky, F. (2013). Neighbourhood amenities and health: Examining the significance of a local park. *Social Science & Medicine, 99*, 1-8.

Poortinga, W. (2006). Perceptions of the environment, physical activity, and obesity. *Social Science & Medicine, 63*(11), 2835-2846.

Portes, A. (2000). Social capital: Its origins and applications in modern sociology. In E. L. Lesser (Ed.), *Knowledge and Social Capital.* (pp. 43-67). Boston: Butterworth-Heinemann.

Poston, W. S. C., & Foreyt, J. P. (1999). Obesity is an environmental issue. *Atherosclerosis, 146*(2), 201-209.

Powell, L. M., Slater, S., Mirtcheva, D., Bao, Y., & Chaloupka, F. J. (2007). Food store availability and neighborhood characteristics in the United States. *Preventive medicine, 44*(3), 189-195.

Putnam, R. (1993). The prosperous community: social capital and public life. *The american prospect, 13*(Spring, Vol. 4.).

RAND (2010). L.A.FANS Data FAQS. Retrieved August 12, 2013, from http://lasurvey.rand.org/documentation/faq.html

RAND/L.A.FANS (2011). Los Angeles Family and Neighborhood Survey. Retrieved August 12, 2013, from http://lasurvey.rand.org/data/restricted/application/version_2/

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods* (Vol. 1): Sage Publications, Inc.

Reardon, S. F. (2006). *A conceptual framework for measuring segregation and its association with population outcomes* (Vol. 1).

Reidpath, D. D., Burns, C., Garrard, J., Mahoney, M., & Townsend, M. (2002). An ecological study of the relationship between social and environmental determinants of obesity. *Health & Place, 8*(2), 141-145.

Reyes-Ortiz, C. A., Ju, H., Eschbach, K., Kuo, Y. F., & Goodwin, J. S. (2009). Neighbourhood ethnic composition and diet among Mexican-Americans. *Public health nutrition, 12*(12), 2293-2301.

Rios, R., Aiken, L., & Zautra, A. (2012). Neighborhood Contexts and the Mediating Role of Neighborhood Social Cohesion on Health and Psychological Distress Among Hispanic and Non-Hispanic Residents. *Annals of Behavioral Medicine, 43*(1), 50-61.

Roberts, C., Troop, N., Connan, F., Treasure, J., & Campbell, I. C. (2007). The effects of stress on body weight: biological and psychological predictors of change in BMI. *Obesity, 15*(12), 3045-3055.

Roman, C. G., & Chalfin, A. (2008). Fear of Walking Outdoors: A Multilevel Ecologic Analysis of Crime and Disorder. *American Journal of Preventive Medicine, 34*(4), 306-312.

Romo, R. (1983). *East Los Angeles: history of a barrio*: Univ of Texas Pr.

Ross, C. E., & Jang, S. J. (2000). Neighborhood disorder, fear, and mistrust: The buffering role of social ties with neighbors. *American journal of community psychology, 28*(4), 401-420.

Ross, C. E., & Mirowsky, J. (2001). Neighborhood disadvantage, disorder, and health. *Journal of health and social behavior*, 258-276.

RWJF (2013). Active Living Resources for Parks & Recreation. *Active Living Research.* Retrieved June 27, 2013, from http://activelivingresearch.org/taxonomy/parks-recreation

Saelens, B. E., Sallis, J. F., Black, J. B., & Chen, D. (2003a). Neighborhood-based differences in physical activity: an environment scale evaluation. *American Journal of Public Health, 93*(9), 1552-1558.

Saelens, B. E., Sallis, J. F., & Frank, L. D. (2003b). Environmental correlates of walking and cycling: findings from the transportation, urban design, and planning literatures. *Annals of Behavioral Medicine, 25*(2), 80-91.

Sallis, J. F., Cervero, R. B., Ascher, W., Henderson, K. A., Kraft, M. K., & Kerr, J. (2006). An ecological approach to creating active living communities. *Annu. Rev. Public Health, 27*, 297-322.

Sallis, J. F., Floyd, M. F., Rodríguez, D. A., & Saelens, B. E. (2012). Role of built environments in physical activity, obesity, and cardiovascular disease. *Circulation, 125*(5), 729-737.

Sallis, J. F., & Glanz, K. (2009). Physical activity and food environments: solutions to the obesity epidemic. *Milbank Quarterly, 87*(1), 123-154.

Sallis, J. F., Owen, N., & Fisher, E. B. (2008). Ecological models of health behavior. *Health behavior and health education: Theory, research, and practice, 4*, 465-486.

Sampson, R. J., Morenoff, J. D., & Earls, F. (1999). Beyond social capital: Spatial dynamics of collective efficacy for children. *American Sociological Review*, 633-660.

Sampson, R. J., Morenoff, J. D., & Gannon-Rowley, T. (2002). Assessing "neighborhood effects": Social processes and new directions in research. *Annual Review of Sociology*, 443-478.

Sampson, R. J., Raudenbush, S. W., & Earls, F. (1997). Neighborhoods and violent crime: A multilevel study of collective efficacy. *Science, 277*(5328), 918.

Sasidharan, V., And, F. W., & Godbey, G. (2005). Cultural differences in urban recreation patterns: an examination of park usage and activity participation across six population subgroups. *Managing Leisure, 10*(1), 19-38.

Sastry, N., Ghosh-Dastidar, B., Adams, J., & Pebley, A. R. (2006). The design of a multilevel survey of children, families, and communities: The Los Angeles Family and Neighborhood Survey. *Social Science Research, 35*(4), 1000-1024.

Schulz, A. J., Kannan, S., Dvonch, J. T., Israel, B. A., Allen III, A., James, S. A., et al. (2005). Social and physical environments and disparities in risk for cardiovascular disease: the healthy environments partnership conceptual model. *Environmental Health Perspectives, 113*(12), 1817.

Sherry, B., Blanck, H., Galuska, D., Pan, L., Dietz, W., & Balluz, L. (2010). Vital Signs: State-Specific Obesity Prevalence Among Adults–United States, 2009. *Morbidity and Mortality Weekly Report, Centers for Disease Control and Prevention*.

Sister, C., Wolch, J., & Wilson, J. (2010). Got green? Addressing environmental justice in park provision. *GeoJournal, 75*(3), 229-248.

Snijders, T., & Bosker, R. (1999). Multilevel analysis: An introduction to basic and applied multilevel analysis: London: Sage.

Stafford, M., Cummins, S., Macintyre, S., Ellaway, A., & Marmot, M. (2005). Gender differences in the associations between health and neighbourhood environment. *Social Science & Medicine, 60*(8), 1681-1692.

StataCorp (2011a). Stata Statistical Software: Release 12. College Station, TX: StataCorp LP.

StataCorp (2011b). xtmixed- Multilevel mixed-effects linear regression *Stata 12 Base Reference Manual*. College Station, TX: Stata Press.

Suro, R., & Tafoya, S. M. (2004). *Dispersal and concentration: Patterns of Latino residential settlement*: Pew Hispanic Center.

Taylor, W. C., Floyd, M. F., Whitt-Glover, M. C., & Brooks, J. (2007). Environmental justice: a framework for collaboration between the public health and parks and recreation fields to study disparities in physical activity. *Journal of physical activity & health, 4*, S50.

Taylor, W. C., Poston, W. S. C., Jones, L., & Kraft, M. K. (2006). Environmental justice: obesity, physical activity, and healthy eating. *Journal of physical activity & health, 3*, S30.

Torres, S. J., & Nowson, C. A. (2007). Relationship between stress, eating behavior, and obesity. *Nutrition, 23*(11), 887-894.

U.S. Census Bureau (2009). *A Compass for Understanding and Using American Community Survey Data: What Researchers Need to Know*. Washington, DC.

U.S. Census Bureau (2010a). Geographic Terms and Concepts-Census Tract. *Geography* Retrieved June 27, 2013, from http://www.census.gov/geo/reference/gtc/gtc_ct.html

U.S. Census Bureau (2010b). How the Census Bureau Measures Poverty. *Poverty* Retrieved December 17, 2013, from http://www.census.gov/hhes/www/poverty/about/overview/measure.html

UCLA: Statistical Consulting Group (2013a). Regression Diagnostics. *Stata Web Books: Regression with Stata.* Retrieved June, 27, 2013, from http://www.ats.ucla.edu/stat/stata/webbooks/reg/chapter2/statareg2.htm

UCLA: Statistical Consulting Group (2013b). Stata FAQ: How can I perform mediation with multilevel data? (Method 1). Retrieved August 19, 2013, from http://www.ats.ucla.edu/stat/stata/faq/ml_mediation.htm

Ullmann, S. H., Goldman, N., & Pebley, A. R. (2013). Contextual factors and weight change over time: a comparison between US Hispanics and other population sub-groups. *Social Science & Medicine*.

Veenstra, G., Luginaah, I., Wakefield, S., Birch, S., Eyles, J., & Elliott, S. (2005). Who you know, where you live: social capital, neighbourhood and health. *Social Science & Medicine, 60*(12), 2799-2818.

Vigil, D. (2008). Barrio Geneology. *City & Community, 7*(4), 366-371.

Viruell-Fuentes, E. A., Ponce, N. A., & Alegría, M. (2012). Neighborhood context and hypertension outcomes among Latinos in Chicago. *Journal of Immigrant and Minority Health, 14*(6), 959-967.

Viruell-Fuentes, E. A., & Schulz, A. J. (2009). Toward a dynamic conceptualization of social ties and context: implications for understanding immigrant and Latino health. *American Journal of Public Health, 99*(12), 2167.

Waldinger, R. D., & Bozorgmehr, M. (1996). *Ethnic Los Angeles*: Russell Sage Foundation.

Walker, R. E., Keane, C. R., & Burke, J. G. (2010). Disparities and access to healthy food in the United States: a review of food deserts literature. *Health & Place, 16*(5), 876-884.

Wang, M. C., Kim, S., Gonzalez, A. A., MacLeod, K. E., & Winkleby, M. A. (2007). Socioeconomic and food-related physical characteristics of the neighbourhood environment are associated with body mass index. *Journal of Epidemiology and Community Health, 61*(6), 491-498.

Wang, S. S., & Brownell, K. D. (2005). Public policy and obesity: The need to marry science with advocacy. *Psychiatric Clinics of North America, 28*(1), 235-254.

Wang, Y., & Beydoun, M. A. (2007). The obesity epidemic in the United States-gender, age, socioeconomic, racial/ethnic, and geographic characteristics: a systematic review and meta-regression analysis. *Epidemiologic reviews, 29*(1), 6-28.

Weinsier, R. L., Hunter, G. R., Heini, A. F., Goran, M. I., & Sell, S. M. (1998). The etiology of obesity: relative contribution of metabolic factors, diet, and physical activity. *The American journal of medicine, 105*(2), 145-150.

Wen, M., & Kowaleski-Jones, L. (2012). Sex and ethnic differences in validity of self-reported adult height, weight and body mass index. *Ethnicity & disease, 22*(1), 72.

Wen, M., & Maloney, T. N. (2011). Latino Residential Isolation and the Risk of Obesity in Utah: The Role of Neighborhood Socioeconomic, Built-Environmental, and Subcultual Context. *Journal of Immigrant Minority Health, 13*(6), 1134-1141.

WHO (2000). *Obesity: preventing and managing the global epidemic*.

Williams, D. R., & Collins, C. (2001). Racial residential segregation: a fundamental cause of racial disparities in health. *Public Health Reports, 116*(5), 404.

Wolch, J., Wilson, J. P., & Fehrenbach, J. (2005). Parks and park funding in Los Angeles: An equity-mapping analysis. *Urban geography, 26*(1), 4-35.

Wright, S. M., & Aronne, L. J. (2012). Causes of obesity. *Abdominal imaging, 37*(5), 730-732.

Yang, T.-C., & Matthews, S. A. (2010). The role of social and built environments in predicting self-rated stress: a multilevel analysis in Philadelphia. *Health & Place, 16*(5), 803-810.

Yen, I. H., & Syme, S. L. (1999). The social environment and health: a discussion of the epidemiologic literature. *Annual review of public health, 20*(1), 287-308.

Zenk, S. N., Schulz, A. J., Israel, B. A., James, S. A., Bao, S., & Wilson, M. L. (2005). Neighborhood racial composition, neighborhood poverty, and the spatial accessibility of supermarkets in metropolitan Detroit. *American Journal of Public Health, 95*(4), 660.

Zhang, Q., & Wang, Y. (2004). Socioeconomic inequality of obesity in the United States: do gender, age, and ethnicity matter? *Social Science & Medicine, 58*(6), 1171-1180.

Zhang, Z., Zyphur, M. J., & Preacher, K. J. (2009). Testing Multilevel Mediation Using Hierarchical Linear Models Problems and Solutions. *Organizational Research Methods, 12*(4), 695-719.

Zhou, M. (1992). Chinatown: The socioeconomic potential of an urban enclave.